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# Understanding citizen perceptions of science controversy: bridging the ethnographic–survey research divide

Matthew C. Nisbet and Robert K. Goidel

Using the contemporary debate in the United States over embryonic stem cell research as a test case, we outline a theoretical framework that points to the central impact of value predispositions, schema, political knowledge, and forms of mass media use in shaping public perceptions of science. In the process, by proposing an alternative approach to the dominant science literacy model, we address the existing divide between survey-based and ethnographic studies. Analyzing nationally representative survey data collected in the US in the fall of 2003, our findings suggest that value predispositions related to Christian conservatism and social ideology, along with schema related to abortion and reservations about science, serve as primary influences on citizen evaluations of embryonic stem cell research and therapeutic cloning, while our measure of issue-specific political knowledge had no statistically significant impact. In addition, after all controls, attention to newspaper coverage along with various forms of genre-specific entertainment television use have unique influences on citizen evaluations, suggesting that the mass media provide an important part of the social context by which citizens judge controversial science. Other survey results since our data collection in 2003 lend support to our findings. Religious and ideological values appear to filter the influence of information disseminated by scientific institutions. We conclude by discussing future research that connects findings from ethnographic studies with survey-based approaches.

## 1. Introduction

In explaining public perceptions of science and technology, readers of *Public Understanding of Science* are familiar with the criticisms directed at a narrow emphasis on science literacy. Still a dominant perspective in the United States; the science literacy model assumes that knowledge boosts public acceptance of the scientific worldview, and promotes the ability of scientists to remain independent from societal control. According to this line of reasoning, a knowledgeable public would view policy debates involving questions of ethics, risks, and uncertainty as experts do, leading to broader consensus and less conflict. As evidence, journalists and policymakers

often cite nationally representative surveys that detail low levels of knowledge among the public about the basic facts of science, and about the nature of the scientific process. In statistical analyses of these survey results, researchers point to the linear relationship between scores on quiz-like survey tests of knowledge and positive attitudes towards science (see Miller, 1998, for an overview).

Accumulated evidence, over the past several decades however, appears to contradict the assumption that science literacy is the driving force behind public evaluations. For example, although a recent meta-analysis of the results of nearly 200 surveys conducted in 40 countries revealed that the more people knew about the technical nature of science, the more favorable their attitudes toward science, knowledge explained only a small amount of the variance in their opinions, whereas other factors such as moral values, religious beliefs, trust, and partisan leanings were stronger predictors (Allum et al., 2005).

Sociologists argue that the heavy focus on science literacy persists because it serves an important political purpose for scientific institutions. Emphasizing what is wrong with the public's knowledge, deflects attention away from any problems within science that may contribute to societal conflict (Irwin and Wynne, 1996). As an alternative, many sociologists favor a "contextualist" approach to the public understanding of science. Using ethnographic case study methods, contextualists focus on the interaction between the public's social values, social identity, and alternative forms of knowledge and the actions of experts. As Irwin and Michael (2003) summarize, in some cases, what is perceived as technical ignorance by experts overlooks valuable forms of localized knowledge among networks of citizens, leading to feelings of alienation and distrust among the affected social group (Wynne, 1992). In other cases, given time, motivation and resources, citizen activists are able to inform themselves of the relevant science, and are able to merge this technical knowledge with their own personal experience, challenging experts on their own "expert" ground (Epstein, 1996). At other times, contextualists find that citizens can offer very good reasons why under certain conditions their ignorance makes sense. These reasons include a deference to experts based on a personal belief that the citizen lacks the capacity to understand a scientific topic; a preference for a "division of labor," where a citizen relies on experts because they lack the motivation or time to be informed; and a "deliberate choice" by citizens that scientific knowledge is not relevant to the primary issues at stake, since the citizen considers the debate to be really about morality or politics (Michael, 1996).

Unfortunately, conflict between the survey-based science literacy approach and the ethnographic contextualist approach has led to an unnecessary methodological and conceptual divide in research on public perceptions of science and technology. Contextualists unfairly characterize survey methodology approaches as exclusively focused on what the public doesn't know, and as emphasizing education as the only means to fix this "deficit." On the other hand, many survey researchers are equally dismissive of ethnographic studies, maintaining that they score low in terms of reliability and representativeness. Yet the two methodologies can be highly complementary. Whereas ethnographic case study techniques maximize ecological validity by studying individuals in their "real life" settings, these settings may not be representative of how most citizens, most of the time make up their minds across science and technology issues. On the other hand, survey research techniques, while sacrificing aspects of ecological validity, optimize generalizability by sampling from a national population of individuals. Ideally, each approach would draw actively on the findings of the other, building understanding through the triangulation of results. Moreover, as Sturgis and Allum (2004) and Einsiedel (2000) write, the contextualist critiques are not applicable to the more nuanced approaches favored in recent academic survey studies of

public opinion. These studies veer from a narrow focus on science literacy, and explore the interactions between social context, forms of knowledge, and/or media use in shaping public views of science (e.g. Bauer et al., 2000; Kallerud and Ramberg, 2002; Priest, 2001; Priest et al., 2004; Sturgis and Allum, 2004).

In this article, we propose a survey-based approach that we believe is an improvement over the science literacy model, complements contextualist theorizing and findings, and offers a possible roadmap for future survey-based investigations of public opinion across controversies. The conclusion that citizens rely on factors other than technical knowledge in reaching judgments about science resonates with the findings in the field of political communication and public opinion on how citizens evaluate public affairs generally. In this research, citizens are characterized as cognitive misers or at least satisficers, who as a general tendency collect only as much information about a topic as they think is necessary to reach a decision (Fiske and Taylor, 1991). This “miserly” tendency of citizens may be motivated by the reasons described by contextualists such as Michael (1996). Indeed, most citizens, most of the time, may have very strong motivations to avoid fully informing themselves about the many events in the political world, and instead rely on their ideology and/or religious values in combination with the considerations most readily available from the mass media to achieve a form of “limited information rationality” (Popkin, 1991). Recent survey research applying this literature from political communication has highlighted the strong heuristic role played by religious values, ideology, schema, and trust in shaping the “miserly” public’s perceptions of science (Nisbet et al., 2002), nanotechnology (Lee et al., 2005; Scheufele and Lewenstein, 2005), agricultural biotechnology (Brossard and Nisbet, in press; Besley and Shanahan, 2005), and embryonic stem cell research (Nisbet, 2005). As we will review, each of these studies also finds news and entertainment media use to be key intervening variables between social values and opinion formation on a given scientific topic.

With an eye towards bridging the ethnographic–survey research divide, using survey data collected in the US measuring public evaluations of embryonic stem cell research and therapeutic cloning, we test a model integrating these multiple influences. The stem cell debate is a particularly useful test case since it offers an example of what happens when members of the public do not constitute an easily identifiable shared community or social movement closely tied to the science in question, and are confronted with an issue outside their direct personal experience. Unlike sheep farmers reacting to expert advice about Chernobyl fallout (Wynne, 1992), or AIDS activists organizing around drug trials (Epstein, 1996), the overwhelming majority of Americans do not have direct personal experience (yet) with the products of embryonic stem cell research or therapeutic cloning. Instead, almost all information about the issue is delivered by way of the direct campaign efforts of elites, and/or via the news and entertainment media.

In light of these considerations, we focus in this study on the following key questions: First, at a national level, what role, if any do forms of knowledge play in shaping American views of embryonic stem cell and cloning research? Second, if knowledge does play a role, how does it compare to the influences of social values connected to Christian conservatism and social ideology? How does the influence of knowledge compare to citizens’ more generalized schematic views of science and feelings about politically connected issues such as abortion? Third, in combination with these variables, what are the connections between news media use, forms of entertainment television viewing and evaluations of stem cell and cloning research? Fourth, based on the model we outline and apply in answering these questions, what are the implications for future research on public perceptions of other science controversies? Finally, what do our findings tell us about the interactions between the public and scientific institutions in the stem cell debate?

## 2. The O-S-O-R model

In an effort to integrate the many influences shaping public perceptions of science, we turn to a growing body of literature that applies Markus and Zajonc's (1985) Orientation–Stimulus–Orientation–Response (O-S-O-R) model from social psychology to explain opinion formation and political behavior across a diversity of public issues and social contexts (Holbert et al., 2003a; McLeod et al., 1999; Nisbet et al., 2002; Scheufele et al., 2003, 2004). As conceptualized in past research, and as an alternative in survey research to the science literacy model, “ $O_1$ ” represents long-term socialized value predispositions such as social ideology or Christian conservatism. The “S” represents the stimulus of media consumption and attention across news outlets and entertainment media. “ $O_2$ ” signifies intervening orientations or behaviors between stimulus and outcome, including forms of knowledge, trust, or schema such as generalized reservations about science, or views on abortion. The “R” represents the final outcome of both sets of orientations and the communication stimuli, in this case, public evaluations of stem cell research and therapeutic cloning.<sup>1</sup> We order, label, and categorize these influences in Table 1, and elaborate on them in subsequent sections.

### *The influence of value predispositions ( $O_1$ )*

We first provide a brief background on the stem cell and cloning debate in the US, since identifying and measuring the relevant values and identities shaping opinion across a national sample of citizens depends in part on understanding the social and institutional context of the controversy. We then elaborate on why we chose to focus on Christian conservatism and social ideology as the two value predispositions guiding public evaluations of embryonic stem cell research and therapeutic cloning, while acknowledging that it is possible that other value orientations play a role.

“Stem cells” are utility and repair units of the body that serve a central function in the maintenance and regeneration of organs and tissues throughout life. Stem cells from human embryos were not isolated for the first time until 1998. Unlike their adult tissue counterparts, embryonic stem cells are “undifferentiated,” meaning these repair units of the human body have yet to be programmed to specific bodily tissues, and are therefore considered by many scientists to be instrumental in developing a supply of tissues to be used in the treatment of a variety of health problems. Since 2001, Federal funding for embryonic stem cell research in

**Table 1.** O-S-O-R model applied to evaluations of embryonic stem cell research and therapeutic cloning

Exogenous	Endogenous			
Demographics and other controls	Orientation $O_1$	Stimulus S	Orientation $O_2$	Response R
Age	Christian conservatism	Attention to news coverage	Knowledge relative to policy debate	Evaluations of embryonic stem cell research
Gender				
Education				
Race	Social ideology	Science fiction television viewing	Schema relative to abortion	Evaluations of therapeutic cloning research
Denominational affiliation				
Church attendance		Science documentary television viewing	Schema relative to impact of science on society	
		Christian television viewing		

the US has been governed by a compromise policy solution introduced by President George W. Bush that limits Federal funding to research that uses only embryonic stem cell lines created before August 2001. Proponents of research have strongly contested the suitability of the Bush administration's allocated stem cell lines, and the amount of funding made available. These proponents seek to overturn Bush's policy, and allow funding for newly created stem cell lines. The debate has also been closely tied to the unresolved matter of human reproductive and therapeutic cloning regulation. The central application of therapeutic cloning involves the creation of cloned embryos for use in the extraction of stem cells, and many scientists hope to gain Federal funding for research in the area, though currently this option is banned by the 2001 Bush decision. At the Federal level in the US, cloning remains unregulated, and Congress remains deadlocked on the topic. One coalition of lawmakers has proposed legislation that would ban reproductive cloning, but would allow therapeutic cloning. An opposing coalition favors a total ban.

In the stem cell controversy, for many members of the public, the value predisposition of Christian conservatism is made relevant and activated in part by the political activities of conservative Christian leaders who have been the strongest opponents of human embryo research. The conservative Christian movement includes Evangelical Protestant elites whose concern for public affairs derives from a strict doctrinal religious view, grounded in a politically strategic interpretation of biblical scripture. The opposition of conservative Christian leaders derives from their belief that embryos are human beings created in God's image and "worthy of full moral protection from the moment of conception" (NBAC, 1999: 99). As a political base, these elites frequently mobilize the 30–40 percent of Americans who consider themselves Evangelical or born-again Christians, and who rely on a strict doctrinal view for guidance both in daily life and in making political decisions.

The literature in political communication and public opinion defines value predispositions generally "as stable, individual-level predispositions to accept or reject particular types of arguments" (Zaller, 1991: 1216). To the extent that individuals are cognitive misers, employing available heuristics as a means to form attitudes, and reach decisions, underlying value predispositions operate as powerful information short cuts. Values as heuristics provide for "a principle of least effort," and serve as consistent and general opinion generators (Sniderman et al., 1991: 269). In relation to the efforts of conservative Christian elites, for the many Americans who at the individual-level adhere to a strong Christian doctrinal conservatism, past research indicates that these value orientations are strongly associated with negative evaluations of embryonic stem cell research (Nisbet, 2005). In terms of other relevant value predispositions, in light of the opposition of many ideologically conservative political leaders to embryonic research, past research also finds that even after controlling for a conservative Christian outlook, social ideology remained a strong selective screening device that guided public opinion, with self-described political conservatives strongly opposed to research, and political liberals (in the American definition of the term) more favorable.<sup>2</sup>

### *The functions and effects of the mass media (S)*

Beyond these first-order value orientations, the mass media play an important role in influencing opinion formation, not only via the news media's persuasive effects, but also via the entertainment media's functional relationship to social identity. In this section we base our discussion of the media's influence relative to science controversies on our reading of mass communication theory, and return to measurement issues in the methods section.<sup>3</sup>

At the individual-level, several studies have attributed news media influences on perceptions of biotechnology to cultivation theory-like processes (Bauer, 2002, 2005a, 2005b;

Bauer and Bonfadelli, 2002), arguing that a relatively homogeneous and promotional set of news images about the technology shapes opinion in a positive direction. Yet these apparent cultivation outcomes can be explained by two simultaneous cognitive processes driving the news media's direct persuasive effects. The first mechanism, "priming," derives from a memory-based or accessibility model of opinion formation which holds that some pieces of information are more accessible in a person's mind than others; that opinion is to a large degree a function of how readily accessible these certain considerations are; and that accessibility is mostly a function of "how much" or "how recently" a person has been exposed via the mass media to these certain considerations (Kim et al., 2002; Zaller, 1991). For example, if the news media only offered one-sided positive considerations and arguments about stem cell research, we might expect news media use to be associated with more positive evaluations.

The second process derives from framing theory. Frames are "thought organizers," devices for packaging complex issues in persuasive ways by focusing on certain interpretations over others. A frame suggests what is relevant about an issue, and what should be ignored. For example, is embryonic stem cell research really a question about social and economic progress? Or is it essentially an issue about Christian morality? By giving more weight to some dimensions of a controversy over others, the frames in news coverage help guide citizen evaluations about the causes and consequences of an issue, and what should be done (Gamson and Modigliani, 1989; Pan and Kosicki, 1993; Scheufele, 1999). Both individual-level mechanisms likely explain the possible persuasive effects of the news media, though experimental research is still needed in untangling the two processes.<sup>4</sup> And, as we will review in the next section, understanding the direction of these effects is heavily dependent on the nature of the message system within a specific news media outlet.

The influence of entertainment television can be explained by a framework where citizens choose media channels or content because of certain psychic or social gratifications they expect to gain because of these interactions (Blumler and Katz, 1974; McLeod and Becker, 1974). A modern media system offering a plurality of diversionary and entertainment genres can serve a fragmenting role in society through its connection to social identity, as citizens select themselves into genre-specific audience groups where they regularly engage in messages that both mirror and strengthen their pre-existing value predispositions (Holbert et al., 2003a, 2003b). At the cognitive level, priming (Shrum, 2002), narrative, and framing (Slater et al., forthcoming) probably play a role in explaining entertainment genre influence, though experimental methods are best suited to testing these micro-processes. Specific to the stem cell controversy, the genres of science documentary television, Christian television, and science fiction television are regular programming choices that fulfill key functional roles for their viewers. We expect that these genres contribute a significant portion of the social context by which a regular viewer judges many new events related to science. In the rest of this section, we describe the content and expected influences for the news media and each of the entertainment television genres.

### *News media coverage*

Previous research has depicted US news coverage of biotechnology generally as overwhelmingly positive, framing the issue in terms of social progress and economic prospects, with actors from industry, science, universities, and the government dominating coverage (Gaskell et al., 1999; Nisbet and Lewenstein, 2002). In terms of the stem cell controversy, recent analyses of media coverage in the elite newspapers conform to this general trend. Coverage has featured elements of opposition to stem cell research, but the media has placed a heavier emphasis on interpreting the issue through the frames of scientific progress and economic development (Nisbet

et al., 2003; Nisbet, 2004a).<sup>5</sup> These findings suggest that news consumption is associated with more positive evaluations of stem cell research and therapeutic cloning.

### *Science documentary television*

From a functional perspective, the repetitive viewing of science documentary television is motivated in part by a deep sense among audiences that science is important, and that science should be valued. Because of the promotional and relatively uncritical depiction of science television documentaries, viewing reaffirms for audiences an allegiance to science as a world-view and as an institution (Collins, 1987; Hornig, 1990). In a survey analysis, Nisbet et al. (2002) find that after all controls, science documentary television viewing was related to more positive views of science generally, and Besley and Shanahan (2005) report that regular science documentary television viewers were more supportive of agricultural biotechnology. On the basis of the content of the genre and these past audience findings, we expect in this study that science documentary television viewing is associated with more positive evaluations of embryonic stem cell research and therapeutic cloning.

### *Christian television*

The limited quantitative research on Christian programming has found that consumption is closely associated with the strength of viewers' "real world" religious convictions, as regular viewers were also more likely to hold to strict doctrinal beliefs, attend church, and pray/read the Bible frequently (Gerbner et al., 1984; Hoover, 1990). Given the content of the genre, repetitive use of Christian television is likely to be connected to perceptions of stem cell research in two ways. First, featuring worship services, and dramas with strong Christian themes, regular consumption bolsters the religious viewer's sense of Christian identity and community, making salient their conservative Christian values as well as the connection of stem cell research and cloning to other "culture of life" issues such as abortion. Second, the public affairs programming found on Christian television serves as a direct vehicle for political communication by conservative Christian elites, who manufacture coverage of politics in a format that reinforces strict doctrinal interpretations. We expect then that Christian television viewing will be associated with more negative evaluations of embryonic stem cell research and therapeutic cloning, even after controlling for Christian conservative values.

### *Science fiction television viewing*

In popular science fiction programs such as *The X-Files* or *Star Trek* series, several images of science have been described ranging from the negative image of "Dr. Frankenstein" and "science spiraling out of control" to more positive images of scientists as heroes and science facilitating social progress (Basalla, 1976; Nisbet et al., 2002). Beyond these general images is the depiction in science fiction of cloning and human genetic engineering as leading to strong negative moral consequences for humanity (Turney, 1998). Expectations about the influence of science fiction television use in shaping citizen orientations about stem cell research and cloning, however, are less than straightforward. One possible indirect connection is via the science fiction genre's relation to more generalized reservations about science. Nisbet and colleagues (2002) show that general entertainment television viewing promoted this schema among heavy viewers, a finding in line with previous cultivation research (Gerbner et al., 1985). Yet the same study also found a connection to scientific optimism, suggesting that the influence of entertainment television reflects its dual imagery. Besley and Shanahan (2005) in a specific test of the direct connection between science fiction television viewing and public opinion about agricultural biotechnology observed a positive impact on support for the technology.

*Knowledge and schema (O<sub>2</sub>)*

In terms of second-order orientations that intervene between media use and public perceptions of embryonic stem cell research and therapeutic cloning, as previously mentioned, the influence of knowledge remains contentious. With few exceptions, where the relationship has been tested, a majority of studies point to a clear connection between science knowledge and science-related attitudes, yet this influence is probably weaker in comparison to other factors such as value predispositions and trust (Allum et al., 2005). In this study, in line with adapting our survey-based approach to contextualist theorizing, we chose to focus our measures on institutional and policy oriented forms of knowledge rather than the traditional science literacy-style questions. As we detail further in the methods section, we asked respondents three questions about the debate over embryonic stem cell and therapeutic cloning research that gauge basic levels of political understanding. While we do not offer a clear expectation about the influence of this exploratory measure, one recent study found a positive relationship between general political sophistication (a stand-in for science-specific political knowledge), and more positive evaluations of science generally (Sturgis and Allum, 2004).

Besides knowledge, another set of second-order orientations include citizens' "schema," a metaphorical term adopted from social psychology to explain how members of the public integrate new information and experiences into coherent clusters (Markus and Zajonc, 1985). Schema are cognitive structures that help individuals organize their issue preferences (Lodge et al., 1991), and as we will explain, are important mediators of value predispositions. In so far as abortion-related schema provide consistency for an individual's opinions about embryo research (Nisbet, 2005), we expect that those individuals subscribing to more restrictive views about abortion are on average to be less supportive of research using human embryos. Specific to science and technology more generally, a second schema regarding "scientific reservations" is a relevant attitude construct identified in previous research as reflecting public concerns about the speed of change in modern life, and a sense that science and technology pose conflicts with traditional belief systems. This research showed that those individuals scoring high on scientific reservations were on average more opposed to new technologies, including genetic engineering (Miller et al., 1997; Miller and Kimmel, 2001). Schema link to value predispositions by serving as "principles of mediated inference" (Sniderman et al., 1991), partially intervening between core value predispositions and an individual's opinion about science controversy. For example, Christian conservatism and social ideology shape an individual's schema about abortion and the impact of science on society, and these organizing devices in turn help individuals assess and categorize the relevancy of the stem cell issue (Nisbet, 2005).

### 3. Method and measures

The data for our study are based on a nationwide random digit dial telephone survey of voting age residents of the United States. The Public Policy Research Lab located on the campus of the Louisiana State University conducted the telephone interviews from 7 November through 25 November 2003. Voting age residents of the US were contacted from a list of random telephone numbers generated by Genesys Sampling Systems. Interviews, lasting an average of 15.4 minutes, were conducted by trained staff at the Public Policy Research Lab. Numbers where callers received no answers were called back ten times before being removed from the pool of eligible numbers. Three attempts were made at refusal conversation no sooner than 72 hours after the initial refusal. The response rate for eligible residential households identified

through random digit dialing was 33 percent and the cooperation rate among households actually contacted was 47 percent, resulting in 407 completed interviews. In this section, we describe how we operationalized our measures of interest, and list descriptive statistics in parentheses for each variable.

### *Exogenous variables*

As Table 1 indicated, our measurement model included exogenous demographic controls including level of *education* ( $M = 3.8$  or some college,  $SD = 1.7$ ), *gender of respondent* as a dichotomous variable with men coded high (39 percent of respondents were male), *age* as a continuous variable ( $M = 46.9$  years,  $SD = 16.1$ ), and race as a dichotomous variable with white coded high (77 percent of respondents), and all others coded 0. We also controlled for frequency of church attendance ( $M = 2.9$  “once or twice a month,”  $SD = 1.3$ ), as well as dummy codes for denominational affiliation, including Protestant (32 percent of respondents), and Catholic (39 percent of respondents).

### *Endogenous variables*

#### *Value predispositions*

*Christian conservatism* was a combined index of three items that asked respondents to rate on a 10-point scale how much guidance religion played in making up their minds a) about political issues ( $M = 4.9$ ,  $SD = 3.5$ ), b) deciding whom to vote for in an election ( $M = 3.9$ ,  $SD = 3.4$ ), and c) in making personal decisions in a typical day ( $M = 6.2$ ,  $SD = 3.4$ ), and a fourth item that tapped respondents’ views of biblical scripture, ranging from 1 = “the Bible is a book written by men and is not the word of God” (16.7 percent of respondents), 2 = “the Bible is the word of God, but not everything should be taken literally” (34.4 percent of respondents), to 3 = “the Bible is the actual word of God” (42.8 percent of respondents). The four items were standardized and summed into a combined index ( $\alpha = .83$ ). In past research, these items in combination have been shown to capture the type of strong Christian doctrinal conservatism orientation discussed in the literature review (Ellison and Musick, 1995). *Social ideology* was measured by a single item that asked respondents to place themselves on a 7-point scale relative to social issues ranging from very liberal, liberal, somewhat liberal, moderate, somewhat conservative, conservative, and very conservative ( $M = 3.9$ ,  $SD = 1.7$ ).<sup>6</sup>

#### *Media use*

We included a control for *general television exposure* ( $M = 145$  min/day,  $SD = 94.7$  min), and for the average number of *days per week respondents reported reading the newspaper* ( $M = 2.7$ ,  $SD = 2.6$ ). Our measure of *attention to newspaper coverage* of the stem cell and cloning debate, combined two items that asked respondents to rate on a 10-point scale their level of attention to newspaper coverage about developments in science and medicine generally ( $M = 5.4$ ,  $SD = 6.7$ ), and their level of attention specifically to newspaper coverage about the debate over stem cell and cloning research ( $M = 4.7$ ,  $SD = 3.6$ ). (Combined, the two items were correlated at  $r = .71$ ;  $M = 10.1$ ,  $SD = 6.7$ .<sup>7</sup>) In measuring genre-specific entertainment television use, we asked respondents to rate on a 10-point scale, how much attention they paid to *science fiction television programming* such as *The X-Files* and various *Star Trek* series ( $M = 3.0$ ,  $SD = 3.0$ ), *science documentary television programming* on PBS, the Learning Channel, or Discovery Channel ( $M = 6.1$ ,  $SD = 3.2$ ), and *Christian television programming* such as The 700 Club, the Christian Broadcast Network, or The Liberty Channel ( $M = 2.6$ ,  $SD = 3.0$ ).

### Political knowledge

As mentioned in the literature review, our study explored items tapping citizens' basic knowledge of what we could determine to be the key aspects of the politics surrounding stem cell and cloning research. As displayed in Table 2, though roughly 40 percent of respondents knew the specifics of current stem cell funding and cloning regulation, and just over half of respondents understood the position of scientists on reproductive cloning, across these items, knowledge was fairly fragmented, a finding in line with the expected "miserly" nature of the public when it comes to public affairs knowledge.<sup>8</sup> Roughly 18 percent answered incorrectly to all three items, and only 44 percent of respondents answered at least two of the items correctly. Because of this fragmentation, inter-item correlations were either non-significant or extremely weak, and the combined index of items ( $M = 1.4$ ,  $SD = .90$ ) scored low in terms of reliability. We return to this aspect of measurement in the conclusion section.

### Schema

*Reservations about abortion* was measured using the combination of two standardized items ( $r = .37$ ), with more restrictive views of abortion coded high. The first item asked: "Which of these comes closest to your views about abortion? A woman should be able to get an abortion if she decides she wants one no matter what the reason (40.5 percent of respondents). Abortion should only be legal in certain circumstances, such as when a woman's health is endangered or when the pregnancy results from rape or incest (41.8 percent). Or an abortion should be illegal in all circumstances (15.0 percent)." The second item tapped views on when human life begins, and was adapted from a recent review of the polls on the topic (Nisbet, 2004b). Respondents were asked: "In your opinion, when does human life begin? When a man's sperm fertilizes a woman's egg (11.8 percent of respondents). When an embryo is implanted in a woman's uterus (22.9 percent). When a fetus is viable—that is able to survive outside the womb (16.0 percent). Only at birth (36 percent)." The schema related to *reservations about science* ( $M = 9.2$ ;  $SD = 5.6$ ) comprised two 10-point items ( $r = .47$ ) developed in previous work by Miller et al. (1997) and Miller and Kimmel (2001), with stronger reservations coded high. Respondents were asked to rate their agreement with the following statements, "Science makes

**Table 2.** Knowledge of stem cell and cloning debate

Question wording	Correct (%)
1. President George W. Bush in 2001 made an important decision about the use of Federal funds to conduct research on stem cells that come from human embryos. From what you know, did President Bush decide to allow unrestricted Federal funds for this type of research, decide to allow funding for research only under strict conditions, or decide to continue the ban on using Federal funds for this type of research? a) Allow unrestricted Federal funds for this type of research. b) Allow funding only under strict conditions. <b>[correct]</b> c) Continue to entirely ban the use of Federal funds. d) Don't know, refused.	42.3
2. True or false, the Federal government has passed legislation regulating the cloning of human beings? False <b>[correct]</b>	42.3
3. True or false, most scientists favor allowing cloning research that would lead to the birth of a human child? False <b>[correct]</b>	56.3
Number of questions correct	Respondents (%)
None	17.7
One	33.7
Two	33.8
Three	9.8

our way of life change too fast” ( $M = 4.2$ ;  $SD = 3.2$ ) and “We depend too much on science and not enough on faith” ( $M = 4.2$ ;  $SD = 3.0$ ).

### *Dependent variables*

#### *Evaluations of embryonic stem cell research and therapeutic cloning*

A recent review of polls finds that although a majority of Americans may find embryonic stem cell research morally problematic, a majority also thinks it may benefit society. Moreover, previous research indicates stronger support for embryonic stem cell research generally versus the more specific application of therapeutic cloning (Nisbet, 2004b). The descriptive results of our survey are in line with these past findings. Our two dependent variables include dimensions of morality and utility evaluations, and distinguish between embryonic stem cell research generally, and the more specific technique of therapeutic cloning. Comprised of an index of two 10-point items, the first dependent variable taps *public evaluations of embryonic stem cell research* generally ( $r = .81$ ,  $M = 12.0$ ,  $SD = 6.6$ ). For these two items, respondents were asked: “As you probably know, many people have made different kinds of statements about scientific research that uses stem cells from human embryos. Would you tell me, in your opinion, how you feel about each of the following statements on a ten-point scale where one means strongly disagree and ten means strongly agree? a) Scientific research on stem cells obtained from human embryos is useful for society ( $M = 6.4$ ,  $SD = 3.4$ ), and b) scientific research on stem cells obtained from human embryos is morally acceptable for society ( $M = 5.8$ ,  $SD = 3.4$ ).”

Our second dependent variable, also comprising two items, measures *public evaluations of therapeutic cloning* ( $r = .84$ ,  $M = 9.9$ ,  $SD = 6.6$ ) by asking respondents similar questions: “Now here are a few statements about a process called therapeutic or medical cloning. As you may have read, seen, or heard, this type of cloning is not designed to result in the birth of a human being, but is instead designed to aid medical research in the development of new treatments for disease. Would you tell me, in your opinion, how you feel about each of the following statements on a ten-point scale where one means strongly disagree and ten means strongly agree? a) Scientific research using therapeutic cloning techniques is useful for society ( $M = 5.3$ ,  $SD = 3.5$ ), and b) scientific research using therapeutic cloning techniques is morally acceptable for society ( $M = 4.8$ ,  $SD = 3.4$ ).” Though as explained, with strong conceptual reasons in mind, we decided to treat these two variables as separate dependent variables, not unexpectedly, both indices are related ( $r = .59$ ). Yet as we will see in the results section, there are several interesting differences in the pattern of predictors across the two variables that provide additional empirical support for their treatment as separate dependent variables.

## **4. Results**

To explore the pattern of relationships outlined in the literature review, stepwise regression with SPSS was used. The sequence of blocks is based heavily on past research exploring media influences on public opinion about science and technology, and previous research developing the O-S-O-R model outlined in the literature review. As Tables 3 and 4 show our regression models accounted for 35.5 percent of the variance in public evaluations of embryonic stem cell research and 23.8 percent of the variance in public evaluations of therapeutic cloning.

### *Demographic variables and other controls*

In predicting perceptions of embryonic stem cell research, as Model 1 indicates in Table 3, both education ( $\beta = .13$ ) and race (white) ( $\beta = .11$ ) were related to more positive evaluations

**Table 3.** Predicting evaluations of embryonic stem cell research

(Controls)	Model 1	Model 2 (O <sub>1</sub> )	Model 3 (S)	Model 4 (O <sub>2</sub> )
Age	.01	.01	-.03	-.06
Gender (male)	.05	.03	.03	.01
Education	.13**	.09*	.00	-.03
White	.11*	.04	.05	.08
Protestant	.01	-.00	-.00	.05
Catholic	.02	.09	.10*	-.01
Church attendance	-.34**	-.17**	-.11*	-.10
Christian conservatism		-.26**	-.23**	-.14**
Social ideology (lib-con)		-.12*	-.11*	-.06
Television (min/day)			.03	.02
Newspaper (days/week)			.09	.09
Newspaper attention			.20**	.16**
Science fiction television attention			.05	.04
Science television attention			.16**	.17**
Christian television attention			-.17**	-.13*
Political knowledge				.01
Abortion schema				-.16**
Science schema				-.19**
Model N	350	348	342	339
Model F statistic	6.618**	7.545**	6.406**	5.868**
Model R-square (%)	14.8	21.9	30.6	35.5
Adjusted Model R-square (%)	13.1	19.9	27.6	32.1

Note: \*\* $p \leq .01$ , \* $p \leq .05$ . All coefficients are standardized betas.

**Table 4.** Predicting evaluations of therapeutic cloning

(Controls)	Model 1	Model 2 (O <sub>1</sub> )	Model 3 (S)	Model 4 (O <sub>2</sub> )
Age	-.09	-.08	-.12*	-.14**
Gender (male)	.10*	.09	.08	.08
Education	.21**	.19**	.15**	.13**
White	.03	.06	.08	.08
Protestant	.07	.05	.06	.06
Catholic	.03	.02	.04	.03
Church attendance	-.21**	-.10	-.05	-.04
Christian conservatism		-.14*	-.15**	-.10
Social ideology (lib-con)		-.17*	-.15**	-.12*
Television (min/day)			-.07	-.07
Newspaper (days/week)			-.11*	-.11*
Newspaper attention			.14**	.12*
Science fiction television attention			.12*	.12**
Science television attention			.07	.07
Christian television attention			-.06	-.03
Political knowledge				.01
Abortion schema				-.12*
Science schema				-.09
Model N	350	348	342	339
Model F statistic	8.660**	10.870**	10.069**	10.357**
Model R-square (%)	11.7	16.3	21.9	23.8
Adjusted Model R-square (%)	9.9	14.2	18.5	19.7

Note: \*\* $p \leq .01$ , \* $p \leq .05$ . All coefficients are standardized betas.

of research, while church attendance was negatively related ( $\beta = -.34$ ). In Model 4, however, all three variables emerge as non-significant after controlling for subsequent variables in the O-S-O-R model. In the case of education, when we observe the coefficient across the regression models displayed in Table 3, its influence dropped out after controlling for the media use variables in Model 3, suggesting that the influence of the variable is fully mediated by education's relationship with news attention. In other words, more highly educated Americans pay closer attention to news coverage of the stem cell debate, and it is this media influence that shapes opinions on the topic, not education directly. For race (white) and church attendance, the influence of race emerges as non-significant after controlling for Christian conservatism in Model 2 while the strength of association with church attendance decreases.

In terms of demographic influences on evaluations of therapeutic cloning, in Table 4, a similar but slightly different pattern emerges. Education ( $\beta = .21$ ), gender (male) ( $\beta = .10$ ), and church attendance ( $\beta = -.21$ ) in Model 1 are all related to evaluations of therapeutic cloning, but in this case, in Model 4 after all controls, education remains significant ( $\beta = .13$ ), with only part of education's influence affected by its relationship with media variables. For perceptions of therapeutic cloning, in the final regression, age also emerges as a significant influence ( $\beta = -.14$ ), with older respondents more negative in their evaluations.<sup>9</sup>

#### *Value predispositions ( $O_1$ )*

In Model 2 in both Tables 3 and 4, Christian conservatism and social ideology are strongly associated with more negative evaluations of both embryonic stem cell research and therapeutic cloning (for stem cell,  $\beta = -.26, -.12$ , and for cloning,  $\beta = -.14, -.17$  respectively). For embryonic stem cell research, however, in Model 4 in Table 3, only Christian conservatism ( $\beta = -.14$ ) remains significant. In following the coefficient across the blocks displayed in Table 3, for evaluations of embryonic stem cell research, both Christian conservatism and social ideology are affected after controlling for their indirect influences by way of Christian television use (Model 3), and by way of their influence on abortion and science-related schema (Model 4). In a similar pattern of indirect connections, for therapeutic cloning, social ideology is the value predisposition that remains significant in Model 4 ( $\beta = -.12$ ). The direct and indirect influences of these variables after all controls, confirm the expectations of the "low information rationality" and contextualist approaches, namely that social values and identity serve as major anchors of public perceptions in science controversies.

#### *Forms of media use ( $S$ )*

In Model 3 in Table 3, attention to newspaper coverage, and scientific documentary television viewing are both related to more positive evaluations of embryonic stem cell research ( $\beta = .20, \beta = .16$ , respectively), a relationship that remains in Model 4 even after controlling for knowledge and forms of schema ( $\beta = .16, \beta = .17$ , respectively). Christian television viewing is related to more negative evaluations of embryonic stem cell research in Model 3 ( $\beta = -.17$ ), a relationship that remains in Model 4 ( $\beta = -.13$ ). In terms of media influences on perceptions of therapeutic cloning, in Model 3 displayed in Table 4, attention to newspaper coverage and science fiction television viewing are both related to more positive evaluations ( $\beta = .14, \beta = .12$  respectively), and after controlling for schema and knowledge in Model 4, both variables remain significant ( $\beta = .12, \beta = .12$  respectively). There are two possible factors explaining the direct influence of science fiction television on evaluations of therapeutic cloning. First, the science fiction audience are by nature strong science enthusiasts, meaning that their viewing habits capture an underlying natural support for science, and repetitive viewing of science

fiction simply strengthens this orientation, cultivating an audience naturally receptive to new innovations in science. Second, it is possible that by familiarizing themselves with the moral dimensions of human genetic engineering through television portrayals, audiences may actually assuage some of their reservations about the technology. For example, science fiction portrayals such as the film *Gattaca* are used in several college courses as a way to stimulate discussion of bioethics.

Still, it remains possible that these apparent media influences simply indicate variation across audience groups in their underlying predispositions, but our data show that after controlling out demographics, Christian conservatism, social ideology, knowledge, and the two schema, media use variables explain an additional 6.7 percent and 4.9 percent of *unique variance*.<sup>10</sup> Therefore, although certain core predispositions might lead citizens to seek out specific types of media content, above and beyond these citizen traits, regular consumption and attention to these forms of media appear to provide a significant part of the social context by which citizens judge controversial science and technology.

### *Knowledge and schema (O<sub>2</sub>)*

For perceptions of embryonic stem cell research, in Model 4 in Table 3, both abortion-related and science-related schema ( $\beta = -.16$ ,  $\beta = -.19$ , respectively) were linked to more negative evaluations of embryonic stem cell research. Knowledge was not related to evaluations of embryonic stem cell research in our model. For therapeutic cloning, only the abortion-related schema was significant, with citizens holding to more restrictive views of abortion, more negative in their evaluations ( $\beta = -.12$ ). Again, in these results we see confirmation of both “low information rationality,” and contextualist theorizing, namely that knowledge in this case, even measured as political understanding of the debate, was not related to perceptions. Instead, citizens appear to use their more generalized feelings about the impact of science on society, and their position on the related issue of abortion, as ways to make sense of the stem cell and cloning controversy.

## **5. Conclusion**

In this article, we have outlined a theoretical framework that integrates a diversity of studies that point to the central impact of value predispositions, relevant schema, and forms of mass media use in shaping public perceptions of controversial science and technology. In the process, by proposing the O-S-O-R model as an alternative approach to the dominant science literacy model, we bridge what we consider an unnecessary divide between survey-based and ethnographic studies. Before elaborating on the implications of our study for understanding the contemporary debate over embryonic stem cell research and therapeutic cloning, we highlight several directions for future research.

### *Issues for future research*

First, given the social context of the stem cell debate, we chose to focus on Christian conservatism and social ideology as primary influences on opinion, though a diversity of other value predispositions might also apply to this topic, or might shape opinions relative to other issues. These include, but are not limited to, the tendency of citizens to sometimes defer automatically to the authority of science (Brossard and Nisbet, in press), and/or the impact of green values (Nielson et al., 2002). Second, in this study we measured just attention to newspaper coverage

of the stem cell and cloning debate. Future research should examine more specifically attention to broadcast and cable television news, to the growing number of ideologically slanted news outlets, as well as to various forms of online news use and Web-based information seeking.

Third, because of the fragmented nature of political knowledge across items, the combined index scored low in terms of reliability, perhaps explaining the null findings for the influence of this variable. As we note, the use of this measure was exploratory, and calls attention to the need in future research to arrive at a method for validly and reliably measuring knowledge of the political context of science. Future studies, while incorporating improved measurement, should test the relative influence of political knowledge against standard measures of science literacy. Improved measurement of political knowledge would also allow for a more careful exploration of the informal learning effects of the news media. Citizens paying close attention to an issue in news coverage may acquire greater knowledge about the topic, and this knowledge may shape judgments of the technology. Fourth, in line with contextualist theorizing and several recent survey-based studies, future research should analyze the influence of citizen trust in the sponsors and opponents of science. As one reviewer suggests, another second-order ( $O_2$ ) variable of interest might be a measure tapping citizens' schema relative to the controllability of science, as many citizens may fear, for example, that it is impossible to prevent the subsequent use of medical cloning for reproductive purposes.

Alternative methods of statistical analysis can also be applied. Structural equation modeling techniques would account for measurement error, and more precisely test the direct and indirect relationships among endogenous variables, while panel survey data would explore more carefully the causal direction of proposed relationships. Given specialized sampling procedures, a particularly useful method of analysis for comparison to contextualist approaches would be multi-level modeling, which allows for testing of not only individual-level factors shaping citizen evaluations, but also national-, community-, or group-level factors (see Allum et al., 2002, 2005). Survey and contextualist approaches are best merged by using mixed-methodologies within the same study, especially in research at the community or local level that would combine in-depth interviews, focus groups, content analyses of local media outlets, and local surveys.

### *Understanding citizen perceptions of the stem cell and cloning debate*

Our study also offers several implications for understanding the relationship between science and the public in the ongoing stem cell debate. As primary influences, our results show that Christian conservatism and social ideology are directly associated with more negative views of embryonic stem cell research and therapeutic cloning, but they also connect to an individual's more global and generalized attitudes about abortion and the impact of science on society, and these more global orientations add to the total influence of the two value predispositions. Our measure of political knowledge was not significantly related to citizen evaluations.

In this study, we also expected that various forms of media use aid citizens in interpreting stem cell and cloning research as a political and social issue. Given relatively positive news coverage, reading about the issue in the newspaper was associated with more positive views of both embryonic stem cell research and therapeutic cloning. For consumption of entertainment television genres, after all controls, attention to Christian television programming was connected to more skeptical views of embryonic stem cell research, while science television viewing was directly linked to more positive views. Specific to perceptions of therapeutic cloning, science fiction television viewing was linked to more positive evaluations. These findings indicate that regular consumption and attention to different types of media content provide a significant part of the social context by which citizens judge controversial science.

Our conclusions in this study are based on data collected in the fall of 2003, but subsequent events and poll findings indicate that research proponents have been able to use the news media in combination with direct communication tactics to boost support for research to slight majority levels. According to data from the Pew Center for the People and the Press, in December 2004, 56 percent of surveyed respondents said it was more important to conduct embryonic stem cell research than to protect embryos, an increase over the 43 percent figure for 2002. More revealing, these same surveys indicate that—with increased media attention to the topic of stem cell research—respondents in 2004 reported hearing more about the issue than survey respondents had in the past, and the more respondents heard about the issue, given positive media coverage, the more supportive they were of research.

Yet, a closer look at the poll results shows that the gains in public support for embryonic stem cell research have occurred almost exclusively among non-Evangelical Protestants and Democrats, while Evangelical Protestants and Republicans remain anchored in their opposition. Again, here we see evidence in line with contextualist theorizing, namely that public opinion is inherently fluid and heterogeneous, with social identities strongly filtering the influence of the information disseminated by scientific institutions. For example, according to data collected in December 2004, among non-Evangelical white Protestants, 69 percent said it was more important to conduct embryonic stem cell research compared to just 33 percent among their Evangelical counterparts. More revealing, however, are the changes over time within these groups. Since 2002, there has been a +18 percent change among non-Evangelical Protestants, but only a +7 percent change among Evangelicals (Pew, 2005).

Besides this Christian conservative gap, recent data also indicate a wide gap in opinion by political party affiliation. According to the Pew survey, among Democrats, 68 percent answered it was more important to conduct stem cell research that might result in medical cures than to not destroy the potential life of human embryos involved in the research. But, in comparison, when asked the same question, only 45 percent of Republicans and 58 percent of Independents said it was more important to conduct stem cell research. There are also important differences in how opinion shifted since 2002 across these groups. The percentage shift from 2002 levels among Democrats was +23 percent compared to only a +7 percent change among Republicans and a +9 percent change among Independents. Confirming this trend, on the dimension of moral acceptability, Gallup polling over the past year indicates a sharp partisan divergence in views about the moral acceptability of research. In May 2002, 54 percent of Democrats and 52 percent of Republicans indicated that using stem cells obtained from human embryos was morally acceptable. In May 2003 and May 2004 the gap widened slightly, but in both years the difference remained within the margin of error for the sub-samples. Yet, following the Presidential campaign when Democratic nominee John Kerry campaigned heavily to overturn Bush's stem cell policy, in May 2005 the partisan gap had widened to 23 points, with 72 percent of Democrats indicating that stem cell research was morally acceptable while the opinion of Republicans remained relatively unchanged at 49 percent (Carroll, 2005).

For future research, these recent poll trend findings suggest that at the individual-level, the influence of news media use and other information sources may be moderated by Christian conservatism and/or political ideology, a finding indicated in one recent study (Nisbet, 2005). However, perhaps of greater significance, these trends indicate that roughly 40 percent of the public, despite tens of millions of dollars spent since 2001 on public communication campaigns by research supporters, remain steadfast in their opposition to embryonic stem cell research. With a belief in the power of knowledge to generate support for science, stem cell advocates have focused on “educating” and “informing” the public about the benefits of research. These communication efforts, however, are having differential influences across a religiously and ideologically heterogeneous public.

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## Notes

- 1 For an overview of the O-S-O-R model, see McLeod, Kosicki and McLeod (2002).
- 2 As we will detail in the methods section, in this study we conceptualize and operationalize political ideology not as a dichotomy liberal/conservative but on a continuum from very liberal, liberal, somewhat liberal, moderate, somewhat conservative, conservative, and very conservative. Moreover, when we use the term social ideology, we refer to, and ask respondents to rate their ideological placement specifically on, social issues as opposed to economic ideology specific to market, tax, and fiscal policy.
- 3 As one reviewer notes, like any distillation of the nearly 100 years of media effects research, this summary is selective and interpretative, and based on our value judgments about relevant scholarship.
- 4 See discussion by Schuefele (2000), and Price and Tewksbury (1997).
- 5 In terms of the amount of media attention to the issue, there are sizable differences between newspaper and television news coverage. For example, for the year 2002, *ABC World News Tonight* and *CBS Evening News* devoted just 11 news stories to the issue, versus more than 120 news articles that ran at the *New York Times* and *Washington Post*. For 2003, the two networks ran 25 news stories compared to 294 articles at the two newspapers (Nisbet, 2004a).
- 6 While Christian conservatism and social ideology are correlated ( $r = .38$ ), the two value dispositions are conceptually distinct. Given the elite debate in the US, stem cell and cloning research has been opposed not only by Christian conservatives, but also by so-called relatively secular social “neo-conservatives” who oppose research not on the basis of biblical authority, but on more secular ethical reasoning. In our measures, in keeping with past research and this elite debate, we chose to measure and test these two possible value predispositions separately.
- 7 As previously detailed, because of the limited amount of attention to the stem cell and cloning debate on broadcast television news, we did not ask respondents to rate their levels of attention to the issue within this medium.
- 8 One reviewer cautioned about the interpretation of this item, noting that members of the public might reason that although scientists say they are not in favor of legalizing reproductive cloning, they might still favor it secretly, therefore the question is one of norms, rather than one to be answered with “true or false.”
- 9 Some researchers have argued that instead of general education, it is science education, usually measured by number of college science courses, that influences perceptions of science and technology (see Priest, 2001). In our first regressions we tested this possibility with a variable that measured number of college science courses ranging from none up to six or more. This variable was non-significant and did not change the pattern of relationships displayed in the final regressions shown across the tables.
- 10 Unique variance is calculated by re-running the regressions with the media block entered last in the regression equation, and then reporting the incremental variance accounted for by this last block, after all other blocks are controlled.

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