Asian Bioethics Review (2017) 9:199–209
DOI 10.1007/s41649-017-0026-8

ORIGINAL PAPER

# Media portrayal of stem cell research: towards a normative model for science communication

**Kalina Kamenova**[1]

Published online: 15 September 2017


**Abstract** As the field of science communication has matured over the past 50 years, there has been a significant move away from the conventional understanding that mass media's role in the public communication of science is limited to reporting new scientific discoveries. Media have been increasingly viewed as important for the legitimation of science and scholars have recognized their agenda-setting effects and ability to facilitate interaction between the public, scientific community, policymakers, interest groups, and other social actors. This article draws on analyses of news media coverage of stem cell research between 1998 and 2013 to demonstrate the active role of mass media in validating scientific claims about discoveries in the field and shaping the public understanding of key bioethical and policy issues. It further assesses whether media, in their attempts to construct the "right" position, have instigated a rational-critical discourse on the controversy. I argue that media representations in different cultural contexts have largely failed to meet normative expectations about the democratization of public discussions on biomedical innovation, as set out in the *public engagement with science and technology* (PEST) model of science communication. Rather than deconstructing the major terms of science policy debates as framed by stem cell advocates and their opponents, media coverage has mostly replicated discussions in political and legislative arenas, presenting the controversy as a strict binary opposition. Media have rarely provided critical reflection on the hype surrounding breakthroughs in stem cell research, thus reinforcing the public's unrealistic expectations about the future of this biomedical innovation.

**Keywords** Media · Stem cell research · hESC · Science communication · Public engagement

✉ Kalina Kamenova
kamenovk@mcmaster.ca

[1] Institute on Ethics & Policy for Innovation (IEPI), Department of Philosophy, Faculty of Humanities, McMaster University, Hamilton, ON, Canada

## Introduction

New media are the primary channel to convey scientific notions to the public and lay people heavily rely on media sources and media professionals for information and interpretation on contentious scientific debates, especially when they attempt to understand controversial science in ways that relate to their own personal lives (Friedman et al. 1999). Past research on media representations of scientific controversies has convincingly demonstrated that news media constitute a major avenue for framing risk information and communicating scientific uncertainty, and can significantly influence the public understanding of scientific debates by providing legitimacy to knowledge claims, social values, ethical concerns, and political interests (Mazur 1981; Pellechia 1997; Weingart 1998; Marks et al. 2007). Media representations of scientific controversies can sometimes amplify negative attitudes towards science. For instance, a longitudinal study of the impact of American media on public attitudes during the contentious national debates over fluoridation and nuclear power from the 1950s through the 1970s has shown a direct correlation between increased media coverage of a techno-scientific controversy and public opposition to the technology in question (Mazur 1981, p. 109). Although there is no conclusive evidence that people's perceptions are exclusively shaped by the media, inaccurate and biased reporting on scientific issues can contribute to low levels of scientific literacy and hinder informed citizen participation in science policy debates. As established by Pellechia (1997) in a longitudinal study of trends in science news reporting from 1966 to 1990 in three major U.S. daily newspapers—*The New York Times*, *The Chicago Tribune*, and *The Washington Post*, media has consistently failed to cover scientific controversies in an accurate and non-biased manner. Additionally, the content analysis indicated that science articles reported primarily on the findings of scientific research and that there were no discussions of contextual factors or methodological details of the scientific studies; knowledge that can increase the public understanding of scientific process (Pellechia 1997, p.61).

This paper explores the evolution of media discourse on human embryonic stem cell (hESC) research between 1998 and 2013, focusing on what strategies have been deployed to frame the underlying ethical and policy issues in the controversy and how scientific claims about therapeutic potential have been validated. My analysis is premised on the assumption that mass media play an active role in shaping the public understanding of scientific controversies, rather than simply reporting scientific facts and discoveries. I illustrate the news media's ability to open controversial scientific innovations to public scrutiny and influence the policy agenda, through a synthesis of research findings from previous studies of media coverage of hESC research and human cloning in the USA, UK, Canada, France, and Poland, including my content analysis of the media portrayal of translational stem cell research between 2009 and 2013. The media responses to the controversy surrounding South Korean stem cell scientist Dr. Hwang Woo-Suk are also scrutinized to show how media have transcended their traditional role as a communicator of experts' opinions to endorse and disallow scientific knowledge claims. Ultimately, this paper aims to assess whether media across cultural contexts, in their attempts to construct the "right" position on hESC research, have instigated a critical discourse that deconstructs the binary structuring of the controversy as involving two conflicting perspectives (e.g., scientific knowledge vs. ethics, science vs. religion, saving lives vs. protecting embryos).

My analysis draws on the *public engagement with science and technology* (PEST) model, a theoretical orientation that has been embraced by scholars in science and technology studies (STS) and science communication to critique paternalistic notions about members of the public as *deficient* in understanding science (Davies et al. 2009; Irwin and Michael 2003; Davies 2013; Brossard and Lewenstein 2010). The *knowledge deficit* model of science communication associated with the early *public understanding of science* (PUS) movement and the PEST paradigm have set out different normative expectations for media discourse on scientific issues. While the former views media primarily as an agent for improving the public's scientific literacy and postulates that science reporting should be an accurate reflection of scientific discourse, the latter advocates a greater democratization of public communication of techno-scientific developments, in which media provide a forum for diverse and critical perspectives. Following the PEST perspective, my analysis of mass media as a public communicator in the stem cell controversy, utilizes three normative criteria for critical media discourse as outlined in Gerhards and Schäfer's (2009, p. 441) normative perspective on the contextualized scientific public sphere: (1) moving away from reporting limited to scientific events and debates that originate within the scientific community; (2) providing a critical reflection on competing perspectives within society, rather than serving as an advocate for science; and (3) more inclusive media coverage that engages diverse social actors in a pluralistic evaluation and interpretation of science.

## Trends in the media coverage of stem cell research

Science reporting routinely uses "frames" or interpretive schemata to make scientific information intriguing, accessible, and comprehensible for lay audiences, while simultaneously limiting the public's interpretations on complex issues (Friedman et al. 1999). The concept of framing describes the process of selective presentation of specific topics, facts, controversies, actors, and assertions in news coverage (Entman 1993). To frame an issue in the media discourse, "is to select some aspects of a perceived reality and make them more salient in a communicating text, in such a way as to promote a particular problem definition, causal interpretation, moral evaluation, and/or treatment recommendation" (Entman 1993, p. 52). Frames are frequently deployed in news reporting to call attention to some aspects of reality, while obscuring other elements. Framing can have a lasting influence since once an issue has been framed in a certain way, public perceptions remain stable over time (Nisbet et al. 2003).

As shown in a content analysis of the American press in the early years of the stem cell debate, media reporting on stem cells between 1998 and 2000 heavily relied on frames and dramatic storytelling (Nisbet et al. 2003). Discussions of hESC research dominated coverage, with both proponents and opponents relying on dramatic narratives to frame the controversy according to their desired policy outcomes. On the one hand, opponents expressed ethical objections against destroying human embryos by employing the metaphors of "playing God," Frankenstein monster, and Faustian bargain, and compared hESC research to Nazi human experimentations using "adjectives such as *evil*, *murderous*, or *gruesome*" (Nisbet et al. 2003, p. 44). On the other hand, stem cell advocates presented their opponents as irrational, religious zealots opposed to scientific progress, and framed the controversy in terms of conflict between

science and religion. Dramatic representations in the news contributed to sensationalizing stem cell research and elevating the issue to the top of the US media agenda.

Media analyses in the USA and UK have shown that the high level of dramatization and opinion polarization over the morality of hESC research was not a singular characteristic of the media discourse; rather, press coverage mirrored the nature of policy debates in legislative and political forums (Nisbet et al. 2003; Nisbet 2004; Williams et al. 2003; Kitzinger and Williams 2005; Shepherd et al. 2007). Interestingly, media coverage on stem cells in America prior to November 1998, when the first hESC lines were reported in *Science*, had focused exclusively on new scientific discoveries and providing background information. A shift from reporting in scientific and technical frames towards moral and strategic framing occurred after a controversial federal ban restricting funding for hESC research was announced by President George W. Bush in a nationwide televised address in August 2001 (Nisbet et al. 2003). Furthermore, stem cell research did not receive significant public and media attention before the summer of 2001, when the issue started gaining prominence in political arenas of the US Congress and the White House (Nisbet 2004). The prolonged debate over hESC research within these overtly political arenas, where policy issues are brought to public attention and tend to be often resolved by appeals to morality, rather than instrumental or rational values, greatly contributed to maximizing its potential to be framed in dramatic terms.[1]

The media discourse on hESC research and human cloning in the UK has similarly mirrored moral and strategic framing in policy debates and the parliamentary arena. As shown by Kitzinger and Williams (2005) in a study of press and TV coverage on the Donaldson Report[2] between 2000 and 2001, journalists were largely uncritical of how the policy debate was framed and represented the issue as a strict binary opposition with little room for cautious optimism. Drawing on theoretical perspectives from *the sociology of expectations*, the analysis highlights rhetorical techniques deployed by proponents and opponents to depict two competing visions about the future of hESC research. Stem cell advocates presented a highly optimistic perspective on the potential of regenerative medicine to free the world from diseases referencing "the start of a medical revolution," "the dawn of a new frontier," and "unlocking a new chapter in medicine" (Kitzinger and Williams 2005, 125). By contrast, opponents claimed that support for hESC research would set a dangerous precedent for demeaning human life that could also lead to reproductive cloning. Their narratives included characterizations

[1] This is a plausible explanation of why stem cell research in the early years of controversy ranked so high on the US media agenda and received an unprecedented coverage in comparison to other emerging technologies. Traditionally, policy debates over biomedical research in the USA take place within the administrative policy arena, i.e., the National Institutes of Health (NIH), the Department of Health and Human Services (DHHS), and the Federal Drug Administration (FDA). Policy decisions within these institutions are routinely made by scientific and technical experts, with limited input from interest groups and the public. The stem cell controversy appeared to be an exception from this tradition of insular decision-making on scientific issues. For further discussion, see Nisbet et al. (2003).

[2] The report *Stem Cell Research: Medical Progress with Responsibility*, released August 2000, included recommendations by an expert group led by the Chief Medical Officer, Liam Donaldson (hence "Donaldson Report"). These policy recommendations provided the basis for the HFEA (Research Purposes) Regulations of 2001, passed by the House of Commons on December 19, 2001. The full text of the Report is available from: http://webarchive.nationalarchives.gov.uk/+/http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_4065084

of this research field as "a huge leap in the wrong direction for mankind" and "a dangerous and slippery path" that would "open the floodgates" (Kitzinger and Williams 2005, 125). While opponents consistently referred to using cell nuclear replacement (CNR) or cloning technology in hESC research as "human cloning" to invoke visions of full reproductive cloning, supporters were keen on the term "therapeutic cloning," which implies clinical benefits. Additionally, supporters avoided referencing CNR as "experimental medical research" since it did not carry the same positive connotations. Overall, the media have tended to validate utopian hopes for future of hESC research as more credible than dystopian fears, emphasizing the promise of hESC research to alleviate the suffering of real people with terrible degenerative diseases against the opponents' ethical concerns about abstract entities like embryos (Kitzinger and Williams 2005).

There are clear similarities in how news media in the USA and UK have constructed the "right" point of view in the stem cell debate. Media discourses in both countries have framed the controversy as a conflict between rationality and emotion, where factual evidence presented by scientists contradicts the speculative concerns and irrational fears of stem cell opponents. Furthermore, news media were complicit in efforts by stem cell advocates to monopolize rationality and expertise and discredit their opponents as anti-science or even Luddites. While explicit references to science fiction were hardly used by critics of the Donaldson Report in the UK media debate, supporters attributed such claims to their opponents to discredit their stance (Kitzinger and Williams 2005). Journalists in the USA have similarly framed the controversy as a conflict arising from the inevitable clash between modern science and religious dogma, further characterizing stem cell research as frontier science. As stated in an article in *Time Magazine*: "Stem cell research has joined global warming and evolution science as fields in which the very facts are put to a vote, a public spectacle in which data wrestles dogma" (Gibbs 2006, p. 28). Finally, media coverage in both countries presented a consensus within the scientific community about the greater clinical potential of embryonic versus adult stem cells and the need to fund and pursue aggressively both lines of research to develop new therapeutic solutions.

Comparative media analyses have shown that fundamental differences in sociocultural contexts and regulatory regimes for hESC research did not necessarily entail discrepancies in metaphorical imagery and discursive repertoire deployed in news coverage. Döring and Zinken (2005) content analysis of *Le Monde* and *Gazeta Wyborcza*, two major newspapers in France and Poland, has established surprising similarities in the portrayal of stem cell research between 1998 and 2000, despite profound cultural and policy differences between the countries, particularly about the role of religious values in public debates. Both media discourses were shaped by a salient rational perspective, emphasizing the potential of stem cell research for the development of innovative treatments for degenerative diseases. Although some differences between the Polish and French press were detected, they were not conceptual, but rather stemmed from contextual dissimilarities such as the tendency of French news coverage to draw on a national bioethical tradition developed in the context of Enlightenment rationalism vis-à-vis emotive frames deployed in Polish news articles (e.g., references to mad scientists and a Frankenstein monster). There were strong commonalities across both languages in the discursive matrices and metaphorical networks shaping hESC research and differences could be explained "not in the sense

of national cultures, but rather of 'ethical cultures' based in ideologically defined groups" (Döring and Zinken 2005, p. 27).

Over the years, media coverage has focused extensively on hESC research, overlooking the promise of other types of stem cells for regenerative medicine (e.g., bone-marrow, mesenchymal stem cells, adipose-derived stem cells, or neural stem cells). In their study, Nisbet et al. (2003) demonstrated that hESCs dominated discussions in the US press in the early years of discovery, in 52.8% of the news reports from 1998 to 2000, and in 74.7% in 2001 when the political controversy reached its peak. Similarly, Bubela et al.'s (2012) analysis of 13,249 articles in English-language newspapers, published between 1991 and 2010 in Canada, the USA, the UK, and other countries, established that hESCs were the major focus of coverage between 1998 and 2010. Nonetheless, an important thematic change in media coverage has occurred since 2010. As shown by Kamenova and Caulfield (2015) in a comparative analysis of the portrayal of translational stem cell research in major daily newspapers in Canada, the USA, and the UK between 2010 and 2013, only 21.5% of the articles reported exclusively about hESC research. Additionally, the study established that most news stories were about clinical translation and new discoveries in the field, rather than ethical and policy issues, which had dominated news coverage prior to 2010. In fact, only 1.6% had ethical issues as their central theme—a rather significant change in comparison to past media representations. While many forces may have been at play in the evolution of media discourse, two factors seem particularly influential: (1) the reversal, the highly unpopular ban on research funding for hESC research in the USA in 2009[3] and (2) evolving public perceptions regarding the controversial nature of this research field (Caulfield et al. 2015).

## Media as a validator of scientific knowledge claims in the stem cell debate

Scientific experts play a central role in the public communication of science, and the stem cell controversy is not an exception from this trend. Stem cell researchers have greatly contributed to the media hype regarding the potential of stem cell by making authoritative claims about advances in clinical translation and forecasting unrealistic timelines for stem cell therapies (Kamenova and Caulfield 2015). The extensive media coverage of the scandal involving Dr Hwang Woo-Suk of South Korea provides an insight into complex entanglements between the media and scientific experts in validating knowledge claims about controversial science. Hwang had announced the successful derivation of hESC lines from cloned human embryos in 2004, and his research subsequently received extensive public and media attention in South Korea and internationally. It was later discovered that results from these experiments were fabricated, which led to the editorial retraction of his publications in *Science* in 2006.

Haran and Kitzinger (2009) have examined rhetorical strategies used by the scientific establishment and the news media to endorse and repudiate the work of Hwang, utilizing "the modest witness figure as a heuristic lens" to unravel hidden "assumptions

[3] See President Barack Obama's *Executive Order 13505—Removing Barriers to Responsible Scientific Research Involving Human Stem Cells* signed on March 9, 2009, which ended an eight-year ban on federal funding for research on new hESC lines (URL: http://www.presidency.ucsb.edu/ws/index.php?pid=85830).

in contemporary media representations of "good" scientists and their practices" (635). Their analysis acknowledges sociopolitical factors in the stem cell research landscape influencing reception of Hwang's work by the research community and the public. The discovery was reported at a time when the potential of hESC research was questioned and promising breakthroughs were much needed to secure continuous public support and financial investment. Hwang's report about cloning the world's first hESC line was validated by the scientific establishment through publication in the prestigious journal *Science*, and deemed remarkable by leading stem cell experts.

A close examination of media reports, coverage of events in the journals *Science* and *Nature* (2004–2006), and press releases from relevant UK and US government and science bodies illustrated how the Hwang case mutated from a story about genuine scientific breakthroughs to a scandal about fraud. Initially, Hwang's work was validated as a genuine scientific achievement by the scientific establishment and media with: "explicit assertions of Hwang's status as a *bona fide* scientist"; "a range of declarations about the virtual witnessing of his work"; "an emphasis on his international renown and collaborations"; and "a body language of representation designed to invoke confidence" (Haran and Kitzinger 2009, p. 640). After the scandal occurred in late 2005, the coverage quickly changed to stories emphasizing the Korean scientist and his research as inauthentic. While the initial representations showed Hwang as a genuine and humble scientist, who performed well the role of "modest witness," news reports after the exposure highlighted his celebrity status, arrogance, and delusions of grandeur. Rhetorical strategies to recast Hwang included "reframing his claims as immodest and grandiose," "expelling Hwang from the community of modest witnesses," "orientalising him and South Korea," "focusing in on his celebrity/"rock star" reputation," and "metaphorically repositioning his trajectory into the fictional genre" (Haran and Kitzinger 2009, p. 643). The change in rhetoric was accompanied by a retrospective acknowledgement of the role of scientists and journalists in the mediation of events, which was missing in the initial coverage. Nonetheless, the revised portrayal of Hwang during the scandal reassigned the problem to his celebrity-seeking behavior, while taking the responsibility away from news reporting and science-media relations. Both scientists and journalists focused on re-establishing their position as truth tellers, rather than acknowledging the interdependency between science and media. Ultimately, the Hwang case demonstrates how the media can become implicated in fabricating scientific truth and falsehood, as well as how "scientists and science journalists routinely disavow the media's intimate involvement in the making of "true science," but retrospectively scapegoat the media in the fabrication of "false science" (Haran and Kitzinger 2009, p. 650).

The analysis above clearly demonstrates how press coverage of hESC research was tightly enmeshed with popular discourses, with mass media taking an active role in the making of stem cell science in the public domain. As Hilgartner (1990) has pointed out, there has been a departure from the focus on "expertise" of scientists in the science communication scholarship towards an understanding of the production of scientific knowledge as situated within diverse communication contexts and communication media. Scientific knowledge is integrated in many, often interrelated contexts, and it may be difficult to establish a strict boundary between genuine scientific knowledge and popularized representations.

## Towards a normative model for media discourse on stem cell research

In the field of science communication, mass media have been increasingly viewed as a key factor for the legitimation of science due to their ability to facilitate and institutionalize communicative interactions between members of the public, scientific community, policymakers, interest groups, and other social actors. In their comparative analysis of genome sequencing in German and American media between 1999 and 2001, Gerhards and Schäfer (2009) discuss two normative models for scientific discourse in the public domain: the "science-dominated scientific public sphere" and the "contextualized scientific public sphere" (438). These opposing perspectives set out different normative expectations for mass media as a communicator of scientific knowledge and an interpreter of new and controversial science. The notion of a science-dominated scientific public sphere is derived from the much-criticized *public understanding of science* (PUS) paradigm, which was the dominant orientation in science communication research in the 1980s. Two major assumptions underlie this "deficit model" of science communication—a belief that scientific knowledge is superior to other forms of knowledge and perceived deficiencies in scientific literacy of the public, with expectations that science communication should be addressing such knowledge gaps (Brossard and Lewenstein 2010). Subsequently, there are expectations that mass media should contribute to improving scientific literacy and that science reporting should accurately reflect the scientific discourse.

By contrast, the second model deconstructs assumptions about the special epistemological status of scientific knowledge and offers a more inclusive and contextual approach to the public communication of science (Brossard and Lewenstein 2010). The notion of a contextualized scientific public sphere assumes that scientific and lay knowledge are equally valid and relevant, emphasizes the dependence of science on society's legitimation, and sets out normative expectations that decisions about policy and regulation should involve participation of diverse actors (Gerhards and Schäfer 2009, p. 440). While the first model views mass media as the primary channel of science communication, the contextualized approach encourages debates in a variety of deliberative public forums such as citizens' panels, consensus conferences, workshops, and roundtable discussions.

The two normative models of the scientific public sphere establish different standards for media coverage of scientific issues (Gerhards and Schäfer 2009, p. 441). Media reporting in the science-dominated model provides extensive information on scientific research and events, focusing on educating the public. Scientific and technical experts are key witnesses in the news stories, which exclude non-scientific interpretations on the issues at hand. Science is routinely represented in a positive light, rather than through a critical lens. The contextualized model, which is based on with the public engagement with science and technology (PEST) paradigm, establishes different normative standards for media discourse on scientific issues. First, it requires that media reporting is not limited to scientific events and debates that originate within the scientific community. Second, rather than serving as an advocate for science, mass media is expected to provide critical reflection on competing perspectives within society. Finally, there is a requirement for inclusive media discourse to engage diverse social actors and citizens' groups and achieve pluralistic evaluation and interpretation of scientific debates.

My cross-cultural analysis of the role of mass media as a public communicator in the stem cell controversy is informed by the normative perspective advanced by the contextualized model for science communication. Therefore, below I provide an assessment of whether the media coverage of hESC research has met the three major criteria for a contextualized and critical media discourse on scientific issues. Case studies of national media debates that were previously reviewed suggest that the first condition for contextualization was met. Media reporting of the controversy was by no means not limited to scientific developments and events that originated within the scientific community. Rather, analyses of media coverage during the early years of policy debate in the USA and UK have shown that the issue received extensive media attention only after it had reached the political and social arenas of society, and that the unprecedented activism from interest groups and citizens around this biomedical innovation was a significant driver of media coverage.

News media in the stem cell debate, however, have largely served as an advocate for science presenting the controversy as an inherent conflict between modern science and religious dogma and implicitly supporting policy options sought by the scientific community, particularly regarding funding for research on embryonic stem cells. Moreover, media have played an important role in validating arguments by stem cell advocates as rational, supported with factual scientific evidence and thus worthy of public attention, while dismissing criticism by opponents as irrational and driven by dystopian fears. Media have also sided with the scientific community on the therapeutic advantages of embryonic stem cells for regenerative medicine, focusing extensively on the potential of hESC research, regardless of scandals in the field and setbacks associated with in clinical translation of hESC treatments (Kamenova and Caulfield 2015). Additionally, news coverage has remained overly optimistic, rather than offering a critical reflection on competing perspectives about the future of this biomedical innovation.

By and large, media representations of the stem cell controversy have failed to meet the normative expectation about democratization of public discussions on scientific issues, which requires that "scientific actors have no privileged status in the public sphere [and] actors from other areas of society and citizens' representatives should be equally well represented" (Gerhards and Schäfer 2009, p. 442). As press coverage of the Hwang scandal has demonstrated, news media tended to reassert their traditional role in the public communication of science and became implicated in validating scientific falsehoods through their reliance on the scientific establishment for expertise and interpretation. Overall, scientists and science journalists have retained a privileged status as communicators and negotiators of scientific claims in the stem cell debate, with little room left for pluralistic evaluation and the engagement of diverse social actors.

## Conclusion

My analysis has indicated considerable similarities in framing and rhetorical strategies in media representations of stem cell research across different cultural and national contexts. Although this is by no means a comprehensive review of media discourses on the issue and it may be difficult to draw generalizable conclusions, the case studies reviewed throughout this paper suggest that science journalists and media organizations have consistently failed to deconstruct the binary nature of science policy debates as

framed by stem cell advocates and their opponents. Media coverage, especially in the early years of controversy, has tended to replicate discussions in political and legislative arenas, presenting the controversy as a strict binary opposition and validating claims to rationality and reason by stem cell advocates as more credible than concerns expressed by their opponents. As stem cell research has ushered in a new era of clinical translation and there are novel ethical concerns about its commercialization and unproven stem cell therapies, it is important to dispense with paternalistic attitudes towards members of the public and encourage the democratization of public debate on this biomedical innovation. Media can play a key role in this process by fostering a more pluralistic discourse and greater engagement of citizens in the public communication of this biomedical innovation.

## References

Brossard, Dominique, and Bruce V. Lewenstein. 2010. A critical appraisal of models of public understanding of science: using practice to inform theory. In *Communicating science: new agendas in communication*, ed. LeeAnn Kahlor and Patricia A. Stout, 11–39. New York: Routledge.

Bubela, Tania, Matthew D. Li, Mohamed Hafez, Mark Bieber, and Harold Atkins. 2012. Is belief larger than fact: expectations, optimism and reality for translational stem cell research. *BMC Medicine* 10 (1): 133. https://doi.org/10.1186/1741-7015-10-133.

Caulfield, Timothy, Kalina Kamenova, Ubaka Ogbogu, Amy Zarzeczny, Jay Baltz, Shelly Benjaminy, Paul A. Cassar, et al. 2015. Research ethics and stem cells. *EMBO Reports* 16 (1): 2–6. https://doi.org/10.15252/embr.201439819.

Davies, Sarah R., Ellen McCallie, Elin Simonsson, Jane L. Lehr, and Sally Duensing. 2009. Discussing dialogue: perspectives on the value of science dialogue events that do not inform policy. *Public Understanding of Science* 18 (3): 338–353. https://doi.org/10.1177/0963662507079760.

Davies, Sarah R. 2013. Constituting public engagement: meanings and genealogies of PEST in two UK studies. *Science Communication* 35 (6): 687–707. https://doi.org/10.1177/1075547013478203.

Döring, Martin, and Jörg Zinken. 2005. The cultural crafting of embryonic stem cells: the metaphorical schematisation of stem cell research in the Polish and French Press. *Metaphorik. de* 8: 6–33.

Entman, Robert M. 1993. Framing: toward clarification of a fractured paradigm. *Journal of Communication* 43 (4): 51–58. https://doi.org/10.1111/j.1460-2466.1993.tb01304.x.

Friedman, Sharon M., Sharon Dunwoody, and Carol L. Rogers, eds. 1999. *Communicating uncertainty: media coverage of new and controversial science*. New York: Routledge.

Gerhards, Jürgen, and Mike S. Schäfer. 2009. Two normative models of science in the public sphere: human genome sequencing in German and US mass media. *Public Understanding of Science* 18 (4): 437–451. https://doi.org/10.1177/0963662507082891.

Gibbs, Nancy. 2006. Stem cells. The hope and the hype. *Time* 168 (6): 40.

Haran, Joan, and Jenny Kitzinger. 2009. Modest witnessing and managing the boundaries between science and the media: a case study of breakthrough and scandal. *Public Understanding of Science* 18 (6): 634–652. https://doi.org/10.1177/0963662509338324.

Hilgartner, Stephen. 1990. The dominant view of popularization: conceptual problems, political uses. *Social Studies of Science* 20 (3): 519–539. https://doi.org/10.1177/030631290020003006.

Irwin, Alan, and Mike Michael. 2003. *Science, social theory & public knowledge*. Maidenhead, UK: McGraw-Hill Education.

Kitzinger, Jenny, and Clare Williams. 2005. Forecasting science futures: legitimizing hope and calming fears in the embryo stem cell debate. *Social Science & Medicine* 61 (3): 731–740. https://doi.org/10.1016/j.socscimed.2005.03.018.

Kamenova, Kalina, and Timothy Caulfield. 2015. Stem cell hype: media portrayal of therapy translation. *Science Translational Medicine* 7 (278): 278ps4–278ps4. https://doi.org/10.1126/scitranslmed.3010496.

Marks, A. Leonie, Nicholas Kalaitzandonakes, Lee Wilkins, and Ludmila Zakharova. 2007. Mass media framing of biotechnology news. *Public Understanding of Science* 16 (2):183–203. https://doi.org/10.1177/0963662506065054

Mazur, Allan. 1981. Media coverage and public opinion on scientific controversies. *Journal of Communication* 31 (2): 106–115. https://doi.org/10.1111/j.1460-2466.1981.tb01234.x.

Nisbet, Matthew C., Dominique Brossard, and Adrianne Kroepsch. 2003. Framing science: the stem cell controversy in an age of press/politics. *Harvard International Journal of Press/Politics* 8 (2): 36–70. https://doi.org/10.1177/1081180X02251047.

Nisbet, Matthew C. 2004. Public opinion about stem cell research and human cloning. *Public Opinion Quarterly* 68 (1): 131–154. https://doi.org/10.1093/poq/nfh009.

Pellechia, Marianne G. 1997. Trends in science coverage: a content analysis of three US newspapers. *Public Understanding of Science* 6 (1): 49–68. https://doi.org/10.1088/0963-6625/6/1/004.

Shepherd, Richard, Julie Barnett, Helen Cooper, Adrian Coyle, Jo Moran-Ellis, Victoria Senior, and Chris Walton. 2007. Towards an understanding of British public attitudes concerning human cloning. *Social Science & Medicine* 65 (2): 377–392. https://doi.org/10.1016/j.socscimed.2007.03.018.

Williams, Clare, Jenny Kitzinger, and Lesley Henderson. 2003. Envisaging the embryo in stem cell research: rhetorical strategies and media reporting of the ethical debates. *Sociology of Health & Illness* 25 (7): 793–814. http://10.1046/j.1467-9566.2003.00370.x.

Weingart, Peter. 1998. Science and the media. *Research Policy* 27 (8): 869–879. https://doi.org/10.1016/S0048-7333(98)00096-1.