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Public culture and public understanding of genetics: a focus group study

Benjamin R. Bates

As the role of genetic science in everyday life has grown, policymakers have become concerned about Americans' understandings of this science. Much effort has been devoted to formal schooling, but less attention has been paid to the role of public culture in shaping public understanding of genetics. Research into public cultural messages about genetics has claimed that the public is likely to adopt problematic accounts, but few studies have explored the public's articulation of these messages. This study is based on 25 focus groups convened to explore the lay public's understanding of genetics. The study found that the public processed a greater variety of messages than assumed by previous researchers, including documentaries, non-science-fiction films, and popular television in addition to previous researchers' focus on science fiction and news media. The study also found that the public does not process the messages through the linear, transmission model assumed by previous research. The public processes messages about genetics complexly and critically. On the basis of these findings, the study suggests that researchers should include a greater variety of texts about genetics in their research and attend more fully to audience processing in addition to content analyses of these texts.

1. Introduction

As genetics science and technology have become increasingly important to the economy and culture of the United States, concerns about Americans' understandings of these technologies have grown. Bill Clinton told the American public that, with new advances in genetic science, genetic technologies could shape "the way you live, you work, you relate to other people, you relate to people all the way around the world" (Clinton, 1999: 381). George W. Bush also understood that genetic technology could have a profound impact on society, claiming that, "with this information comes enormous possibilities for doing good," but that "this knowledge of the code of life has the potential to be abused" (Bush, 2002a: 719). To ameliorate concerns that the American public would use genetics in a deterministic and discriminatory manner, science educators have urged that more genetic science be incorporated into educational curricula (Committee on Science Education K-12, 1998; Weiss et al., 2001). The Presidents, unsurprisingly, have encouraged formal schooling to change the way

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that members of the public understand genetic science (Clinton, 1998; Bush, 2002b). Less often discussed by policymakers, however, is how public culture helps shape public understanding of genetics.

Formal schooling forms only part of scientific knowledge. In their report on scientific literacy, the American Association for the Advancement of Science (AAAS) claims, "it is evident that family, religion, peers, books, news and entertainment media, and general life experiences are the chief influences in shaping people's views of knowledge" (AAAS, 1994: 281), not the formal classroom. The evaluation of school curricula is valuable, but more can be done to assess how members of the public use other cultural resources to understand genetic science. The purpose of this paper is to explore public culture and its relationship to public understanding of genetics in the United States. In this paper, I will discuss public culture—cultural forms such as cinema, music, sport, and television that shape collective experience—as it helps citizens to understand recent advances in genetic technology. I begin by reviewing previous work of public understanding of genetics as it has been shaped by public culture. After noting some limitations of this work, I present a focus group study of public understanding of genetics. Using examples offered by participants in these groups, I outline ways the focus group participants used public culture to discuss genetics. Although some examples offered by the participants are not "really" genetic technologies, or are debatably so, they are reflective of the way that the public reasons about genetics and may serve as analogies to "real" genetic research. I discuss the differences between the aspects of public culture emphasized by the participants in these groups and those emphasized by previous researchers to indicate areas for future study and implications for the public's understanding of genetic technology.

2. Expressing genes

Public culture is not separate from scientific culture. American culture is becoming more and more scientized and science must often be made relevant to public interests to continue to receive funding (Lessl, 1996). As the public and the scientific increasingly intersect, the distinction between public knowledge and scientific or technical knowledge becomes blurred (Goodnight, 1989). Thus, rather than separating the scientific from the public, it may be necessary to integrate scientific knowledge with other systems of knowledge in order to understand how public understanding of science is formed (Fausto-Sterling, 2003; Leftwich, 2002). In fact, research into the public's understanding of genetic technology has already begun this discussion. A growing body of research indicates that members of the public are very good at bringing their personal frames of reference to bear on their understanding of genetic science (Barns et al., 2000; Cunningham-Burley and Kerr, 1999; Davison et al., 1997; Kerr et al., 1998a, 1998b; Lambert and Rose, 1996; Michael, 1992; Morris and Adley, 2001; Parsons and Atkinson, 1992; Stockdale, 1999; Wynne, 1995). Research with these publics has sought to discover how people transform scientific information into personally meaningful units with which they can make decisions. Several of these studies address how peers and family help to shape the public understanding of genetic science, but they do not address other sources of public culture such as media artifacts. When the mediated dimension of public culture is investigated, two areas of public knowledge have received the most analysis: science fiction and news media.

If science fiction (sci-fi) is written to speculate on the potential impact of science on society, it is not surprising that genetic technology has been portrayed in that genre. Although sci-fi is speculative fiction, it also takes its subject matter seriously. Because sci-fi

often begins with known facts and imagines what might happen with a few developments, sci-fi can serve as a harbinger of the futures expected by the public. As such, sci-fi understandings of genetic technology can be as important to a scientific public culture as the actual science that is known (Nelkin and Lindee, 1995; Turney, 1998). Current readings of sci-fi as public culture have often relied on the close textual analysis of a small number of texts. Sci-fi narratives have both advocated extensive development of genetic technologies and argued for regulation and limitation of these technologies (Bendle, 2002; Thacker, 2001, 2003; Condit et al., 2002a; Gomel, 2000; Turney, 1998). Although they may have persuasive content, sci-fi narratives are roundly criticized by scientists and educators as misleading and by students as shallow and limited (Michael and Carter, 2001). Regardless of whether sci-fi tends to advocate for or against genetic technology, scholars have asserted that sci-fi guides the public's understanding of genetics and makes some uses of genetic technology acceptable or unacceptable to the public (Bendle, 2002; Rosner and Johnson, 1995; Turner, 2002).

The other area of public culture that has received substantial attention is news media. This attention may be because, as Geller, Bernhardt, and Holtzman claim, "the mass media are primary sources of health and science information for many Americans, including scientists and physicians" (Geller et al., 2002: 773; see also Conrad and Markens, 2001; Young, 2002). Television, magazine, and newspaper reports often simplify stories about scientific findings and may omit important information about the research (Bader, 1990; Conrad, 1999, 2001; Molitor, 1993; Richards, 1996). Most studies of the news media have relied on representative sampling techniques to draw cases out of a massive body of literature (Anderson, 2002; Bauer, 2002; Condit, 1999b; Condit et al., 1998, 2002a; Conrad, 1999, 2001; Conrad and Markens, 2001; Craig, 2000; Dimopoulos and Koulaidis, 2003; Geller et al., 2003; Miller, 1995; Wilkes et al., 2001). These studies have found significant changes in how the news media covers genetics over time, for different audiences, among nations, and for different levels of readership. Investigations of the news media have associated these changes with different levels of genetic determinism and have indicated alterations in the meanings assigned to important terms like evolution, mutation, and causality. These studies indicate that the news media often has untrained journalists who rely on statements from experts to present politically charged findings to the public (Anderson, 2002; Singer et al., 1999; Bauer, 2002; Conrad, 1999, 2001; Dimopoulos and Kouladis, 2003; Leftwich, 2002; Geller et al., 2003; Makgoba, 2002). Many of these studies conclude that the public receives an overly deterministic account of genetics and comes to fundamental misunderstandings of how genetics research is done (Brookey, 2001; Conrad, 1999; Craig, 2000; Hubbard and Wald, 1999; Nelkin and Lindee, 1995; Petersen, 1999; Rothman, 1998), although some question the extent and the impact of these accounts (Condit, 1999a, 1999b; Priest, 1995). Others have found that these reports do little more than present "genetic pornography" designed to raise fear of genetic science (Wolpert, 1999; Ramon et al., 2002; Turner, 2002).

In discussing public culture, analysts of news media and sci-fi often overemphasize the message and underemphasize the audience that receives those messages. The audience in the majority of these studies is seen as an inactive audience; it is one that receives messages and, largely, rearticulates them. A number of studies make this commitment clear by noting their reliance on powerful effects, media framing, media dependency, or classical hegemony models (Bauer, 2002; Conrad, 1999, 2001; Conrad and Markens, 2001; Geller et al., 2003; Hubbard and Wald, 1999; Gollust et al., 2002; Henderson and Kitzinger, 1999; Petersen, 1999; Singer et al., 1999; Nelkin and Lindee, 1995; Rothman, 1998; Nelkin, 1994; Nordgren, 2003; Zimmerman, 1999). For these studies, the audience is considered passive;

the views of the audience are simply and directly shaped by media messages. These studies argue that because there are deterministic, racist, sexist, or otherwise problematic accounts of genetics in news media, the implications of news media messages are that the public will become genetic determinists, racists, sexists, or hold otherwise problematic attitudes. A few studies move beyond assumptions of conformist responses to see how the audience actually responds. These studies manipulate messages to examine whether changes in the characteristics of the message (substituting the term "recipe" for "blueprint" or altering the trustworthiness of the source, for example) produce changes in the audience's understanding of the message (creating less deterministic effects or enhancing the credibility assigned to a message, in these examples) (Condit, 1999a; Michael and Carter, 2001; Doble, 1995; Frewer et al., 1998, 1999; Frewer and Shepherd, 1994; Petersen, 2001; Priest, 1995). These studies claim that the audience processes messages complexly and claim that this audience in an active audience. Although these studies claim there is an active audience, this audience is treated as a reactive audience. The audience is supplied with a message and asked to respond to fixed measures. It is the audience's reactions to messages that are examined, not the audience's action with messages. In these studies, there is little room for the audience to argue back or to present alternative interpretations that are not allowed for in the researcher's study.

In performance, these studies adopt a traditional transmission model of communication. Transmission models of communication assume that communication is a linear process in which a message sender creates a feeling, attitude, or knowledge base accepted by the receiver (Lasswell, 1948; Shannon and Weaver, 1949). Many complicating variables are poorly accounted for in transmission models of communication. Interference from noise in the message channel, the possibility for multiple message senders, misunderstanding or mistakes in decoding, the existence of previous messages, and, most important, a receiver that is him- or herself a message sender make simple transmission unlikely.

Instead of a transmission model of communication to discuss how public culture works to shape knowledge, we should be open to a model that is more complex. People do not simply receive messages and adopt them as their own understandings (or not). Audiences select some portions of messages to make their own while rejecting other portions of the same messages. Instead of being produced by cultural messages, audiences are also producers of cultural messages (Daunton and Hilton, 2001; du Gay et al., 1997). Because audiences take messages, edit and reorganize them, and produce new messages, top-down models of communication should be used with caution. Selecting a body of messages, and then assuming that the audience will believe these messages, is only one way of accessing public culture. It is as important to examine how audiences use media as it is to consider how media uses audiences. In addition, the messages used by the audience are more than those selected and manipulated by researchers. Rather than a top-down approach to message selection, several researchers have urged that evaluations of the public understanding of genetics should use democratic research methods (Doble, 1995; Frewer and Shepherd, 1994; Stockdale, 1999; Zimmerman, 1999). Members of the public should be allowed to articulate their own ideas and deploy their own messages. Central to the call for democratic research into public understanding of genetics is that members of the public are allowed to discuss genetics in their own language, not just the language of scales and messages chosen by researchers (Condit et al., 2002a; Levitt, 2003; Macintyre, 1995; Garland, 1999). To discuss how public culture shapes public understanding of genetics, I used a series of focus groups to examine how members of the public use the media to express their understanding of genetics research.

3. Participants and procedures

To explore how members of the public draw on public culture to express their understanding of genetics, a focus group methodology was employed. As part of a larger project investigating the public's understandings of the relationships among genetic science, public policy and ethnicity, our study group conducted 25 focus groups with 216 total participants from August 2001 through March 2002. Group sizes ranged from 4 to 10 participants (M = 8.6). The groups met in conference rooms in public meeting spaces in the participants' communities. Three research sites in the southeastern United States were used: Atlanta, Georgia (a large urban area), Gainesville, Georgia (a regional hub that was primarily agricultural, but is now in transition), and Athens, Georgia (a university town). Sessions lasted about two hours.

Participants were recruited by nomination from community advisory boards located at each of the three research sites. Community advisory boards were employed to have input into the research process with regard to the appropriateness of research materials within their local community. The boards suggested many revisions to these materials that improved their clarity and avoided materials that would generate unnecessary controversy. Each community advisory board was recruited by a person with ties to the local community (by family, work, or residence). Recruiters attempted to include a balance of persons who were African American and European American, male and female. They attempted to incorporate a wide range of occupational and income groups. They also incorporated persons who were differently abled, had experience with genetically based conditions, or represented other minority groups. They attempted to include predominantly "lay" persons rather than experts in genetics. To recruit participants for the focus groups, community advisory boards were first asked to discuss what constituted their community. Then they were asked to nominate individuals not on the board who would represent the breadth of perspectives in their community. Those individuals were then telephoned by research team members and invited to participate if they did not self-identify as "experts" in genetics. Participants were told whom they were nominated by and offered $50 to compensate them for transportation, childcare costs, and time.

Participants were assigned to groups based on their self-identified race. In the United States there is a long history of using "genetic" warrants to promote racial discrimination (Condit, 1999b; Hasian, 1996; Selden and Montagu, 1999). There is also a clear contemporary concern that genetics will be used to justify this racial discrimination (Zilinskas and Balint, 2000; Sapp and Smith, 1996; Zeta Phi Beta National Educational Foundation, 2000). Because of these historical and social factors, and the importance of race in American society generally, there is a strong reluctance on the part of European Americans to speak in "mixed-race" settings. As such, our research team chose to segregate most of the focus groups, although two integrated groups were retained for possible comparison. Twelve groups had persons self-identifying as "Black" or "African American," seven groups had persons self-identifying as "White" or "European American," and two groups had approximately equal numbers of African Americans and European Americans. Two groups had persons self-identifying as multi-racial and two groups had persons self-identifying as Hispanic or Latino. Moderators were matched by self-identified race, with one integrated focus group being moderated by an African American female and the other moderated by a European American female.

Focus group participants were 118 African Americans, 71 European Americans, 15 Hispanics, and 11 self-identified multi-racial persons, and one person declined to answer; 104 were female and 112 were male. All participants provided written informed consent,

and appropriate institutional review boards approved the study. People with a lay understanding of genetics were recruited from urban (62), suburban (83), and rural (71) communities in the southeastern United States. Participants ranged from 18 to 64 years of age ($M = 32.7$). Family income ranged from $7,500 to $700,000 with a median of $50,000 (median income for the state is $36,372). Educational levels ranged from less than high school (3 percent) to a terminal degree (1 percent). Most participants had either a high school diploma (20 percent), some college education (31 percent), or had completed a bachelor's degree (31 percent). The remainder had some graduate (9.5 percent) or doctoral (5.2 percent) education.

Standard qualitative focus group procedures were followed. Moderators employed a common series of questions, which had been developed by the research team and then reviewed and revised by the three community advisory boards. The full moderator guide is available upon request to the author. In the uses of public culture outlined below, the questions to which the participant responded will be included. Moderators were encouraged to include follow-up probes or to revise wordings in questions to seek full exploration of the issues by as many participants as possible. Audiotapes of the sessions were transcribed. These transcripts were then compared to the videotape and corrected as necessary. Transcripts were not corrected for grammar or for formality in order to capture the oral nature of the discussion. Specific questions asked by the moderators have been reported on elsewhere (see, for example, Condit et al., 2002b, 2003; Dorgan et al., 2003; Parrott et al., 2003, 2004; Bates et al., 2003; Bevan et al., 2003). In this study, I took a more global view of the data. Rather than focusing on answers within discussions of specific questions, I reread the transcripts to find general themes that cut across questions. Sections where participants used public culture to discuss their understanding of genetics were isolated for closer analysis. I report representative examples from this use of public culture below.

4. Findings

Participants in these focus groups were able to draw on a wide range of texts in public culture. The average American spends about 7.5 hours each day consuming media product; 28.8 minutes reading a daily newspaper, 18.8 minutes reading magazines, 32.4 minutes using the Internet, 191.4 minutes listening to the radio, and 191.3 minutes watching television (Readership Institute, 2003). Americans consume large amounts of media product from multiple sources. Our participants created a complex matrix of texts to express their understanding of genetics research. The participants drew on sci-fi texts and news media reporting. They also drew on other aspects of public culture to articulate their understandings. Because the public indicates that they attend to a wider variety of material than is assumed in the literature surrounding media and public understanding of genetics, there is a concomitant need for researchers to take these other elements of public culture into consideration.

News media

Although there is extensive discussion of how news media reporting shapes public understanding of genetics, participants in these focus groups rarely drew explicitly on news media accounts. When they did refer to specific news media, they also provided reflective statements about these accounts. An African American female (3-102) indicated that news media had a high degree of salience to viewers. After a group discussion of the question "are

there other concerns that you have with regards to the ways in which genetic research might affect different groups differently," near the end of a focus group session, 3-102 said,

> you constantly hear "research studies show," and you hear that over and over and over again, especially on CNN news, a national news station, one of the most prominent news stations in the country . . . and everybody's like "what is it?" and they're going to believe what they hear.

In other words, 3-102 believed that news media does play an influential role in shaping the public's understanding. Because news sources were prominent and created a sense of drama, she held that the public would believe what the news reported.

The other two statements referencing news media indicated that the news media was important in revealing the dangers of genetic and medical research. When her group was asked generally whether "media messages would increase discrimination in some fashion," participant 6-110, an African American female reported that she had seen a news magazine show discussing genetics (Condit et al., 2003, report on this question fully). She said, "I think it was Dateline or something like that, and they were talking about genetic makeup, where they wanted the blue eyes, blonde hair. . . . They can make sure that that would happen. It's all taken care of. I mean you can determine what your child looks like." 6-110 explained that it was likely that parents would choose Nordic traits for their children and deselect other traits in a quest for "perfection." The option to choose a socially constituted "perfection" was, for this participant, a submission to European American standards. Suspicions about the racist use of genetic engineering were expressed on a broader level as well. 12-103, an African American male, used a newspaper to justify his suspicion of governmental involvement in genetics research. During a group discussion of whether the public would trust messages about racially varied pharmacogenomics (Bates et al., in press, discuss the full findings from this study), 12-103 said,

> In South Africa, you know, they've broken out Apartheid and they found out that they had all types of programs going on—similar to the Nazis, you know, what they were doing to the Jews. But they would try and develop and design Black people, and that was in the *New York Times* last year. So, you know, I don't put anything past our government.

Although the *Times* report cited was about the South African government, this participant crafted an analogy to the United States. Rather than simply reflecting the news story, these participants processed the stories in a way that remade them and used them as grounds for arguing against some kinds of genetics research.

As interesting as the way these news media accounts are deployed by the participants is that there are so few explicit references to news media. If previous research is correct that the news media has a powerful and profound influence, the public should draw on these accounts. The lack of references may indicate that the news media is not the most influential source in crafting public understanding of genetics. Alternatively, because it is so pervasive, the lack of references to news media may indicate that these reports are always already incorporated into the public's understanding, making explicit reference to these accounts unnecessary. The news media may become the background for public understanding, rather than being the element that is viewed prominently. Regardless of whether the news media is an influence that subtly pervades all understanding or is a little-used source for genetics information, the kinds of public culture that people draw on explicitly to articulate their understanding of genetic research is also interesting.[1]

Documentaries

Although the public rarely draws on news media explicitly, this finding does not mean that the public ignores non-fiction accounts of genetics to form their understanding. Participants commonly reference documentaries—informative programming on issues of social, historical, or political matters—as sources of public culture. Documentaries were used to discuss the history of genetics research and the implications of genetics research as understood by the public.

The participants read the history of genetics research as shown in documentaries in diverse ways. For example, 3-201, a European American male, claimed that documentaries helped him understand human evolution. After his group was asked "do you think there are any genes that are different between people of different races" (Condit et al., 2002b, develop this question in more detail), he said,

> I watched some shows on the Neanderthal man and *Homo sapiens*. . . . I guess it was The Learning Channel, like a crossover when we both were on the earth at the same time for a certain amount of time. And how *Homo sapiens* were more well adapted to the environment, and they were apparently smarter and able and we taught them for a while, and this is all theory, I guess.

Although 3-201 articulated concerns over the reliability of the information, he indicated that documentaries serve as a useful source of information. Similarly, 2-305, a Hispanic male, indicated that documentaries were useful for understanding how genetics has been used to justify racism. After his group was asked whether "genetics research could offend the religious beliefs of some groups," 3-201 claimed that the important issue was discrimination writ large. He stated,

> in this century, with the influence of the United States, and Germany, on the nations, even that England was in the background and in Europe also, we have heard so many stories and proof of damage, racial damage, that's been done in so many countries, . . . Now, I don't know how much the truth of those documentaries on Discovery or National Geographic but that give you an idea of things, discrimination, that really have happened in an area of a nation.

Again, there is a disclaimer that notes potential unreliability of the information presented in documentaries. This disclaimer is accompanied by an indication of the source's educative value. These participants indicated that they watched documentaries and learned about the role that genetics has played in history. Moreover, they did not simply accept the claims made in the documentaries, but held them at a distance for critical evaluation.

In addition to watching documentaries to learn history, participants reported that documentaries helped them to understand the uses for genetic technology. For example, 10-120, an African American male, claimed that documentaries showed him the uses for DNA testing in criminal cases. In response to the question to group AA10, "do you think that [genetic science] might possibly benefit the well to do more," he said,

> It's always been an advantage to the rich people rather than the poor, so that's the question that anybody can answer, you know. I look at the Discovery Channel a lot and that is a very good channel to look at. And I've seen, sometimes, in the courtrooms, they hold a guy in prison what 20 years, then go back and we've got this new discovery of the DNA and now we think you can go free because we got a hair strand.

Because there were cases portrayed in documentaries where DNA evidence allowed innocent people to go free, this participant was better able to understand what genetics

research was good for. He also indicated that only those who could afford genetic services would benefit. By noting that there were multiple cases where a documentary had shown DNA evidence in the courtroom, this participant was able to show that the information presented by the documentaries was reliable and representative.

6-201, a European American male, claimed that documentaries had helped him realize how far cloning technology had developed and what its uses were. As his group answered the general introductory question "what have you heard about genetic research," he reported,

> I've definitely seen the animals with an ear, definitely a mouse, with an ear growing out of its back. I think I saw that on the show on Discovery Channel. It's a weird medical phenomenon show. One of the guys had gone up in the mountains and had frostbite and gangrene and they had taken off part of, a piece of his face and they went in and they grew this ear and nose . . . that's all I know.

Although the mouse was not, technically, an example of genetic engineering (Ochoa and Vacanti, 2002), the participant indicated that the documentary was helpful. Since seeing tends to be believing, and because the documentary provided a clear explanation for how tissues could be engineered for transplantation, this participant reported a greater understanding of the uses of genetic technology. Moreover, because there was an explanation of how this treatment was experimental and had worked in a test case, the participant felt that there was sufficient ground for believing the message despite its presence on a "weird" medical show.

Fiction

The uses of genetic technology seen in documentaries were mostly positive uses such as organ transplants, better medicines, and proper identification in crimes. Hopes for positive outcomes were also expressed through the use of fiction as a lens for understanding genetics. On the basis of seeing a drama, 8-103, an African American male, explained how genetics research would allow testing for disease. During a discussion of the costs of genetic testing, the moderator used the probe, "Now is there some dollar amount above which you would think that this option is too expensive and some other option should be used?" (Bevan et al., 2003, discuss public perceptions of the cost of genetic medicine as a barrier to its regular use in more detail). 8-103 said, "All it is, is DNA. It doesn't have to be a drop of blood . . . Can't it be like hair, or skin? Once they take it, what do they have to do with it? That's the thing. Has anyone seen the movie *John Q*? Cuz this is like [that]." Having seen physicians in a movie use a drop of blood to identify a heart problem, this participant indicated that physicians in real life could probably do the same when performing genetic tests. 8-103 then used this element of public culture to discuss the costs of genetic testing. If one assumes, as 8-103 does, that the procedure shown in the film was a genetic test, then the high costs of medical testing that precluded its use by John Q's family might also exist outside the film. This balance of concern over the cost of medical science with the optimistic outlook on the power of technology came through in other uses of cinema.

Hopes for medical treatments were commonly drawn from fictional films. For example, to interpret stem cell research, 7-208, a European American female, recounted the plot of a movie she had seen. In response to our introductory question, "what have you heard about genetic research," she asked,

> Did anyone else watch it . . . the one with Jennifer Askos and she had Lou Gehrig's Disease . . . The movie was about how her family came up with, like, money to do

> research about stem cells. Because that was like, what happens is their motor neurons die off and that was like the only way that they could replace cells with these stem cells. Because they'll turn into motor neurons; they think they'll turn into anything.

In this film, stem cell technology is far removed from everyday clinical genetics. Nevertheless, the strong association between stem cells, cloning, and genetics generally may encourage members of the public to use their attitudes toward stem cells to guide their attitudes toward most genetic technologies (Fink, 2002; Sitko, 2002). Other participants cited other genetically related technologies in fiction to support their claims that genetics research would be beneficial. The participants noted the fact that these were fictional sources. These markers outlined the reliability the participants assigned to the information and served as signposts for their interlocutors. The coherence of the narrative and its correspondence to what the participants had seen in other sources was also indicated. Although some accounts were more fictional than others, they did show how public culture helps to frame positive expectations for genetic technology.

Although participants who drew their knowledge from fiction cited several positive uses of genetically related technology, many examples from public culture portrayed negative uses. A counter-example about stem cell research was drawn from 8-205's, a European American male, viewing of a film. After his group was asked "does anybody think that we shouldn't be doing this kind of research," 8-205 asked,

> Has anyone ever seen that movie *Extreme Measures*, with Gene Hackman and Hugh Grant? You know they're doing the brain stem, and stuff and getting these homeless people off the street and doing all this research on them, causing some of them to be vegetables, and doing all these things with people that apparently nobody cares about. And um, he's doing it in the name, he's doing for the good of society. His purposes are good but his methods are probably a little questionable.

By using this film, and drawing out dangerous ethical implications of research, this participant supported his disapproval of stem cell research. In this example, the connection to genetics is even more tenuous. The brain stem is distinct from stem cells. Yet, by conflating the brain stem with stem cells and by positing stem cell research as genetic research, 8-205 was able to use the example from the film to talk about the problems of ends and means in genetic research. Although he understood why one would want to cure diseases through stem cell investigations, he felt that the methods for curing these diseases could not be supported.

Other participants drew on fictional accounts to argue that genetics research would be used for eugenic purposes. Some participants indicated that the quest for genetic perfection would consider White people to be perfect. In response to the question "what kinds of discrimination are you concerned about as we apply findings from genetics research to health issues" (Bevan et al., 2003, discuss worries over discrimination from these focus groups), 12-102, an African American female, reported that she thought genetic engineering was

> sort of like, remember *The [Six] Million Dollar Man* and *Woman*? Where I think like, in genetics, they will probably try to deal with this genetically perfect person, but how do they define perfect? I think it will lean toward more of a Caucasian person than a minority.

12-102 created an analogy between the "perfect cyborg" and future genetic creations. Because the "perfect" people shown in fiction were all of European descent, this participant felt that perfection would be modeled on a European ideal. The lack of persons of color in

representations of the genetically elect raised suspicions about the use of genetic engineering. For instance, 12-101, an African American male, thought that genetic research could be used to eliminate non-Caucasians. During his group's discussion of racially varied pharmacogenomics (Bates et al., in press) he said,

> I was watching this movie last night, *Three the Hard Way*? It was made in '74. Jim Brown, Jim Kelly, and Fred Williamson. This one guy, he was real rich and he's trying to. . . . He came up with this drug, where he puts it in the water system. He was doing three cities: Washington, L.A. and Detroit. You know, to kill Black people. And that was in '74 when they came up. They may be just talking about the same thing.

This classic Blaxploitation film is not about genetics. Rather, the plot of the film is that a White supremacist group plans to taint the water supply with a toxin that is harmless to Whites but lethal to Blacks. Instead of a direct reference to genetics, 12-101 is creating an analogy that racially varied pharmacogenomics could be used like the poison in *Three the Hard Way*. Because genetic engineering could be used to select against persons of particular racial backgrounds, it could be considered equivalent to plots to exterminate African Americans because of their race. As such, 12-101 reported that this film guided his attitude toward racially varied medications. "Don't take it. Take what the White man's taking," he said.

The potential for eugenics was not feared on the basis of race alone. Some participants used films to discuss the way that individuals would be affected by eugenics projects. When asked "do you all think that this research might make some people less willing to interact socially with people from other groups" (Parrott et al., 2004), the film that participants used as the exemplar of this fear is *GATTACA*, a movie about the creation of genetic classes in a futuristic world. A European American female, 2i-204, used this film to support her claim that genetic information would be used to discriminate against people with so-called "bad" genes. She said,

> If they could get hold of information and determine whether babies were going to be born with a genetic predisposition, they'd maybe encourage people to change that one way or another. Like that movie, *GATTACA* that came out a few years ago, where everybody had test tube babies that were genetically perfect and so babies who happened to be born "by accident," by a normal pregnancy, couldn't get good jobs.

Likewise, 6-207, a European American male, claimed that *GATTACA* showed that genetic engineering was dehumanizing, despite its intentions. He argued,

> I don't know if anyone saw the movie *GATTACA*, where, basically, if you aren't the best, then people start to manipulate their children's genes and almost order what they want, like a package deal. . . . When it becomes so important that you lose your sight of the fact of the individual.

Although the parents had the best of intentions, they would program their children and deny their children the possibilities provided through genetic chance. Although the film does show the protagonist overcoming a system of genetic hierarchy, these participants used *GATTACA* to articulate their concerns about genetic engineering.

Participants used film to point to other kinds of potential discrimination from genetics research. After his group was asked "what kind of discrimination are you concerned about as we apply findings from genetics research to health issues" (Bevan et al., 2003), 12-107, an African American male, used *The Sixth Day* to argue that cloned people would be treated as non-human. In the film, "if they knew you were cloned, like say for instance, you had all this

wealth and whatever, your wealth would be took away from you. It's like, you got no rights." On the other hand, 1i-207, a European American male, was more concerned about the status of deliberately mutated humans. Drawing on his viewing of *Total Recall*, he asked, "are the non-genetic created folks gonna hang out with genetic created folks? Oh, they're manufactured, we don't wanna be with them." Although there are not yet human clones or intentional mutants, the participants in these focus groups used fiction to outline concerns that researchers may want to address.

At a more basic level, participants used fiction to define key terms in genetics. All groups were asked to discuss the meaning of the words "DNA," "mutation," and "genes" (Condit et al., 2002a, discuss the development of "mutation"; similar analyses for "DNA" and "genes" are under way). Participant 5-206, a European American female, drew her definition of "DNA" from the movies. She said that DNA was "whatever a map looks like. Double helix. I get that from *Jurassic Park*. Do you ever watch *Jurassic Park*? They build on the left. If that stuff is true, that's how much I know." Although she noted the limitations of *Jurassic Park* as an information source, she felt comfortable in using it to help define the term. More common was the use of fiction to define the term "mutation." 3-104, an African American female, said that "mutation" made her think of "the Ninja Turtles' song, uhm, it makes me think of no, X-Men." Several participants used these cartoons. Two African American men had this interchange:

7-101: Think about it. You can even go back to like dumb stuff when you was kids watching cartoons. Everything that was mutated was some little funny little thing, creature or something that wasn't right. You would just like, you know.
7-109: X-Men.
7-101: Yeah, I'm trying not to go there. But yeah, you could say the X-Men if you wanted to.

A similar conversation occurred in a European American focus group.

5-202: Mutation, they may think some kind of monster, some kind of problem. I mean, I don't know.
5-209: And it's a negative change.
5-202: And mutation just doesn't sound good.
5-208: Well, you call them a mutant. I mean that just.
5-202: Like the Mutant Ninja Turtles!

The science behind the *X-Men* and the *Teenage Mutant Ninja Turtles* is questionable at best. Nevertheless, these cartoons gave participants a source of genetic information. Fictional sources supplied a repertoire of common definitions for scientific terms. It is also interesting that the participants chose heroes to define the term "mutation" rather than villains. The preference for the X-Men and the Turtles rather than Godzilla, the Mole People, or the class of Nuke 'Em High may indicate that genetic alteration has a positive face for the public. Alternatively, these participants may hold that "normal" humanity is better than "superior" or "inferior" humanity and be using denotatively positive examples (superheroes) to express a connotatively negative affect (mutation is bad).

5. Discussion

In their discussions of genetics, the participants in these focus groups went beyond the texts suggested by previous researchers. The participants did use news media accounts of genetics

research and science fiction films to discuss their views. In addition to these sources, the participants used other elements of public culture. The participants referred to documentaries, television, and non-science-fiction films as well as sources that have been investigated previously. They do not discuss "hard" scientific reports. This lack does not mean that a reliance on public culture separates the participants from an understanding of scientific culture.

Public culture allows non-scientists to discuss genetic science. Public culture may be as important a source to the public understanding of genetics as is hard scientific data. Relatively few people in the United States are scientific practitioners,[2] but lay persons can still discuss science coherently (AAAS, 1994: 322). The participants in these focus groups drew on different, non-scientific, kinds of data to support their claims. The kinds of data used—news media, documentaries, and popular fiction—indicate that public understanding of genetics relies on public culture. Reliance on public culture does not mean, though, that the public is duped by fantasy or shows an uncritical acceptance of claims. Instead, the public uses public culture as a data source. The public sifts through cultural referents and processes them in support of claims. The public notes the limitations of data sources; these participants state reservations to show the strength of their claims. The data are also weighed against one another and data that "ring true" to the participant are emphasized more than data that appear fantastic in nature. When using public culture, participants provide detailed explanations for how they are using texts or examples to express their understanding. In short, the public displays critical processing skills when using public culture. This evidence is used to make claims and the participants in our focus groups were aware of the need for reliable and representative evidence.

The use of evidence alone does not make for an informed public discussion. In addition to being able to use evidence, our participants were aware that there may be more than one good way to interpret a given set of data. Our participants displayed this awareness by indicating both the limits of scientific research and the limits of public culture. In discussing how news media and documentaries present research, the participants acknowledged that scientific research is an ongoing and unfinalizable endeavor. Although they claimed that some people would take reports on research as the "last word," our participants were willing to suspend judgment on the research until there was greater confirmation. On other issues where there is not conclusive evidence—such as the potential interactions between Neanderthals and *H. sapiens* or the early history of genetic research—the participants stated that they would accept the most supported theories but would be willing to accept plausible alternatives.

This openness to alternative arguments was also shown in the public's use of fictional texts. Although fiction was primarily used to show the potential dangers of genetic technology, our participants were also aware that fiction is used as a dramatic way to make an argument to the public. The participants demarcated fictional texts clearly, labeling them so that their interlocutors would know that a different kind of evidence was being deployed. Because some stories from fiction were more compelling and had narratives that "hung together," participants use these stories to articulate possible futures. By noting that these were fictional, however, the participants made clear that alternative stories could be told and that actual developments in genetic technology needed to be witnessed. Narratives from fictional and non-fictional public culture are used to provide interpretations. Contrary to much previous research, though, the public does not regard these narratives as closed stories. The public views reports of genetics in the news and in documentaries and stories about genetics in fiction as ways of interpreting the impact of genetic technology on social collectivities. The public allows these interpretations to conflict; the public recognizes

multiple valid interpretative frames for discussing the impact of genetic technology rather than only allowing one interpretative frame to dominate.

Last, even as participants used public culture to talk about genetics, they used public culture to talk about *genetics in society*. Genetic technology could be used to edit children's DNA. The participants expanded this use to talk about the dangers of eugenics on a social scale. DNA tests can be used in medical diagnosis and in criminal identification. The participants talked about how DNA testing could influence the larger medical and legal systems. Stem cell research may allow for innovative treatments. The participants discussed the ethical ramifications of this line of research. Cloning and intentional mutation may be areas of interest to some genetics researchers. The participants speculated on how cloned and intentionally mutated humans would be treated in society. Other issues at the intersection of genetic science and society were discussed through other referents in public culture. In sum, the participants did not isolate science from culture. Instead, by using public culture as a base of reasoning, the participants tried to make sense of the scientific and scientized culture in which they lived. Rather than deferring to authority, the public may be willing to think through public culture referents and scientific findings to better understand the role and use of science in contemporary culture.

6. Conclusions and implications

The public is able to use public culture to understand genetics. The public's complex processing and use of public culture indicates that linear assumptions of media influence on public understanding of genetics may be overstated. In addition, the public's reorganization of media messages, alongside and with unintended messages and non-media messages, to produce new arguments implies that assumptions of an uncritical, passive public may be false. The results point to a need to rethink the relationship between mass media and public understanding of genetics.

Given these results, the transmission model of genetics information, in a linear and causal sense, does not hold up well. Analyses of the content of media *are* important, but the content of media messages is not necessarily determinative of the public's understanding of genetics. Too many studies assume a "garbage in, garbage out" paradigm. But people are not computers. Rather than reading a newspaper article or a sci-fi novel and adopting its viewpoint, members of the public take a more complex action. The public reads these messages and integrates them with prior media messages to create new ideas. Moreover, because much of a person's understanding of science is influenced by family and peers, conversations with other members of the public have the potential to reshape a person's understanding of media products in a way for which linear transmissions models are less able to account. Even if much news media and sci-fi tends to repeat deterministic, racist, or otherwise problematic accounts of genetics, other messages—often non-deterministic, non-racist, and otherwise less problematic ones—check the influence of "bad" media accounts in public culture. Media representation and public understanding do not exist in a one-to-one relationship.

The public processes messages complexly. To understand these processes and to investigate public understanding of genetics more thoroughly, it may be necessary to perform more studies with actual audiences. It may also be necessary to allow these audiences democratic voice in the research process. It is good to understand message content; it is necessary to examine how the public uses that content. It is good to see how the public responds to messages chosen by researchers; it is necessary to find out what messages

the public chooses as important ones. A research agenda that takes active, processing audiences more seriously and that allows these audiences to become co-investigators in that agenda should be part of future investigations of public understanding of genetics.

In addition to audience studies, the current research indicates that we should broaden the range of texts that we explore in our content analyses. News media and sci-fi are important places to look for messages. This study confirms the need to do content analyses of these media forms. After seeing what the public uses to form their understanding, though, it is clear that we should look to other parts of public culture as well. The public uses documentaries. Researchers may want to perform content analyses of shows on PBS, Discovery, National Geographic and similar stations to see what messages about genetics are presented there. The public also uses non-science-fiction films to understand genetics. Although sci-fi may provide the clearest content area in which messages about genetics are portrayed, other kinds of film, such as drama and action, may have some content useful to the public for interpreting genetic science. In addition, the public may draw analogies from medical dramas to understand the smaller world of genetic science. Other audiences might point to additional referents, providing additional access points into public understanding of genetics that should be investigated.

Finally, the public must be treated as a complex body that is able to interpret messages about genetic science. The public is not composed of scientists, nor should it be. Just because the public does not have a highly technical background does not preclude them from making sensible judgments about genetic science and genetic technology. A person can drive a car perfectly well without understanding the physics of internal combustion or body shell design. These drivers are also allowed to express opinions on where roads should go, what the speed limit should be, and the relative importance of pollution, accidents, and noise to automotive policy. This public should also be trusted to make sense out of genetics research. Their input on where genetic technology should go, how quickly it should try to get there, and the potential ethical, legal, and social ramifications should be taken into consideration. Only by including public understanding and scientific understanding of genetics are we likely to avoid having potholes in the bridge to the twenty-first century.

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Notes

1 Celeste M. Condit and colleagues have found that the public gives low ratings to how often they have heard about genetics in the news media, lending support to the second proposition (unpublished data).

2 The United States Bureau of the Census (2002) estimates that about 484,000 persons are employed by organizations “engaged in conducting original investigation undertaken on a systematic basis to gain new knowledge (research) and/or the application of research findings or other scientific knowledge for the creation of new or significantly improved products or processes (experimental development)” (definition found at Sector 5417). This number includes administrative and other staff not directly engaged in the research or experimental development and probably overestimates the number of people who are directly engaged in scientific practices. More important, at the outside estimate, this number indicates that, in a population of about 281,000,000, about 0.1% are scientists.

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