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Gender, Knowledge, Scientific Expertise, and Attitudes Toward Biotechnology: Technological Saliency and the Use of Knowledge to Generate Attitudes

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1. Introduction

Since the advent of recombinant DNA techniques in the early 1970s, biotechnologies have received much attention both for their potential to help and to harm individuals and society. Through the development of gene therapies, stem cell technologies, reproductive technologies and genetically modified crops, biotechnologies have promised to help the sick, the barren, and the poor live more fulfilling lives. At the same time governments, the general public, and scientists themselves have recognized the risks involved with biotechnologies. Since the very beginning of modern biotechnological techniques, scientists have warned that there is “serious concern that some of these artificial recombinant DNA molecules could prove biologically hazardous” (Berg et al., 1974: 303). Risks include the unknown consequences of consuming organisms that have been genetically manipulated, and the release of novel genetic material into wild populations (Torgersen et al., 2002). But aside from the technical risks involved with biotechnologies, concerns have also arisen over the ethical implications of manipulating basic life processes. Critics have rebuked scientists for “taking a technological and reductionist perception of life itself” (Torgersen et al., 2002: 39), and the seemingly imminent development of human cloning and “designer babies” (McGee, 2000; Hughes, 2004) were added to the already controversial issues of embryonic stem cell research and genetically modified organisms. The potential to simultaneously do great help, and great harm, has made biotechnology one of the most important science policy issues of our time.

Often the views of scientists, industry, government, and the public have been at odds. Because of their enormous commercial potential, industry has largely downplayed the risks and emphasized the benefits of biotechnologies (see, for example, Rampton’s and Stauber’s (1998) exposé of Monsanto’s attempts to suppress evidence that one of its products, recombinant bovine growth hormone, causes cancer). National governments, recognizing the importance of biotechnology as a key technology in the post-industrial marketplace, have simultaneously sought to protect industry from an overzealous public, yet appear responsive to public concerns. The general public has been especially critical of

biotechnologies, though the level of skepticism varies by region and the particular issue at stake (Allum et al., 2002).

In the case of biotechnology, public concern has turned out to have significant influence. In the arenas of politics and economy, public concerns about biotechnology have translated into real transformations. Bauer and Gaskell observe that,

In contemporary times, public opinion is not merely a perspective “after the fact”; it is a crucial constraint, in the dual sense of the limitations and opportunities for governments and industries to exploit the new technology. Whereas the biotechnology industry assumed that regulatory processes were the sole hurdle prior to commercialisation, it is now apparent that a second hurdle, national and international public opinion, must be taken into account (2002: 1).

Both by voting with their dollars, and by making it difficult for biotech firms to bring products to market (Weber et al., 2009), “public opinion” has affected the development and distribution of biotechnologies (for a more extended discussion of the efficacy of public opinion see Page and Shapiro, 1992). Furthermore, governmental bodies at the national level, as well as the European Union, have heard concerns and adjusted policy accordingly (Torgersen et al., 2002). Clearly, if the future of biotechnology is to be grasped, public opinion, and the processes by which it is formed, must be understood.

One issue that is frequently referred to when considering the public’s attitudes is knowledge of biotechnology. Despite initial hesitance, “an increasing number of scientists concluded that the risks had been exaggerated” (Torgersen et al., 2002: 34). Yet public attitudes have become more negative, and more ambivalent, over time (Shanahan et al., 2001). Despite some studies that suggest a link between genetically modified organisms and health problems (e.g., a recent study that found a connection between the consumption of genetically modified corn and organ failure in rats; Vendômois et al., 2009), scientists have largely dismissed public outcry over biotechnologies as reactionary and a consequence of a public that remains uninformed (see, for example, McHughen, 2007). This very basic hypothesis – that people will become more accepting of biotechnology once they better understand it – has received some support in studies of public opinion (Allum et al., 2008; Bak, 2001; Wright & Nerlich, 2006). However, not all people use knowledge in the same way. The *contexts* in which knowledge is called forth have been shown to play a crucial role in how it is used to formulate opinions toward science and technology. Studies that test for interaction effects show that the effect of knowledge on attitudes varies by region (Allum et al., 2002), levels of political knowledge (Sturgis & Allum, 2004), and by gender (von Roten, 2004; Simon, 2010, 2011).

Gender differences in the use of knowledge to formulate attitudes are particularly intriguing because of the persistent gender gap in support for science and technology. Whether asked about environmental issues (Stern et al., 1993; Hayes, 2001; McCright, 2010), nuclear power (Freudenburg & Davidson, 2007; Davidson & Freudenburg, 1996; Krannich & Albrecht, 1995), biotechnologies (Qin & Brown, 2007; Bryant & Pini, 2006; Simon 2010, 2011) including reproductive technologies (Napolitano & Ogunseitan, 1999), or science in general (Trankina, 1993; Barke et al., 1997; von Roten, 2004; Mallow et al., 2010; Breakwell & Robertson 2001; Hayes & Tariq 2000), women express more skepticism toward science and technology than men do. Gender is an important determinant of people’s attitudes toward science and

technology, and the fact that there is some evidence that indicates that men and women use knowledge differently to form attitudes suggests this is of critical importance for understanding public attitudes toward science and technology.

In a previous study of gender differences in attitudes toward biotechnology (Simon, 2010), I found that the more knowledge that men had on the subject, the less inclined they were to be pessimistic about its effects on society. The effect I found for men clearly supports the knowledge deficit hypothesis: the more men know, the more likely they are to support biotechnology. However, the effect of knowledge on attitudes proved to be the *opposite* for women: women became more *critical* of biotechnology with more knowledge. The results of that study suggest scientific knowledge persuades men to be supportive of biotechnology, but that same knowledge causes women to be critical of it.

What is causing men and women to use knowledge in such radically different ways? One hypothesis is that science and technology, and biotechnologies in particular, have radically different implications for men and women. Because of gender roles associated with childbearing and childrearing, women are more likely to be directly affected by some of the negative consequences of science and technology. As Dorothy Nelkin suggests regarding attitudes toward nuclear power, women are its “most active and outspoken critics” because of “the special effects radiation has on the health of women and on future generations” (1981: 15). This perspective is echoed by ecofeminists such as Mallory (2006) who argue for a parallel between the exploitation of nature characteristic of science and technology and the exploitation of women, and Bryant and Pini who theorize “a relationship between chemicals and women’s reproductive bodies” (2006: 268). Biotechnologies may be especially relevant to women because the implications for bodily contact and harm are an integral element of the controversies surrounding biotechnology (DuPuis, 2000). With respect to gender differences in attitudes toward biotechnology, Napolitano and Ogunseitan remark, “many of the applications [of biotechnologies] towards human health issues will likely affect fetuses, mothers, and young children more than adult males and non-childbearing female members of society” (1999: 202).

The implication of these arguments is that biotechnology is more *salient* for women than it is for men. I submit that the gender difference in *technological salience* produces the circumstances that facilitate a unique set of evaluative criteria for women that are not utilized by those with more distance from biotechnology. The hypothesis is that, for women, biotechnology is *personal* in a way that it is not for men, and the more women understand about biotechnology the better they are able to grasp this.

The technological salience explanation of gender differences in attitudes toward science and technology (developed with my colleague Katherine Johnson; Johnson and Simon, n.d.) suggests certain hypotheses. The theory states that the criteria that people will use to form attitudes toward science and technology will be determined by how salient the particular issue is to their own lived experiences. The hypotheses I intend to explore have to do with how men and women use knowledge differently with respect to their views on the public’s role in science policy. It is intuitive that when people think the public should decide science policy, their own knowledge of a topic should be an important determinant of their attitude toward it. However, when people think experts should decide science policy, it is unclear how knowledge might relate to attitudes toward biotechnology. If biotechnology is really a personal matter for women, a matter relevant to their bodies, values, and roles in a way it is

not for men, then knowledge of it should be absolutely crucial for determining their attitudes under nearly all circumstances. Even when women are willing to abdicate responsibility to scientific experts or government to regulate other forms of science and technology, because biotechnology has an especial salience for women, they should be unlikely to disregard their own knowledge when evaluating it. On the other hand, I predict that men's use of knowledge to generate attitudes will be conditional upon their willingness to let scientific experts and government regulate science and technology. Because biotechnology is not especially salient for men compared to women, they should categorize it alongside other issues in science and technology that are not especially salient for them. When men abdicate responsibility for science policy to experts, their own knowledge of biotechnology should be less important in determining their attitudes compared to men who think science policy should be decided by the public.

In technical terms, I am hypothesizing a three-way interaction of gender, knowledge, and willingness to leave science policy to experts in determining attitudes toward biotechnology. For women, the effect of their knowledge on their attitudes should be the same no matter what their opinions on the role of experts are (Hypothesis 1), because even if they are generally willing to let experts decide science policy, the especial salience of biotechnology for women will make their understanding of it relevant under any circumstances. But because biotechnology is not especially salient for men, when the responsibility for determining a positive or negative attitude is externalized to experts, the importance of one's own knowledge about the topic should be less important because responsibility is transferred to an external source (Hypothesis 2). Because of the particular salience of biotechnology for women, the effect of their knowledge on their attitudes should be unconditional. Because biotechnology is less salient for men, the effect of their knowledge on their attitudes should be more likely to be affected by other circumstances; in particular, it should become less relevant when they believe the public should stay out of scientific affairs. Stated formally:

H1: Controlling for other relevant variables, the effect of knowledge on attitudes toward biotechnology will be *unconditional* upon the opinion that experts should decide science policy issues for females (i.e., the knowledge-experts interaction will *not* significantly predict attitudes for females).

H2: Controlling for other relevant variables, the effect of knowledge on attitudes toward biotechnology will be weaker when males hold the opinion that experts should decide science policy issues, and stronger when males hold the opinion that the public should decide science policy issues. (i.e., the knowledge-experts interaction *will* significantly predict attitudes for males, and it will be negative).

2. Data and methods

2.1 Sample

The Eurobarometer 63.1 is used to test these hypotheses because it features items on attitudes toward biotechnology, the role of experts in scientific decision-making, and a twelve-question quiz designed to measure scientific knowledge. The Eurobarometer 63.1 is a representative sample of thirty-two European nations and includes household respondents aged 15 and over. These nations include 25 European Union member countries: Austria, Belgium, Republic of Cyprus, Czech Republic, Denmark, Estonia,

Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, and the United Kingdom, plus the EU candidate countries of Bulgaria, Croatia, Romania, Turkey, as well as three European Free Trade Association countries: Iceland, Norway, and Switzerland (Papacostas, 2006).

Data for the Eurobarometer 63.1 were collected between the 3rd of January and the 15th of February 2005 by TNS Opinion and Social on behalf of the European Commission. It utilized a probabilistic, stratified sample design in which each nation was stratified first by region, then municipality. In each country, a number of sampling points were drawn with probability proportional to population size and to population density. Finally, households were chosen within each municipality. The survey was administered at the homes of the respondents in face-to-face interviews (Papacostas, 2006).

2.2 Dependent variable

The purpose of this study is to investigate gender differences in attitudes toward biotechnology. Hence, the dependent variable is derived from a question asking respondents whether they think biotechnology “will have a positive, negative, or no effect on our way of life over the next twenty years.” This variable was recoded so that all respondents indicating that they think biotechnology will have a negative effect “on our way of life” were coded as 1 and all other respondents were coded as 0. The dependent variable is therefore a measure of *pessimism* about biotechnology.

2.3 Independent variables

Independent variables of interest are gender, scientific knowledge, and a variable derived from the question, “Which of the two following views is closest to your own? Decisions about science and technology should be based primarily on the advice of experts about risks and benefits involved, or on the general public’s views of risks and benefits?” All respondents who indicated that decisions should be left to experts were coded as 1 and all respondents who indicated that the general public should make decisions were coded as 0.

To create the gender variable used in the analysis, all males were coded 1, and all females were coded 0.

The knowledge variable is a scale constructed from a twelve question factual test on scientific knowledge administered with the Eurobarometer. This test asked questions about science in general, not about biotechnology specifically. The items were recoded so that correct responses were equal to 1, and incorrect responses were equal to 0. Each respondent’s score on the knowledge variable is equal to the proportion of correct answers they made on the knowledge test (e.g., someone who earned eight correct answers would be coded as .67). The knowledge scale obtained an $\alpha = .72$.

Control variables included variables capturing political attitudes, age, education, and religiosity. The political attitudes variable was derived from responses to the question: “In political matters people talk of ‘the left’ and ‘the right’ . How would you place your views on this scale?” Respondents were asked to rate their political attitudes on a scale of 1 to 10, with

lower values indicating that they are more “left”, and higher values indicating that they are more to the “right”. Respondents’ age was coded in years. The Eurobarometer’s education item does not directly measure respondents’ educational attainment; instead respondents are asked to give the age at which they left school. This variable was recoded into dummies that roughly correspond to stages in the educational career: respondents who left school before high school age (“Edu. 0-14”), those of high school age (“Edu. 15-18”), those of college age but who have not reached the typical age of college graduation (“Edu. 19-21”), and those who left school after the age of 22 (“Edu. 22+”), assumedly college graduates. Another dummy was created for respondents who had not yet left school (“still studying”). This education measure is not ideal, but previous work (Simon, 2010, 2011) with the Eurobarometer’s education measure has showed that it possesses criterion validity when predicting attitudes toward biotechnology. Respondents’ religiosity was measured with an ordinal item asking respondents, “Apart from weddings or funerals, about how often do you attend religious services?”, with responses ranging from “never” to “more than once a week”. Higher values indicate more frequent attendance of religious services, and lower values indicate less frequent attendance.

2.4 Analytic sample

The total number of respondents included in the Eurobarometer 63.1 is 31,390. Missing values were addressed using pairwise deletion. After deleting missing values the sample was reduced to 26,621. Because of the complex sampling design, the data were weighted with a weight designed to accommodate analyses that make use of all the nations in the study. Weighting the data further reduced the analytic sample to 24,630. Splitting the sample by gender resulted in an $n = 12,379$ for males, and an $n = 12,251$ for females.

2.5 Analytic approach

Hypothesis 1 predicts that the experts-knowledge interaction will not be significant in the female model. Hypothesis 2 predicts that the experts-knowledge interaction will be significant and negative in the male model. To test the hypotheses, the sample was split by gender, and separate logistic regression models predicting attitudes toward biotechnology (with “it will have a negative effect on our way of life” coded as “1”) were run for males and females, including a test of the “experts-knowledge” interaction in both models.

3. Results

Table 1 shows means (or proportions) and standard deviations for all variables by gender. A few items are of note. First, while slightly less than 20 percent of males thought biotechnology will have a negative effect “on our way of life over the next twenty years”, slightly more than 22 percent of females had the same opinion. While the gender difference in attitudes is slight, it is consistent with previous research that has shown females to be more skeptical of biotechnology than males. Also consistent with previous research, females possess less scientific knowledge than males. (averaging .59 on the knowledge test vs. .66, respectively, a difference of nearly one entire correct answer). Approximately three-quarters of both males and females believe that experts, not the general public, should decide science policy issues.

	Males		Females	
	Mean or Proportion	Std. D.	Mean or Proportion	Std. D.
Pessimism	.20	.40	.22	.41
Knowledge	.66	.22	.59	.23
Experts Decide	.74	.44	.73	.45
Politics	5.30	2.23	5.22	2.08
Age	43.33	17.82	45.60	18.64
Edu 0-14	.18	.39	.23	.42
Edu 15-18	.38	.49	.38	.49
Edu 19-21	.15	.36	.16	.36
Edu 22+	.17	.38	.14	.35
Edu Still Studying	.12	.32	.10	.29
Religiosity	3.53	2.33	4.01	2.36

Males: $n = 12,379$
Females: $n = 12,251$

Table 1. Mean or proportion and standard deviation by gender.

Table 2 features results of a series of logistic regressions predicting attitude toward biotechnology for females only. Odds ratios are shown. Model 1 features only the knowledge scale as an independent variable; it is positive and significant. Without controlling for any other variables, each additional correct answer on the knowledge test increases the likelihood of being pessimistic about biotechnology by about 33 percent. Model 2 adds the experts variable as a predictor; it is negative and significant. Controlling for level of scientific knowledge, feeling that experts and not the public should be responsible for science policy decreases the odds of being pessimistic toward biotechnology by about 31 percent. Model 3 retains the knowledge and experts variables as predictors, but adds the knowledge-experts interaction term. Recall that Hypothesis 1 predicted that, for females, the effect of knowledge on attitudes toward biotechnology would be about the same regardless of the respondent’s opinion about the role experts should play in science policy issues. Model 3 reveals that the effect of knowledge on attitude is not affected by opinion about the role of experts in science policy. Model 4 shows that this is true even when controlling for political attitude, age, religiosity, and education, confirming Hypothesis 1.

Table 3 shows logistic regression results for the male sample only. Model 1 uses only the knowledge scale to predict pessimism toward biotechnology. Without accounting for any other variables, each additional correct answer on the knowledge test results a reduction in the odds of being pessimistic about biotechnology of about 20 percent for males. However, adding the experts variable reduces the effect of knowledge to insignificance. Like their female counterparts, when males leave policy decisions up to experts, they are much less likely to oppose biotechnology. Model 3 adds the interaction term. The effect is strong, negative, and highly significant. The correlation between knowledge and attitude

is much weaker for males who think science policy should be decided by experts compared to males who think it should be decided by the public. Model 4 includes the control variables. The experts-knowledge interaction effect on attitude is slightly reduced when controlling for political ideology, age, religiosity, and education, though it is still strong, negative, and significant, confirming Hypothesis 2. This is a much different scenario than for females, for which the experts-knowledge interaction did not predict biotechnology attitude.

To further illustrate how opinion on the role of experts in science policy tempers the effect of knowledge on biotechnology attitude for males but not for females, each male and female sample was further split by whether the respondent thought science policy decisions should be made by experts or by the public. Table 4 shows results of logistic regressions predicting biotechnology attitude by gender and science policy opinion. Model 1 displays the coefficients only for females who believe that science policy decisions should be left to experts. With all of the control variables in the equation, each additional correct answer on the knowledge test results in a 53 percent increase in the odds of being pessimistic about biotechnology. Model 2 shows results only for females who think the public should decide science policy issues. For these women, greater knowledge also leads greater odds of rejecting biotechnology. Model 3 features the same regression model, but this time only for males who put their faith in experts. Controlling for political views, age, religiosity, and education, the effect of knowledge on attitude is strong and negative: with each additional correct answer on the knowledge test, the odds of being pessimistic about biotechnology are reduced by about 47 percent.

	Model 1	Model 2	Model 3	Model 4
Knowledge	1.325**	1.539***	1.354	1.421*
Experts		.686***	.609**	.698
KnowXExperts			1.208	1.029
Politics				.964**
Age				1.003
Religiosity				1.017
Edu 0-14				.956
Edu 15-18				1.134
Edu 19-21				1.068
Edu Still Studying (Edu 22+ ref cat)				.753*

*sig. at p.<.05
**sig. at p.<.01
***sig. at p.<.001

Table 2. Logistic regressions predicting whether or not biotechnology will make things worse, female sample only.

However, the effect of knowledge on attitude is drastically different for males who think science policy should be the domain of the public. For these males, the effect of knowledge is strong and *positive*, nearly doubling the odds of being pessimistic about biotechnology with each additional correct answer on the knowledge test. For females, more knowledge leads to a greater likelihood of rejecting biotechnology no matter who they think should be making science policy decisions, and in both cases the effect of knowledge on attitude is about the same. For males, the effect of knowledge on attitude cannot be predicted unless the respondent's opinion on science policy decisions is known.

	Model 1	Model 2	Model 3	Model 4
Knowledge	.800*	.818	2.087**	1.619*
Experts		.717***	1.782**	1.453
KnowXExperts			.257***	.353***
Politics				.951***
Age				.997
Religiosity				.993
Edu 0-14				1.388**
Edu 15-18				1.179*
Edu 19-21				1.323**
Edu Still Studying (Edu 22+ ref cat)				1.254*

*sig. at p.<.05

**sig. at p.<.01

***sig. at p.<.001

Table 3. Logistic regressions predicting whether or not biotechnology will make things worse, male sample only

4. Discussion

This paper made two predictions about how males and females use knowledge differently to generate attitudes toward biotechnology based on the idea of *technological saliency*. It was predicted that because biotechnologies are more salient to females compared to males, the effect of their knowledge on their attitudes should hold no matter what their opinions on the role of experts are, because even if they are generally willing to let experts decide science policy, the especial saliency of biotechnology for women will make their understanding of it relevant under a more robust set of circumstances.

But because biotechnology is not especially salient for men, when the responsibility for determining a positive or negative attitude is externalized to experts, the importance of one’s own knowledge about the topic should be less important because responsibility is transferred to an external source. Because of the particular salience of biotechnology for women, the effect of their knowledge on their attitudes should be unconditional. Because biotechnology is less salient for men, the effect of their knowledge on their attitudes should be more likely to be affected by other circumstances; in particular, it should become less relevant when they believe the public should stay out of scientific affairs. Hypothesis 1 predicted that the experts-knowledge interaction would not significantly predict biotechnology attitude for females; that is, the effect of knowledge on attitude should be the same regardless of their opinion about who should make science policy decisions. Table 2 showed that, indeed, the experts-knowledge interaction was not significant for females. Hypothesis 2 predicted that the effect of knowledge on attitudes toward biotechnology should be weaker when males hold the opinion that experts should decide science policy issues, and stronger when males hold the opinion that the public should decide science policy issues; that is, the knowledge-experts interaction should be *negative* and significant for males. The evidence in Table 3 supports this hypothesis. When males do not trust the general public to make good policy decisions, their own knowledge is less important in determining their attitude toward biotechnology. Females, however, seem equally insistent upon using the knowledge they have under any circumstances.

	Females		Males	
	Experts	Public	Experts	Public
Knowledge	1.563*	1.171*	.526***	1.925*
Politics	.967*	.961	.952***	.950*
Age	1.000	1.012***	.998	.996
Religiosity	1.027	.988	.981	1.021
Edu 0-14	1.091	.702	1.290*	1.590*
Edu 15-18	1.155	1.071	1.178	1.166
Edu 19-21	1.105	1.000	1.343**	1.257
Edu Still Studying	.606***	1.314	1.477**	.784
(Edu 22+ ref cat)				

*sig. at p.<.05

**sig. at p.<.01

***sig. at p.<.001

Table 4. Logistic regressions predicting whether or not biotechnology will make things worse, by gender and opinion on expertise.

Table 4 lends further support to the theory of technological salience, and complicates the way we understand how men's and women's knowledge differently affects their attitudes toward biotechnology. Consistent with previous research on how males and females use knowledge to generate attitudes (Simon, 2010), this study found that women become more likely to reject biotechnology with greater knowledge of it, and this relationship holds regardless of their opinion about who should make decisions about science in society. It is intuitive that when people think science should be controlled by the public, their own knowledge of a topic should be an important determinant of their attitude toward it. However, for women, even when they believe that science is best run by the experts, their knowledge is just as important for determining their attitude toward biotechnology, and in both cases they become more skeptical of it the more they understand. Table 4 also shows the dramatic difference in the way males who trust experts use knowledge compared to males who believe science policy decisions should be a public affair. Though Hypothesis 2 – that knowledge would be less important in determining attitude for males who abdicate to experts compared to males who think the public should be responsible for science policy decisions – was supported in by the results displayed in Table 3, Table 4 revealed that knowledge still significantly predicted attitude for males who defer to experts. While the effect of knowledge on attitude is stronger for males who think science policy should be decided by the public, Table 4 shows another telling gender difference. Males who trust experts become *less* likely to reject biotechnology with increasing levels of knowledge; males who insist that science should be controlled by the public become *more* likely to reject biotechnology with increasing levels of knowledge.

I propose that the explanation that best accommodates these findings is the differential salience of biotechnologies for women compared to men. Previous research has suggested that because of gender roles associated with childbearing and childrearing, women are more likely to be directly affected by some of the negative consequences of biotechnologies (Napolitano & Ogunseitan 1999; Bryant & Pini 2006). The more women understand biotechnology, the more they see the personal implications, and the more skeptical they become. When a technology is particularly salient to one's lived experiences, it is likely to be viewed from a much more personal perspective, one in which opinions about the role of experts in policy decisions become of secondary importance compared to how the technology is likely to affect one's own life.

Because biotechnologies are not as salient to males, they use knowledge to generate their attitudes in a different way. This study has suggested that when males award experts responsibility for making important decisions about science in society, the way they use knowledge largely conforms to the deficit model (Allum et al., 2008; Bak, 2001; Wright & Nerlich, 2006): the more they know, the more supportive they become. This seems to typify the kind of male frequently described in the literature on gender and science, one that has much invested in hegemony of scientific institutions, and the one described so eloquently by Hayes:

Because men have historically commanded the technoscientific components of society, they have not only acquired the necessary scientific and technological knowledge to dominate nature but have also been socialised to unecological attitudes toward the environment. Denied access to the technoscientific realm, not only have

women been traditionally prevented from acquiring this knowledge but they have also been socialised to the more ecologically benign roles of mother and nurturer as reflected in their reproductive and greater child-rearing responsibilities within society (2001: 658).

However, not all males fit this stereotype. Although only about 27 percent of males in this study thought that science policy should be decided by the public, those who did became more critical of biotechnology with increasing knowledge of it, an effect of knowledge typical of females.

This study has several implications for the future of biotechnology and the study of its relations with society. If public opinion has been as instrumental in the development of biotechnologies as Bauer and Glaskel (2002) insist that it has been, then it seems that gendered experiences of biotechnologies have been instrumental in equal measure. In Bauer and Glaskel's edited volume on public perceptions of biotechnology – the most comprehensive and influential single text on this subject to date – gender is hardly mentioned at all, and when it is it is utilized as a control variable, not a focus of sustained analysis. If the future of biotechnology depends on its public reception, then it is also dependent upon gender roles and experiences, and how they relate to biotechnologies.

What do these results tell us about the relationship between understanding biotechnology and its acceptance? As Priest remarks, "It remains tempting for the scientific community and those who speak in public on its behalf to assume that dissent generally represents ignorance, and that it therefore can be reduced or eliminated by education" (2001: 98). But charges by scientific experts that resistance to biotechnologies is a consequence of an ill-informed public are only half true. It seems that, rather than providing the general public with accurate information, advocates of biotechnologies would have an interest in keeping women ignorant. Proponents of the "public understanding of science" have largely missed the point when it comes to women because they tend to see science and technology in terms of an objective cost-benefit analysis (e.g., Wertz et al., 1986) rather than as objects of lived experience. Embryonic stem cell techniques may sound innocuous to men, who may view the experimental material simply as a collection of cells. But when you have had a fetus in your own body, or even simply have the potential to carry a child, then embryonic stem cell techniques become more about powerful social institutions doing things to your body, and less about the greater good for humanity.

While this study is suggestive, it is also limited in some respects. The argument rests on claims about women's knowledge of biotechnology, though the knowledge variable used in the analysis measures general scientific knowledge, not knowledge about biotechnology specifically. It is assumed that general scientific knowledge can be taken as a faithful proxy for knowledge of biotechnology. There are surely arguments that could be summoned to challenge this assumption. However, it should be noted that the gender-knowledge interaction found here is similar to that found in a previous study (Simon, 2010) that made use of a knowledge test focused exclusively on genetics and biotechnologies. Another limitation is that the salience of biotechnology to respondents was not directly tested, but merely inferred from previous research on gender and technology and the gender differences in attitude formation observed from analyses of the Eurobarometer 63.1. I have

elsewhere begun to perform more direct tests of technological saliency with Katherine Johnson (Johnson and Simon, n.d.), but more research needs to be done to rule out alternative hypotheses. Perhaps there is some other gender division that is causing men and women to use knowledge in such disparate ways. The technological saliency hypothesis is consistent with the findings presented here, but more direct tests need to be performed before it can be accepted with confidence.

5. Conclusions

This chapter has sought to utilize the technological saliency hypothesis to better understand gender differences in attitudes toward biotechnology. The analyses presented here support the idea that the saliency of technologies to one's lived experiences engender unique criteria with which to evaluate those technologies. Based on previous research that has suggested that biotechnologies are especially salient for women compared to men, it was predicted that women would be less likely to discount their own knowledge in forming attitudes than men. This prediction was affirmed. Further analyses of the Eurobarometer 63.1 indicated that for men who concede science policy to experts, higher levels of scientific knowledge lead to a lesser likelihood of being pessimistic of biotechnology, while for men who insist that science policy should be the public's responsibility, higher levels of scientific knowledge lead to a greater likelihood of being pessimistic about biotechnology. While the analyses support the technological saliency hypothesis, further research should use more direct measures of saliency, rather than assuming gender automatically determines saliency, as I have done.

6. References

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