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**Visualizing Discourses and Governance of
Human Embryonic Stem Cell Research
in South Korea (in comparison to the UK)**

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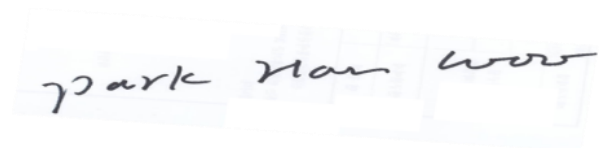
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Statements of co-authors

Statement from Han-Woo Park (Yeungnam University, South Korea)

Leo and I have been working together in the application of social network analysis in the field of science and innovation studies. We have co-authored and published the article, Diagnosing "collaborative culture" of biomedical science in South Korea: Misoriented knowledge, competition and failing collaboration. *East Asian Science, Technology and Society: an International Journal*, 9 (3). I contributed to the article with literature review of scientometrics and mentioned the status of international research collaboration network. Leo did the domestic review of biomedical network and presented theoretical discussion of scientific collaboration that was the core of our arguments. I mainly wrote literature review from the perspective of scientometrics and a few paragraphs in the introduction. Leo wrote the rest of parts and engaged in data analysis.

A handwritten signature in black ink that reads "Park Han Woo". The signature is written in a cursive, slightly slanted style. It is positioned above a horizontal line that serves as a baseline for the signature.

signature

Statement from Nam-Hyeok Kim (Ars Praxia, South Korea)

As an engineer from computer scientific background, I developed the text analysis engine *Optimind* that is my company's commercial solution. Having background knowledge in advanced mathematics including graph theory, natural language processing and machined learning, I developed an automated computer algorithm that was applied in the article Connecting Opinion, Belief and Value: Semantic Network Analysis of a UK Public Survey on Embryonic Stem Cell Research. *Journal of Science Communication*, 14 (1). For the article, I processed the UK text data and stabilized the output based on Leo's theoretical guideline. Leo interpreted the semantic meanings of graph theoretical positions (betweenness centrality and Bonacich power) and translated them into the concepts of denotation and connotation. Leo also proposed ways to categorize equivalent semantic concepts from the network perspective. I faithfully applied those theories into text-mining and visualizing algorithms, and he kindly included my name in his academic article.

김남혁

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Abstract

This thesis investigates how the discourses and governance of human embryonic stem cell (hESC) research operated in South Korea. Comparing South Korea to the UK in three fields (government, newspapers, and public responses) and reflecting scientific misconduct in the South Korean scientists' community, the study tries to identify hidden variables that influenced the national trajectory.

To capture dynamic yet underrepresented national and cultural characteristics, the author has analysed microscopic interactions including actors' utterances, media framing, human relations and strategies. By using the methodology to pursue sociological approaches with semantic and social network analysis, concepts usually inferred and narrated by the researcher gain a visual and measurable representation in terms of Actor-Networks.

The study concludes that the failure to institutionalise a sustainably cooperative research environment and (bio)ethical regulation in South Korea is an outcome of the lack of reflexive social discourse and deliberative governance. The national characteristics mainly derived from the subdued status of experts, scientists, in the government and the predominant media framing to represent life science as a mere tool to economic development. More crucially, people in general accepted the economy-oriented discourse.

From the outcome of the semantic network analysis, it turns out that the public attitude was mainly constructed from people's limited objective and desire to utilise science to pursue social status and economic development. South Korean people largely disregarded the possible threat of hESC research to women's bodies that was related to human rights. A new scientific leadership should recognise this culturally embedded atmosphere and more effectively mediate government, mass media, lay public and scientific community by reconstituting expert role, critical media framing of science, and broader deliberation on the social function of scientific knowledge.

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1. Introduction¹

In February 2004, Professor Woo-Suk Hwang's Seoul National University team published a ground-breaking paper in *Science*, announcing the successful derivation of a single stem cell line from a cloned human embryo (Hwang 2004). In May of the following year, Hwang reported an even more stunning accomplishment, namely the derivation of 11 "patient specific" stem cell lines, which were seen as bearing witness to strikingly improved levels of efficiency in using human eggs (Hwang, 2005). However, what was celebrated in South Korea as the nation's scientific triumph was soon undermined by allegations of ethical misconduct, followed by accusations of scientific fraud.

At first glance, it looked like simple scientific misconduct. However, the cause and effect of the scandal was complex and offers an analytical challenge to social scientists hoping to understand its underlying dynamics. At the beginning of the controversy of Hwang's embryonic stem cell research, most domestic opinion-leading newspapers and also a large number of South Korean people participated in protecting their scientific hero. Culture seemed to play a role in the perception of the purchase of women's eggs and coercive derivation of ova from a female researcher in Hwang's laboratory. For example, in the South Korean broadcast MBC's live TV discussion, a panellist claimed: 'it is Westerners' logic that even if the internal researcher's donation of egg was carried out by voluntary consent, it is regarded as involuntary... In Asians' humanitarian sentiment true volition is possible' (Y Kang, 2006). The panellist went on to propose the legalisation of the female researchers' donation of eggs by institutionalising signed approval by her parents as long as she is single, and by her spouse when married. The live discussion that was

¹ This introduction reflects my previous article: Explaining the Hwang scandal: national scientific culture and its global relevance. My thesis incorporates several articles that were published and modified for the PhD thesis format. They are as follows:

- 1) Kim, L (2008) Explaining the Hwang scandal: national scientific culture and its global relevance. *Science as Culture*, 17 (4) [Chapter 1]
- 2) Kim, L (2012) Governing discourses of stem cell research: Actors, strategies and narratives in the UK and South Korea. *East Asian Science, Technology and Society: an International Journal*, 6 (4) [Chapter 3]
- 3) Kim, L (2011a) Media framing of stem cell research: a cross-national analysis of political representation of science between the UK and South Korea. *Journal of Science Communication*, 10 (3) [Chapter 4]
- 4) Kim, L and Kim, N (2015) Connecting Opinion, Belief and Value: Semantic Network Analysis of a UK Public Survey on Embryonic Stem Cell Research. *Journal of Science Communication*, 14 (1) [Chapter 2 & 5]
- 5) Kim, L (2013) Denotation and connotation in public representation: semantic network analysis of Hwang supporters' internet dialogues. *Public Understanding of Science*, 22 (3) [Chapter 6]
- 6) Kim, L (2011b) 'Your problem is that your face reveals everything when you are lying': making and remaking of conduct in South Korean life sciences. *New Genetics and Society*, 30 (3) [Chapter 7]
- 7) Kim L (2009) Beyond Hwang 'international stem cell war' in South Korea. International Institute for Asian Studies Newsletter, 52 [Chapter 7]
- 8) Kim, L and Park, H (2015) Diagnosing "collaborative culture" of biomedical science in South Korea: Misoriented knowledge, competition and failing collaboration. *East Asian Science, Technology and Society: an International Journal*, 9 (3) [Chapter 8]

aired throughout the country ended with the conclusion that the South Korean government should seek ways to legalise the female scientists' egg donation retrospectively (Cho, 2006). The media was not alone in lobbying for women to be legally enabled to donate eggs to facilitate national research objectives. The reaction of hundreds of female supporters of Hwang also reinforced the view that South Korean women should demonstrate loyalty and support for national scientific advancement by contributing their "raw material" as well as their labour. Hundreds of women supporters started to campaign for voluntary ova donation (S Kim, 2006).

Tens of thousands of angry South Korean people posted comments on the MBC's web page fiercely criticizing the broadcast. Online communities of Hwang fandoms each composed of thousands of members boycotted television commercials and organised massive demonstrations in front of the MBC building. In response to the threat and animosity felt throughout the country, the MBC dissolved the 20 years' long-lived investigative program *PD Notebook* until anonymous scientists on the Korean website of the Biology Research Information Center (BRIC) started to post evidence of Hwang's fabrications. Meanwhile, a truck driver set himself alight in protest over the charges against Hwang, claiming Hwang was the victim of an international conspiracy and unjustness in Korean society.² The public protest went on even after, in 2006, Seoul National University and the Prosecutor's Office investigated the affair and concluded that Hwang had fabricated evidence and behaved unethically (Y Kang *et al.*, 2006).

Many commentaries have tried to make sense of the scandal and its broader implications. As *Nature* put it succinctly, the drama of the Hwang scandal was "Shakespearean" in both its tragic and familiar aspects (Editorial, 2006). It reiterates the core components of a tragic drama depicting a fallen hero, as Hwang was framed in such a way. Within South Korea, commentaries have changed over time in both tone and focus. Initial arguments had been politically indignant, criticising Hwang's shrewd tactics of "bluffing" and the government's blind support for Hwang's research (Kang et al, 2006; Lee, 2006; H Kim, 2006). In a similar vein, some studies made comments about the coupling of social issues such as nationalism (T Kim, 2008), mobilisation of women's bodies (Korean Women Link, 2006; Leem et al, 2008), and the network Hwang developed with bureaucrats and politicians (S. Hong, 2006). Hwang's network of alliances reflected the state's industrial strategy to rapidly exploit life science and S. Hong (2006) identified the limitations of this strategy to ensure sustainable development of life science. Also, recent work has covered other layers, including media framing and discourse (Won et al, 2006), ethnographic study on Hwang's

² There was a widespread belief then that Hwang was entrapped by a US conspiracy to steal South Korea's stem cell technology, and jealous domestic rivals such as medical doctors collaborated to disgrace Hwang.

organised supporting groups (J Kim 2007), and studying the research methods of Hwang's stem cell team in the context of the general scientific environment in Korea (G. Kim, 2007).

Among non-Korean commentators there is a diversity of emphasis as well. Initial criticism had attributed the Hwang scandal to "non-Western" characteristics of the academic and research ethics system and "developmental" problems (Gottweis, 2006) or had accused Hwang's team of turning "good" science into a "bad" enterprise (Fox, 2007). More recent commentaries recognise 'universal' elements in the story (Haran et al, 2007; Bauer, 2008, Kitzinger, 2008). In those implicit or explicit ways, the Hwang scandal was seen to carry global implications for research ethics and peer-review practices.

The commentaries and academic literatures seem to agree that there was some uniqueness in the "Shakespearean" debacle in South Korea. Culture obviously played a part, but culture alone explains very little. In this thesis, I show that the Hwang scandal should be understood as an interplay of several factors: the government policy and strategy, legislative background, mass media's framing of life science and human embryonic stem cell technology, people's perception of the science and knowledge, the way resources and recognition are distributed among scientists, the methods of research directed and conducted by scientists and other factors. We need to investigate the conduct both within and outside the scientific community, government, mass media and in particular, the public. We also need to study if there is a particular form of discourse and governance specific to Korea, which formed typical value-orientation and behavioural patterns of actors related to the conduct of science. Here, the discourses signify social utterances of how people evaluate the new human embryonic stem cell research, how ethical guidelines should be drawn to regulate the research, and how scientists should behave to make themselves worthwhile in the society. The governance part covers how promotional or regulative legislations are discussed in governmental bodies and in parliament, and what kind of policy is applied in distributing resources for scientific research.

So far, the aforementioned literatures solely focus on one aspect - the failure of governance, individual scientists' misbehaviour, people's distorted attitudes and perception, media framing that contributed to the public misperception, national scientific culture, etc. As the focus of interest and explanations are segregated and dispersed, the mechanism of mutual interaction is unclear, and culture becomes a vague word. I believe the researcher should clarify how the most powerful actors and prominent messages in the government and mass media interacted with one another. In doing so, we need to clarify the interplay between discourse and governance above all because they form the basis of public thought and action. Throughout this thesis, I argue that excessively bureaucratic governance and economy-oriented discourses of life science in Korea induced the general public and the scientists to focus on rent-seeking activities to proclaim the profitability of embryonic stem

cell research, including publicly displaying unfinished or faked scientific results to get ahead of rivals, instead of pursuing the development of life scientific knowledge itself. The following chapters try to provide evidence for the claim, and offer clues for an improved understanding of the causes of the scientific failure.

While the Hwang scandal had features specific to a South Korean context, it also illustrates conflicts intrinsic to scientific research in general. In order to understand both the specific and the general aspect of scientific action, studying South Korea alone will not suffice to draw the boundary between the specific and the general characteristics of interaction between discourse and governance. A comparative approach is useful to identify key differences that work, to quote Max Weber's term, as a "switchman" of scientific trajectory. Although my research is not designed to make a fully balanced and systematic comparison, fundamentally more focused on South Korea, I chose the United Kingdom (UK) as the counterpart to South Korea. My choice is based on the fact that the UK has been the most proactive and competitive country across different continents in promoting human Embryonic Stem Cell (hESC) research. In each, governmental promotion includes not only financial support but also active institutional establishment, and an active concern with public opinion. In the UK, the revised Human Fertilisation Embryology Authority (HFEA) bill was passed in 2001 to allow hESC research while containing possible abuse. For similar purposes, the Bioethics and Biosafety Act was endorsed in South Korea in 2003. As I show in Chapter 3, to the notion of patriotism, leveraged to support legislation and governmental action, played a pivotal role in the public sphere in South Korea as well as in the UK, albeit with more subtle rhetoric and some reservation in the latter.

The UK has been recognised as the global leader in the stem cell field through the early 2000s and its regulatory environment has been identified as arguably the most important factor underpinning its global prominence (Jasanoff, 2005; UK Stem Cell Initiative, 2005: 86). In South Korea, in contrast, the failure of regulatory design and implementation has been frequently mentioned when repeated scandals of scientific fraud occurred (H Kim, 2006; J Kim, 2009). National comparison reveals how and why apparently identical approaches to promoting hESC research yielded different outcomes in South Korea and the UK. The dichotomy of developed vs. developing nation or South Korea's "blind nationalism" (Gottweiss and Kim, 2009) theses do not offer a satisfactory explanation. More specific attention should be paid to the concrete operation of discourses and power games played among key actors, legislator, scientists, media, etc. Then the researcher should review how the operation differs in the two countries. From the comparative method, I ask:

- What are the key differences of S Korea and the UK in terms of governance (legislative

trajectory, governmental strategy, regulative framework) and discourses (opinion-leading newspapers' framings, public perception, and their value system)?

- Can we explain the dramatic outcome of Hwang scandal through the interplay between the important elements of governance and discourse? If so, what are the key features?
- Finally, what are the implications of the identified interaction between governance and discourse for scientific actions of individuals, and for the development of the national scientific community?

In order to elucidate new form of interaction between discourse and governance, I used a novel method of data analysis. As the intended description of interaction among multi-contextual variables will be inevitably complicated, there is a practical need to identify key features and concentrate on their interaction with a formalized method. The computerized methods of data analysis, semantic network analysis and social network analysis, offer tools to identify salient messages and prominent actors out of the complex communication and interaction among actors. The formalized process can extract key semantic elements (keywords) that represent discursive characteristics; and indicate the most central scientists engaged in human embryonic research in South Korea and their relation-making strategies. This kind of data visualization represents the interactions of signifiers and actors and their structural patterns in a more vivid way than before. The theoretical underpinning of these methods and their concrete methodologies are explained in the next chapter.

My thesis is based on articles that have been either published in or submitted to peer-reviewed journals (see Footnote 1). After explaining related theories and methodologies in chapter 2, the following chapters cover the overall description and comparison of Korea and the UK in the trajectory and governance of stem cell research (Chapter 3); the semantic network analysis of the relevant arena of mass media (Chapter 4) and lay perceptions (Chapter 5, Chapter 6); and, the report of the conduct of significant actors in South Korea and the influence upon them of the discursive settings (Chapter 7), followed by the conclusion (Chapter 8). Taken together, the chapters aim to visualize microscopic aspects of science-related actions more effectively and bring them into existing sociological reflection.

Chapter 3 initially overviews the regulation in stem cell research during the 1997-2009 period in the UK and South Korea, using governmental documents and interviews. This chapter discusses how the UK and South Korea went through different trajectories to legitimate the scientific practice of stem cell research and respond to public opinion.

Chapter 4 poses the question of how different governmental framing and strategies are reflected in the mass media. It compares opinion-leading newspapers' frames of stem cell research

in the UK and South Korea from 2000 to 2008, using semantic network analysis to show the media's representative strategies in privileging news topics and public sentiments.

Chapter 5 presents a snapshot of the British public response to stem cell research before discussing the Korean public's responses to elite media frames. Through the analysis of survey responses collected as part of the UK government's consultation on human embryonic stem cell research, I discuss what kind of social value other than the formal process of public participation should receive particular attention for the democratic governance of stem cell research.

Chapter 6 represents the case of a failed deliberation on life science, as it attempts to explore South Koreans' motives when responding to the government and mass media's representation of stem cell research. The chapter describes how the supporters' dramatized discourses of embryonic stem cell research come to compete with expert knowledge, highlighting the general public's distrust of the official experts and underlying frustrations.

Chapter 7 describes what problematic actions were taken in the field of stem cell research in South Korea as part of the result. If previous chapters described societal and macroscopic characteristics of communication, this chapter focuses on a few individuals who appropriated the social atmosphere.

Finally, Chapter 8 concludes that a different strategy to link knowledge and power is necessary before designing any research schemes – which might not be confined to embryonic stem cell research. Governing bodies should seek ways to create a different identity of researcher and citizen. To these ends, I argue that a different value and knowledge orientation are prerequisite to change in South Korean scientific activity.

2. Theory and Methodology

The theories I present are closely intertwined with my pioneering methodological practice, which aims to visualize key interactions of discourse and governance that form the background of scientific action in hESC research. The function of governance, related to new scientific research and application, is not only the regulation by government to approve or prohibit certain practices in the laboratory. Apart from the traditional governmental practices of regulation and resource distribution, another aspect becomes growingly important in life science: the shaping of public discourse. As witnessed in the nationwide public protest against the import of genetically modified food across Europe in 1990s (Durant, Bauer and Gaskell, 1998), the art of persuasion and channeling public opinion to pursue certain ends has become a new barometer of governance (Gaskell and Bauer, 2001). The public framing of life science is a subtle task because, as observed in the case of biotechnology, people freely associate images of technology to be “Frankenstein” (genetically modified soybean) or “holy grail” (stem cell).

Governance can operate with public opinion and imaginations as well as legislation and administration. From a theoretical perspective, governance is not only about top-down directing, but also about bottom-up negotiation to delineate the boundary of understanding, accepting specific knowledge, and settling on an implicit rule of game (Foucault, 1994). From a similar perspective, Latour (1987) highlights in *Science in Action* how scientific knowledge is evaluated within and outside the laboratory through the networking of various actors beyond the interaction of scientists. This process of evaluation inevitably entails a struggle for recognition among scientists. Bourdieu (2006) depicts the subtle and strategic interplay between scientists and government officials, in order to secure public support and resources. More often than not, such struggle and negotiation becomes more political activity than “pure” research. Although there are a number of literatures in the media that illustrate the competitive nature of scientific research and underlying strategies³, few academic works actually visualise such aspects and patterns with analytical measures. Even fewer literatures have attempted to make a connection between the “big governance” (legislation, regulation and resource distribution) and “small governance” (communication, collaboration, rule setting, evaluation, etc.). Between the two poles, mass media literally mediates discourses that empower certain scientific groups and their practices. Overall, I intend to visualize these connections.

In this regard, I pose three questions: a) What kind of discourses, engaged in the early stage of

³ For example, see James Shreeve’s *The Genome War* that records the “war” between Craig Venter and other biologists who mutually struggled to preoccupy the territory of human genome sequencing. Various strategies and public speeches that intended to mobilise government and media support, and belittle the competitor, are vividly described.

human embryonic stem cell research, have been promoted in South Korea from 2000 to 2013? b) how can we monitor and visualize the prevalence of a certain discourse over the others? and c) how such discourses interacted with some notable scientific actors and societal characteristics in South Korea? To paraphrase Thomas Lemke (2011: 117), we need to pay attention to how politics and discourses “incite and initiate, discipline and supervise, or activate and animate” subjects in ways other than prescription and prohibition.

While Sheila Jasanoff (2005) analysed cultural and institutional causes of life scientific approaches in some Western countries (US, UK and Germany) such as the legacy of eugenics, constitutional setting, specific operations of parliamentary democracy, underlying societal values, her analysis remains a retrospective sociological description focused on the political culture of a few countries in Western Europe and Northern America. Although the scope of “political culture” remains a useful lens for looking into national differences, on its own, it has limited explanatory power. A broader understanding of specific cultures can be found by considering the actors’ underlying strategies, related to the hESC research, to link the scientists’ and people’s perception, knowledge, interest and available resources. Jasanoff’s comparison between Western countries overlooks these elements as different perception and media framing are flattened with a homogeneous “national frame”. However, as I will show, the “national frame” turns out to be a tentative outcome of the interaction between heterogeneous perceptions, knowledges, interests and powers whose equilibrium is not always reached without conflict. Incorporating the heterogeneity and their interaction into the analysis, supported by data-driven methods, of national frame of science can sharpen our understanding of scientific discourse and governance. Extending the scope of comparison to a non-Western country like South Korea, a democracy, aspiring to develop life science, opens up a new opportunity to deliberate on subtler and causal relations (for example, see Sleeboom-Faulkner and Hwang, 2011). In line with such approach, I pay attention to the specific power relation and cultural context that explain the interplay between discourses and governance. Especially the power relation of some notable Korean scientists and some notable discourses that represent South Korean society in relation to life scientific practice will be made visible by novel data output. To do this, I try to reinterpret and link following theories and methodology.

Theories

In this thesis, I ask what led to the failure of governance in hESC research in South Korea to privilege or protect scientific practices, such as the mass mobilisation of ova to create embryo; what kind of belief and hope did people have about the technology: how were they socially represented; and, what kind of identity or subjectivity of people did such social representation imply in

connection with modes of governance in South Korea. I support my argument with both quantitative and qualitative data analyses. My approach differs from existing research in that it enables us to analyse and derive key characteristics of complex social interactions with both measured and visualised data outcomes.

I focus on four major fields of literature and concepts that form the backbone of my methodology and argument. They are: a) Actor-Network theory; b) social representation theory; c) Foucault's governmentality and biopolitics; d) other selected theories in STS and, to a lesser degree, innovation studies.

Actor-Network and data representation

Foucault used the notions of biopolitics and governmentality to describe and conceptualize the critical changes of medieval European society to modern politics mainly using selective text analysis and a narrative style. The latest methodological approaches of network analysis I utilize can transform the metaphorical "constellation" or "network" of key elements as direct object of data analysis. The virtue of the new methodology assisted by computerized methods is that it can process a vast amount of data quickly and represent the result without human intervention, so that the researcher might be able to find unexpected or under-represented meanings. While various network analysis methods were developed independently from Actor-Network Theory (ANT) (see Wasserman, 1994; De Nooy, Mrvar, and Batagelj, 2005), the proposed meaning of the notion of network in ANT (Latour, 2005; Callon, Law and Rip, 1986) inspires the kind of methodological considerations that should be made to enhance the method and interpretive power.

Latour (2005) asserts that existing social scientific approaches do not adequately trace the dynamic and associative characteristics of variables, be it natural or social. If presupposed, the social categories, e.g. class, culture and institution, are "arbitrary" in nature. They not only fail to effectively represent the diverse set of phenomenon but might also repress the intellectual efforts to explore a *terra incognita*: different causes and characteristics might emerge from the underrepresented data. Latour (2005: 128-131) claims that the characteristics of "network" (or relational characteristics of heterogeneous variables) are underrepresented. These are, "a string of actions where each of the participants is treated as a full-blown mediator" to execute strategies of alliance by linking human actors, material resources and semantic symbols. In a similar vein, John Law (2011) argued that the current impasse of Science and Technology Studies (STS) represented a "crisis of normativity", observing that unilateral and unsuccessful description has become endemic. Law recognises the problem in the researcher's banal way of "describing the social structure while

making futile efforts to follow and add rules” (Law, 2011: 71) while not discovering and properly representing novel relations and their influences with alternative analysis.

Callon, Law and Rip (1986) initially demonstrated how philosophical and anthropological concepts of Actor-Network Theory (Latour, 1987; 1993; 2005) could be brought into empirical research by using computerized processing of bibliographical data into a network. The authors extracted keywords from abstracts of academic articles and policy reports and then demonstrated relations of those keywords based on a co-occurrence matrix. With a rudimentary computing tool and techniques available at the time, they expressed hope that these symbols, keywords, could translate once intangible abstract concepts into concrete research objects for calculation and evaluation, opening up a new era of social science. Later, researchers found a way to deal with textual data such as bibliographical information of patents and academic citations and interpret their social implications in the network of scientific innovation and decision-making, (for recent works, see Leydesdorff, 2004; 2008). After technical developments in scientometric studies, the main objects of data analysis have extended to news media articles (Hellsten, Dawson and Leydesdorff, 2010; Kim, 2011) as well as existing information on patents (Leydesdorff, 2006), co-authorship and citation (Li-Chun *et al.*, 2006; Kim and Park, 2013; Moed, Glänzel and Schmoch, 2004) in part to represent the “imagined” actants and their social and/or semantic networks.

Latour himself refuted some claims that recent social network analyses could represent his Actor-Network Theory (Latour, 2005), and criticized that some social scientists ignore grave physical and natural characteristics by reducing them to the work of “signs and representations” (Latour, 1993). Sunder Rajan (2006: 20) in his ethnographical study in *Biocapital* similarly argues that the account of a system of global capitalism that formulates biocapital, ‘cannot simply be a network analysis that traces various types of technoscientific or capital flows that occur in order to produce and sustain this system’, and adds, ‘This [social network analysis], I believe, is the simplification that actor-network theory, an otherwise extremely provocative analysis of the mechanics of how technoscience functions, falls prey to’ (Sunder Rajan, p. 290, Note no. 26).

Indeed, ANT comprises not only semantic signifiers but also non-human, material entities. From this ANT perspective, we could, in theory, imagine the Actor-Network as a holistic world with limitless data and material. However, there is practically no way to represent such a holistic world without the researcher’s own interpretation and construction, and whatever the amount of data we acquire. This limitation produces tension between the critical philosophy of Actor-Network theory defined in *Reassembling the Social* (that questions the existing representation of the assembled social) and its empirical practice, because any attempts to confirm the theory fitted with the actual world, as demonstrated in Latour’s *Pasteurization in France*, inevitably reduces itself to a narrative highlighting preconceived nodes (variables) and their links. In other words, some

phenomenological understanding is necessary to make the theory practical for any data-driven research. That is, the researcher should be ready to admit that the apparently “objective” data analysis in this thesis, assisted by computer algorithm, is also a construct of the researcher. Even so, the data-driven approach that prioritizes the significance of connectivity of diverse variables makes itself compatible with the critical objective of Actor-Network theory: excavating different layers of relations and variables inadequately grasped by current social categories.

In my research, I mainly use two methods: semantic network and social network analyses. As will be explained in detail in the methodology section, the former attempts to highlight central notions of a vast textual dataset containing discourses on specific topics of stem cell research. The latter method is utilized to represent South Korean scientists’ strategies of alliance and the underlying power structure. Putting them together, we can get a closer picture of how strategies of linking human actors, material resources and semantic symbols operated, also representing a vivid image of governmentality and biopolitics.

While I retain ANT’s emphasis of connections of various kinds, I also intend to translate them into the linkage of semantic variables or crucial actors, and to process them with novel analytical methods. In doing so, I will visualize, analyse and qualitatively interpret semiotic relationships, reflecting the discourse pattern and underlying power struggle, and the human actors’ power relationships in the scientific field. From a theoretical and methodological perspective, new value may be offered by a visual and quantifiable representation of the network: attempts to fulfill Callon’s aspirations for scientometrics, latterly disowned by Latour, might have greatly benefited from social psychological, communicative and semiotic concepts to bolster their theoretical underpinning. I explain this in the next section.

Social Representation and semiotic translation

From a social-psychological perspective, the communication and discourses of actors require particular attention to understand social actuality. This is because the general public’s construction of knowledge, that is, how the contested knowledge is framed, can become “more real than the reality” (Moscovici, 2000), in a sense that it can direct expert’s and governing bodies’ typical set of discourse and behaviour to adapt to societal demands and beliefs. New technology, like stem cell research, which requires people to make a “life choice” (Giddens, 1991; Rose, 2007), is making public discourse more diverse and dynamic. Therefore, the researcher that intends to follow the dynamic and diverse discourse needs to incorporate and analyse multiple interactions of sign, public meaning and cultural context.

Social representation theory (Moscovici, 2000; Deaux and Philogène, 2001) presents a formal way of considering multiple levels of signification in science communication, by actively incorporating lay people's knowledge and perception of science. Acquiring similar knowledge through socialization, and constructing knowledge in similar ways from public discourse, people integrate similar information in similar ways and form similar social representations (Baden, 2010). In this way, cultural groups are defined as sharing specific discourses and interpretations, which also implies on-going competition between multiple frames and discourses.

The social signification processes regarding a particular social issue highlight the dynamic process of social representation, which is mediated by semantic and social psychological interactions. The signification processes are not reduced to individual cognition, but represent an emerging structure of signs that can be semantically related, classified, and hierarchically evaluated by analytical method. To analyse the semantic structure, I especially use the concept of denotation and connotation presented by Roland Barthes (1967). According to Barthes, denotation serves to clarify a relation between the expression and the content of a sign, and connotation refers to an underlying contextual meaning or ideology manifested through a converging cultural object. The theory of social representation can particularly highlight the connotative aspect that is the "implicit, cultural, sensational and phenomenal side of the sense making process" reflecting utterers' embedded social context and shared phenomenological experiences (Wittgenstein, 2001; Peirce, 1998). In other words, I attempt to reveal inner social motives that are not outspoken, yet represent a critical part of society and culture.

Discourses visualized as a semantic network can help to explain how socially controversial issues, like embryonic stem cell research, are defined; technically speaking, I question what are their salient causal interpretations; what are their associated value references; and their converging solution and desire (Entman, 1993), signified by a central organizing idea (Gamson and Modigliani, 1987). In this way, the utterers are not defined by presupposed social categories but "emerge" through the day-to-day practices of producing selective words. Understanding this emergence is facilitated by the use of a theoretical model to make an automatic algorithm, which in turn classifies the words and extracts their core relations.

While efforts to classify keywords of natural texts might reflect a "universal cognitive tendency, which serves to either simplify an overly complex world, or to render it more intelligible" (Lakoff, 1987), as in the case of Latour's problematization, it is important to realize that there is nothing inevitable about the particular categories, or the content of those categories (Augoustinos, 2001: 203). If an analytical window is only open to the outcome of segregated words thrown together in a box for their co-occurrence, then the defining power of the researcher is limited to a predetermined causality, because words merely thrown together into a category offer little

information. But variables linked in an unexpected, yet systematized, way can raise a pragmatic “doubt” about existing explanations.

By analyzing people’s often-clashing perceptions and desires, I am particularly interested in representing themes and concepts that represent a social struggle and pain. In doing so, an underlying power struggle inscribed in the assemblage of knowledge, belief, and individual strategy might be reviewed from a novel academic perspective. I seek this methodological novelty. The network visualizing and analyzing the relation of concepts on a certain issue, e.g. stem cells, broadens the concept of social representation, because it introduces a methodology that might uncover concealed meanings in the complex web of signification. In doing so, I try to open a novel way of “understanding” (*Verstehen* in Max Weber’s sense), rather than claiming a fixable interpretation, of the observed outcomes of the systematized semantic network analysis. In this way, the semantic interpretation is designed to encourage the sociological and anthropological “possibility of thinking otherwise”, via the social psychological and semiotic perspective of the actor-network.

Governmentality and Biopolitics

In the *History of Sexuality Vol. 1*, Foucault introduces the term “biopolitics of the population”. This notion has since produced diverse readings of Foucault’s concepts of power, knowledge, governmentality and subjectivity.⁴ Foucault initially differentiated between disciplinary power and biopower (Lemm and Vater, 2014: 8; Foucault, 2008), as sovereign power shifted from the former to the latter, that is, from sanctioning of life (negative effect) to deliberative formation of life (positive effect) with economic (and later on, neoliberal) rationality. In the *Will to Knowledge*, Foucault describes the main role of biopower: “to ensure, sustain, and multiply life” instead of imposing death in order to govern. As mentioned before, newly discovered medical knowledge played a crucial role to enhance such biopower. Since Foucault, the political administration of changes and the new possibilities of life sciences have become closely linked with the

⁴ Previously, biopolitics and governmentality were understood with varying emphasis. Muhle (2014: 77-78) criticizes that there is ‘misreading’ of biopolitics either as rigidly linked to the regime of politics or sovereign power by Agamben, or as undue reduction of vital politics that overemphasizes the liberating aspect of individual choice or self-management of body by Canguilhem (1978). For the former example, Agamben (1998) criticizes the state’s role to alienate or even exterminate biological ‘bare life’, an oppressive state apparatus that kills or lets some population die as reflected in the history of Fascism and Stalinism. From the latter perspective, (on the contrary,) Rose (2007:4) took up the interpretation of Canguilhem and similarly announces, ‘human beings may come to experience themselves in new ways as biological selves whose vital existence becomes a focus of government, the target of novel forms of authority and expertise’ while cherishing the contemporary person’s liberal capacity to choose what kind of newly developed drug to take for self control and emotional enhancement.

understanding of biopolitics (Muhle, 2014; Rose, 2007). The prefix “bio” incorporates terms like “life”, “body”, “population” and (vital) “subject”. Deliberative governance becomes possible by use of the latest scientific knowledge, ethical conduct, and economic calculation to bring maximum effect, such as the promotion of the “healthy” population. Foucault’s notion of biopolitics heralds new power relations, where technology or knowledge can be wielded as social control (e.g. governments choosing how or whether to make birth control available), and wherein exists a new type of modern subject (individual), at the intersections of life, labor and language in the Western Europe.

The concept of biopolitics is inextricably linked to Foucault’s discussion of governmentality (Lemke, 2014; Agamben, 1998), because governmentality means not only the administrative functioning of government but more crucially the organised practices (mentalities, rationalities, and techniques) through which subjects are governed. Foucault emphasizes this in the latter part of *History of Sexuality Vol. 3* when he describes “technologies of the self” of the Ancient Greeks, which refer to the practices and strategies by which individuals represent to themselves their own ethical self-understanding. In some contemporary interpretations of Foucault, the governmentality part gains additional meanings, as Rose (1996) retranslates the concept as “self-governing capabilities”. Through enterprising and autonomous self-identity and through our freedom, ‘particular self-governing capabilities can be installed in order to bring our own ways of conducting and evaluating ourselves into alignment with political objectives’ (Rose, 1996:155). However, the constructed and reproduced subject might not be fully free or autonomous. The constellation of power relations, heterogeneous knowledge, public opinion and shifting economic considerations might, if not entirely, significantly delimit the self-governing capabilities and free choice of the individual. The possibility of doing otherwise, the autonomous capacity, is not purely exerted by endogenous individual characteristic, but by the deliberate functioning of biopolitics, because it operates as “a modality of power that in a precise historical moment overdetermines the other modalities of power” (Muhle, 2014:87). Therefore, a reflexive methodology to analyse the concrete networks of power-knowledge as conditions of possible form and practice of governmentality becomes more important than cherishing abstract individual autonomy and the capacity to make a choice.

In this sense, my understanding of Foucault’s “conduct of conduct” (Dreyfus and Rabinow, 1982), a dynamic social structure working behind the individual’s (mis)conduct, leads me to closely investigate what kinds of information, knowledge, belief, attitude, opinion and value collectively form people’s typical behaviour. Governmentality is an effect of the dynamic linking of those “information, knowledge, belief, attitude, opinion and value”, and biopolitics is a deliberate strategy to concentrate power to construct and sustain a desired subjectivity. To investigate this aspect, to

reiterate, we should above all acknowledge that people's "free choice" might not be fully free, and instead is circumscribed or framed, if not fully determined, by dominant powers, political economic interests, and people's desire and fear. As Foucault (2008: 63) states, 'the new art of government therefore appears as the management of freedom, not in the sense of the imperative: "be free"'. On the other hand, the operating power is not omnipotent, but relational and fragmented (Rabinow, 2003).

For an empirical study, it is important to analyse what kind of salient discourses circulate in society, which are silenced, and how they collectively influence people's behaviour relating to scientific knowledge and practice, in order to reflect on the condition of governmentality. To follow Lemke (2014: 72), Foucault's underlying will to "contribute to the constitution of new subjectivities and alternative norms that offer more space for autonomy and ethical self-formation" is the essential part that I want to incorporate in my use of the notion of biopolitics. Here, the "new subjectivities" connote a radical and thorough transformation of actors engaged in a scientific field, especially in relation to their knowledge, belief, attitude, opinion and value. Thus my analysis focuses on, to paraphrase Lemke (2011: 119), "the network of relations among power processes, knowledge practices, and modes of subjectivation". While the first parts of this thesis (Chapter 3, 4, 5 and 6) analyse what kind of actors participated in the legislation of embryonic stem cell research and what kind of discourses proclaimed salience to form the background of governmentality, the latter part (Chapter 7 and 8) explains how they have constrained the individual's behaviour, and discusses what alternative biopolitical strategy could be possible when observing the clashes of power and ensuing fractures in the network.

Science and technology studies, innovation and leadership

In regard to the literature review of Science and Technology Studies (STS), my original interest concerned the analysis of the national scientific frame through discourses and actions (Sleeboom-Faulkner and Hwang, 2012; Sleeboom-Faulkner, 2011; Ong, 2010; Sunder-Rajan, 2006; Jasanoff, 2005) and public understanding of science (Wynne, 2002; Bauer, 2002). This initial coupling was in part influenced by the observed crisis of governments and experts in dealing with the global public resistance against emerging biotechnology, and following scholarly arguments that emphasize the importance of the public's contextualization of science.

In the recent scientific environment, several changes are noticeable: a) Increase of interest in popular science (Bauer and Gutteling, 2002); b) Popular science becomes an essential part of the imagined scientific community, especially if the technology directly affects people's health and

body (Bauer and Gaskell, 2002); c) Contention happens when experts fail to respond to public voices. Despite the “crisis of legitimacy” in scientific governance (POST, 2001; Collins and Evans, 2002), the challenge does not necessarily imply the termination of the role of the expert, but rather encourages experts to reflect upon their role and to actively include the other engaged actors. Collins and Evans (2002) have argued that the ‘problem of legitimacy’ has been replaced by the ‘problem of extension’, blurring of boundaries between relevant participants in decision making. However, Wynne (2002) suggests that the challenge should not be limited to narrowly redefining which participants should have a role scientific decision-making. Instead he raises a more profound question about ‘how public issues are framed and thus given meaning, unveiling the neglected questions about how proper knowledge for relatively new domains like “environmental” and “risk” problems should be negotiated as matters of “civic epistemology”’ (Wynne, 2002: 402-405). If debates on the crisis of scientific legitimacy and the expected task of extension present a challenge to governance, so do they to the utility and effectiveness of researchers engaged in the STS. Wynne’s (2002) questioning of the role of social studies in elucidating actors’ framings, representative strategies and their intersections urges us to seek better answers to the question of “how to do” technoscience, rather than emphasizing the alternative forms of politics (Papadopoulos, 2010; Beck, 2009; Castells, 1997) in various subfields.

While I agree with the inclusion of the public in scientific decision-making, the results of my empirical research (Chapters 3 and 6) suggest that unconditional public participation is not a panacea to parliamentary democracy or scientific governance. In the area of emerging, unpredictable science, extending the possibility of different ways of thinking and identifying overlooked risks with semantic analysis can be more important than simply incorporating more people and organizations into the same way of thinking. Therefore, participants should be able to deliberate on social and scientific issues, and this requires not only a certain level of knowledge but also common values, trust and a mindset that contribute to a common cause (see Chapters 5 and 6).

Social network analysis results in Chapter 7 showing the evolution of the collaborative structure of scientists in South Korea, and calling attention to critical actors’ misconducts, require an additional dimension of thinking. As Martin (2013: 181) points out, the assumption of “self-policing” - ‘scientific misconduct is rare, self-correcting, and quickly detectable by peer review’ - is under serious doubt in the current scientific environment. That environment has become more complex, competitive, and increasingly influenced by economic interests. I argue that it is not only democracy or self-policing in science that matters, but also the efficiency of collaboration, and the leadership that ensures it. Scientific fraud can occur as a result of, and be exacerbated by the failure of resource distribution policy and collaboration among scientists.

As the South Korean case shows, public opinion and framing might prepare the background that could more easily induce scientific (mis)conducts. But it is ultimately the problem of the scientists in the expert field. In this regard, the discussions of Hackett (2005), Vermeulen and Penders (2010), Shrum (2010), Vermeulen (2009) and Calvert (2010), focusing on the topic of scientific collaboration, provide important frameworks of reflection. In brief, the failure in scientific collaboration undermines trust among actors, making their efforts more vulnerable to rent-seeking strategies and misconducts.

The cooperative action is not a spontaneous one waiting to happen among scientists. Contrary to the common image that scientific achievement results from the brilliance of a highly creative individual scientist, the complex work environment of a contemporary laboratory, burdened with numerous workforces, resources (and often complicated communication and knowledge) requires highly organised processes to ensure the effective execution of ‘problem definition, information gathering, information organization, conceptual combination, idea generation, idea evaluation, implementation planning, and monitoring’ (Hemlin, Allwood, Martin and Mumford, 2013: 11). Moreover, “the actions taken by the leaders of an organization represent one of the most powerful influences on people’s perception of climate – including a climate of creativity” (Jaussi and Dionne, 2004: quoted from Hemlin, Allwood, Martin and Mumford, 2013: 12). This holds true in my case study of Woo-Suk Hwang’s fraud and the misconduct of other laboratories in South Korea. The leadership style and behavior coupled with mediating (self-efficacy, intrinsic motivation and psychological empowerment) and moderating factors (conservation, cognitive ability and style, team heterogeneity and creative climate) influence the concrete feature of the creative knowledge environment (Denti and Hemlin, 2013).

Yet, I argue that the socially embedded attitude and conduct of individuals, their *habitus*, in Pierre Bourdieu’s terminology, can be influenced by broader leadership than that of a team leader or an operator of any technical “knowledge management” (O’Dell and Hubert, 2011) in order to transform. In other words, scientific leadership requires more than a management technique. At the end of thesis, I discuss the cultural and institutional grounds of knowledge-related practices that nurture scientific leadership. As will be depicted in the following South Korean cases, Korean people’s knowledge orientation, including those of scientists, and their strategic conduct, hindered collaboration and creativity. In a sense, the operation of discourse and governance should be able to transform individual *habitus* and motivation to develop an effective ethos of innovation and knowledge creation. I try to identify the concrete ground through my empirical studies in following chapters.

The innovation studies literature offers some practical implications for scientific success. Valente and Roger’s (1995) perspective on how innovation diffusion happens in networks,

mediated by active interaction of information exchange, problem solving and mutual learning, can clarify the object of research and methodological application. To understand the interactive process of learning, the concepts of trust (Fukuyama, 1996), social capital (Putnam, 2001) and struggle for recognition (Honneth, 1996; Markova, 2003) with roots in sociology and social psychology, become important: these literatures argue that actors do not always act based on economic rationality alone. However, more concrete case studies that clarify actors' interactions in scientific and technological fields (see Fagerberg, Martin, and Andersen, 2013) need to be developed.

As my empirical research covers the fields of government, mass media and the academy, there is also an overlapping area with the "Triple-Helix" (Leydesdorff, 2006) perspective, which focuses on the collaborative interaction among government, the academy and industry, and their underlying dynamics. But my methodological approach is more discourse (communication) oriented and sociological than formal modeling and measurements of regional innovation, even when I use (social and semantic) network analyses.

Methodology

Background of research

In my thesis, I confine the targets of empirical research to three discursive fields: government policy, mass media and lay perception (Bauer, 2002). These fields represent the constitutional and historical position of the state in relation to science and technology.

One important field missing here is business and industry. As will be explained in the following chapters, the development of stem cell research is tied to the prospect of wealth creation for individual and national ends. However, the fledgling human embryonic stem cell industry is not yet fully realized, and thus is a premature field of study. At present, to conjecture possible trajectories, it is effective to observe what kind of rhetoric and discourses are mobilized to attract investments during this early stage, and what kind of related practices occur in the research and clinical fields.

The discourse of expected economic activity penetrates every field, and the salient discourses of stem cell research and actions of important actors in the three analytical fields construct the possible space of key stakeholder's strategic action. As will be discussed in following chapters, the current mode of life scientific production in South Korea, in which discourse and practice are mobilized, produces an academic-industrial subject who takes advantage of public hype, speculative investments based on it, and disproportionate social power relationships between doctor/patient,

professor/student and senior/junior. Both acknowledged and disregarded aspects of academic-entrepreneurial conduct will be incorporated in the discussion of both biopolitics and individual conduct.

While studying stem cell discourse in each discursive area, I mainly investigate the governance of life science constructed by narratives of persuasion and mobilizing strategies. In doing so, I aim to elucidate motivations, interests and struggles of critical players that are either overlooked or underrepresented in existing research, such as the actions deriving from coercive relations among scientists. Finally, I consider alternative forms of scientific governance and conduct of academic-entrepreneurial actors beyond current practices observed in South Korea.

Facing data with grounded theory approach

The data analysed for this thesis consists of two dimensions: social representation and action in South Korea in regard to hESC research. For the social representation, I collected opinion-leading newspaper articles discussing “stem cell” research (see Chapter 6) to grasp the public framing of human embryonic stem cell research in South Korea and the United Kingdom, to identify what kind of interest, opinion, belief, value, argument and metaphor turn out to be salient. A similar approach was adopted in collecting data from open questionnaire survey responses on the subject of hESC in the UK (Chapter 5). The UK survey results were compared to South Korean internet talk about Woo-Suk Hwang, with each dataset deemed an indicator of social values in the two national contexts (see Chapter 6). To formalize and analyse the public framing and salient concepts, semantic network analysis was utilized and developed as will be explained in the next section.

To trace actions, I reviewed governmental documents to study the process of legislating the guidelines for hESC research (Chapter 3). In the process, we learn how conflicting ideas clash and settle. With similar purpose, I conducted interviews with scientists and students in the stem cell field. In doing so, I tried to answer the following questions: what is the practical constraint in their action; how do they struggle under such constraints; and what kinds of strategies are used to adapt to the situation (Chapter 7). The change in social network of stem cell scientists in South Korea between 2004 and 2005 (Fig. 7.2 and 7.3, Chapter 7), however, also signifies that a governmental resource distribution strategy can have an important impact on scientists’ alliances and perhaps research conduct, as well as means of communication.

In my case studies, besides document reviews, I either interviewed or quoted from 4 Korean and 3 UK scientists, 4 Korean and 2 British administrators or policy makers who had major positions in governmental bodies, 4 Korean masters and PhD students studying in University

laboratories, 2 Korean, 2 UK and 1 US reporters from media corporations, and 3 Korean and 1 UK researchers in regenerative venture firms that were directly or indirectly engaged in the development of stem cell research. Although they may not represent the stem cell field itself, I used their testimonies to verify and substantiate meaning inferred from the data representation of the semantic network analysis.

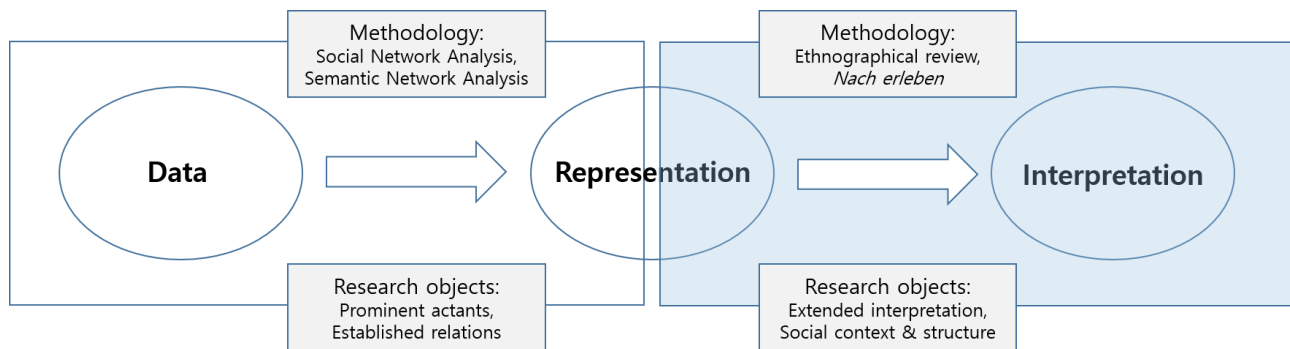
As mentioned above, my thesis builds on independent articles, and the arguments in each chapter might be more diverse than those of a monograph-styled thesis format. The underlying methodological intention, nevertheless, is to construct a cumulative set of arguments and hypotheses based on the findings from a formalized set of qualitative analysis, while actively using newly developed computerized tools. My approach could be recognised as a “grounded theory” (Glaser and Strauss, 1967; Corbin and Strauss, 2015) approach insofar as I try to find emergent characteristics or categories out of coded data from each empirical study, derive core themes, and extract an overarching theory or theme out of them. However, in contrast to the earlier emphasis of Glaser and Strauss (1967: 4) to shun “logically deduced theories based on ungrounded assumptions”, I have explicated theories that represent my predetermined research perspective. This reflects my research experience that pure induction is practically impossible, and can even be detrimental, confining the potential of sociological reflection. I assert that there is always a working pre-concept in data interpretation, and a formal procedure of qualitative analysis cannot exclude it (Thomas and James, 2006).⁵ On the other hand, I concur with Corbin and Strauss (2015: 25), who write that ‘the analytic process, like any thinking process, should be relaxed, flexible, and driven by insight gained through interaction with data’ and ‘it is not the event itself that is the issue in our studies; it is the meaning given to events as evidenced in the action-interaction that follows’.

Background knowledge is substantiated by an explicit ethnographical review (Tambayong and Carley, 2012) and/or implicitly what German sociologist Max Weber refers to as *Nacherleben* (reliving) through ideal-typically reconstructed representation. Therefore, in agreement with such representation, the methodology of social and semantic network analysis is positioned in the academic tradition of interpretive sociology, and aims to invoke critical questioning. As described in Figure 2.1, both social network and semantic network analysis seek to find prominent actants, respectively persons (a social variable) and concepts (a semantic variable) as central nodes, and the linkage among them – persons or concepts. The linkages are said to reflect power relations (a social variable) and conductivity of discourse (a semantic variable). Although extracting these research objects might be possible without utilizing SNAs, the SNA approaches offer a standardized way to

⁵ Corbin and Strauss (2015)’s recent textbook seems to take a more flexible stance on the relation between deduction and induction. While guarding against ‘armchair theorizing’, in the introduction, Corbin makes it clear that Strauss’s historical construction of grounded theory was heavily influenced by symbolic interactionists like George Herbert Mead and the pragmatic worldview of John Dewey.

extract core representational characteristics out of large sets of unstructured data. The representation undergoes a verification process with collected evidence and counter-evidence: an ethnographical review either confirms or denies the interpretation of social context and structure. Although the answers derived from the review are necessarily subjective, the former part of the data processing is an opportunity for the researcher to challenge preexisting notions for interpretation with the critical perspective of grounded theory.

Figure 2.1. The role of SNAs in interpretive sociology



Visualizing and measuring discourses with semantic network

The opinion, imagination and values of lay people as well as those of experts in relation to the new life sciences are increasingly important, and novel ways of studying their content is becoming an essential part of science and technology studies. In fact, emerging life sciences such as stem cell research have become an “arena” (Bauer, 2002) that tests actors’ discursive capacity to formulate the future of science and governance. Therefore, methodological sophistication and sociological imagination are necessary. In other words, to cast light upon underrepresented characteristics of scientific discourse is a prerequisite to substantiate both the democratic and rational, rather than rationalizing, practice of science. This enterprise may also provide significant anthropological insights into the “forms of life” (Wittgenstein, 2001) that reflect the social nature of science, continuously reassembling itself (Latour, 2005). As I will explain, I believe these ends can be effectively sought by visualizing the structure and dynamics of semantic signifiers and their related public actions practiced by interested actors.

Besides the substantive parts of the thesis and the conventional use of social network analysis, a detailed explanation of semantic network analysis is needed, as it is not presently well known. First, the difference between methodology and method(s) should be explicitly stated. In simple terms, methodology is a coherent way of interpreting analytical results from a predefined

perspective, based on a set of theories and research practices, while methods denote the functional procedures of data analysis (in this case, systematic coding). In this thesis, the “methodology” of semantic network analysis is a coupling of a semiological modeling of content analysis and its qualitative interpretation, occasionally supported by some ethnographic and other social scientific research. In practical terms semantic network analysis is supported by a computer-assisted algorithm that offers particular methods to analyse social groups represented through the arrangement of particular words.

Traditionally, content analysis is a tool for making inferences about the message context rather than just measuring aspects of the message content. As Krippendorff (2004) argues, a message by itself does not have meaning: it is a set of signs. The meaning or semantics of a message is the connection between the symbols and the things to which they refer. Since each receiver or sender of a message can interpret the message differently, it is important to realize that a message only has a meaning in the “context of its use” (Krippendorff, 2004: 33). As the communication research question determines which aspects of a message are interesting, it also defines the context in which the message is to be interpreted. The task of content analysis is to “infer” the relevant meaning in that context from the symbols in the message (van Atteveldt, 2008: 16).

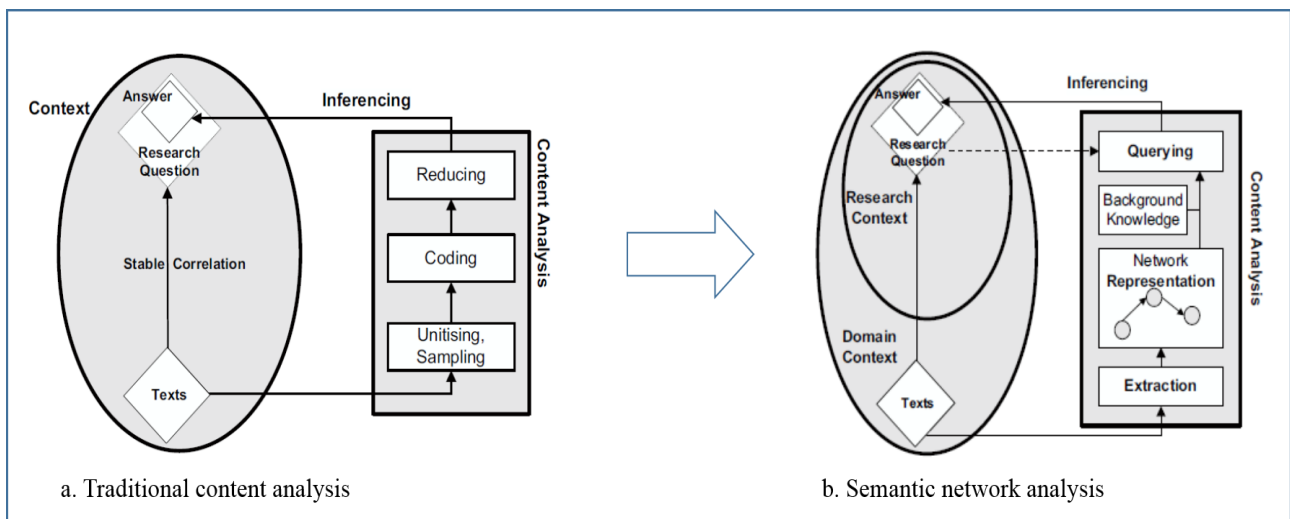


Figure 2.2. The framework of content analysis and semantic network analysis

* Source: van Atteveldt, p. 17, 26.

Wouter van Atteveldt (2008: 16-28) compares semantic network analysis and Krippendorff’s frame of traditional content analysis (Figure 2.2). In contrast to the relatively simple procedure of inference derived from the stable correlation between text and research question in traditional content analysis, semantic network analysis goes further, exposing multilayered contexts of texts and research questions, and proceeds to infer the answer through an active feedback loop between network representation and background knowledge.

The selective links of concepts in the semantic network represent a symptom of the social representation (Moscovici, 2000) of utterers, and they are incorporated into discourse analyses that delve into microscopic relations of power among actors – mediated by language. The dialogue, depicted graphically in the semantic network, is a social action that creates a collective narrative, or an “occurring” event (Bourdieu, 1991). The event represents specific socio-historical contexts; ‘words and concepts become ideological units of life that both reflect and refract particular social relations’ (Crossley and Roberts, 2004: 77). Therefore, when a word is uttered ‘it is not merely an individual’s identity that is invoked, but also a social and historical whole through which the utterance has been indicated and through which it has gained a specific evaluation’ (Crossley and Roberts, 2004: 85).

I use two measurable concepts other than frequency in content analysis – “conductivity” and “prominence” – to open up additional dimensions in analyzing the discourse. Both are represented by the linkage of identified concepts in the text. Conductivity is ‘the capacity of an expression in context to carry (or trigger) information in a directional flow, which is connected by a path between two nodes of concepts as keywords or phrases’ (Carley and Kaufer, 1993). Information flows in a certain direction when it triggers and is triggered by other available information in the context. Amidst the constructed semantic network, I analyse the relational content of keywords, the thematic “roles” determining the association between subjects and descriptives that are composed of substantives (Moscovici, 2000). Conceptual realms are very often hierarchical and sequential, meaning that an object A is inferred or thought about within the context of the object B, but not vice versa. In linguistic use, for example, it was common to refer to “peace” after “war” but not the other way round. Social psychological inferences can be made from examining relations (and their hierarchies) in a network. This psychological translation of semiological characteristics embodies a powerful methodology for classifying keywords (Kronberger and Wagner, 2007: 302–309). To analyse the pattern of “conductivity” in network analysis, the criterion of categorization is “structural equivalence”. The notion of structural equivalence focuses on the structural/functional role of nodes (keywords), by studying their associations among semantic relations, and identifying homogeneous nodes identically located in the network of relations (Wasserman and Faust, 1994: 348–349).

As to the coding, the researcher should be aware that the selection of data and coding requires semantic and cultural interpretations of the data (Carley and Cicourel, 1990). Despite variable manual and automatic techniques developed for different contexts, there are certain transcending principles and a convergence of ideas regarding the procedure and rules for the coding of textual data into the matrix format of a network. Above all, defining the relation of a directed link between two concepts has to do with whether the first concept is seen to have some type of “prior”

relationship to the second concept (Franzosi, 1990; Carley, 1993; Kronberger and Wagner, 2007). Various types of prior relationship can be thought of. For example, ‘a implies b,’ ‘a comes before b,’ ‘if a is true, then b is true,’ ‘a qualifies b,’ or ‘a (subject) <verb> b (descriptive).’ Unlike the co-word analysis that links all the co-occurring words without the a priori relation, this coding directionality of semantic network is important because it can provide information about the way in which the impact of new information propagates through the network and affects decisions, and the structure of meaning (Carley, 1993: 96).

Originally, the root idea for coding was already applied in co-occurrence or co-word analysis of text that applies hierarchical clustering of co-occurring keywords. In response to the development of co-citation maps during the 1970s by Small (1973), Callon *et al.* (1983) proposed developing co-word maps as an alternative to the study of semantic relations in scientific and technology literatures (Callon *et al.*, 1986; Leydesdorff, 1989). Ever since, these techniques for “co-word mapping” have been further developed, for example, into “Latent Semantic Analysis” (e.g. Leydesdorff, 1997). These methods operate on a document-word or word-word matrix in which the documents (or words) provide the cases to which the words are attributed as variables. It is assumed that search terms identifying actors or issues that appear close to each other in a text indicate an association between these actors or issues. The drawback of this technique, however, is that it ignores the semantics of concepts, context and expressed relations (van Atteveldt and Takens, 2010), and the links become too complex to concisely denote the relation of reference. Also, co-occurring words in a sentence or a paragraph presupposes the relation of reference, but those words do not always form referential relationships. Overall, the currently available automated techniques and tools of co-word analysis offer limited insight, as they ignore sequential relations between words. In contrast to the co-word analysis, my utilization of semantic network analysis applies different assumption and technique:

- While co-word analysis basically derives tagged units of co-occurring keywords, my utilization of semantic network analysis tries to recognise “semantic” relations between words. This means that both manual and automatic coding recognises subject-descriptive relations instead of mechanically linking all the words that co-occurred that passed a certain statistical threshold
- As semantic network regards semantic relationships as important from the stage of coding, natural language processing (NLP) technology was actively used in automated analysis. This goes beyond the parsing of grammatical units such as the most important substantives, nouns or adjectives. In automated analysis,

machine-learning algorithms should especially detect the parsimonious relation of what subject (subject) receives what kind of evaluation (descriptive)

- Above all, semantic network recognises the relationship between precedent and antecedent keywords. It presents ways to calculate the relatively distributed prominence of keywords based on such relations. Betweenness and in-closeness centrality are often used to measure the prominence out of the sequential relationship. While recent co-word analyses also utilizes centrality indices, they do so without recognizing the semantically and statistically extracted relationship between precedent and antecedent relation.

In regard to the “prominence” of concepts, the two network indices of betweenness and in-closeness centrality, respectively, deliver Roland Barthes’ (1967) main tool of investigation, that is, a semantic dichotomy of denotation versus connotation. Denotation is the literal or core meaning of a sign and connotation refers to secondary meanings associated with it. Denotation clarifies what serves to connect the expression and the content of sign, and connotation reveals an underlying contextual meaning or ideology, manifested through a converging cultural or symbolic object. To explore the cultural features on which this thesis concentrates, as Barthes emphasizes, connoted meaning is more heavily drawn upon. The social network analysis attempts to translate these concepts as the relevant (corresponding) nodes of keywords essentially inherit the functionally prominent roles. That is, a node (conceptual keyword) with the highest betweenness centrality takes up the role as a mediator of communication, as it is located in the intersection of different clusters of concepts. In comparison, a key concept with the highest in-closeness centrality is connotative because it is the eventual result of communicative interaction that positions itself closest to the centre of reference (Figure 2.3).

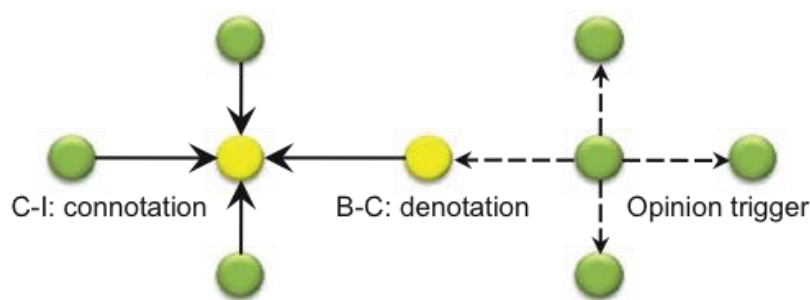


Figure 2.3. The network model of denotation and connotation

The semiotic concepts of denotation and connotation can clarify the social signification processes among social groups in social psychological interpretation, that is, anchoring and

objectification (Veltri, 2013). If anchoring is a process by which people in a social group “make the unfamiliar familiar” (Moscovici, 2000) by relating new objects to existing ones, objectification is a process through which a new object materializes, as linguistic signs are attached to material structures. These social signification processes are a dynamic process mediated by semantic interactions that are not reduced to individual cognition, but remain highly abstract, without formal methods of classifying the levels of signification in practice.

In sum, the “cognitive map” (Carley and Palmquist, 1992) representation of text can be regarded as a constellation of signifiers expressed by linkages of keywords or concepts. Links have directions, arrows. These directed edges, like Lacan’s “transference” (Lacan, 1994), refer to not only syntactical statements but also to the implicit flow of “desire” embedded in a person’s expressions: By directing some other words, they reveal what their concerns or desires really point at. The preceding concept that used to be abstract is displaced to more concrete experiences, thoughts and feelings of utterers. That is, a node emerges as a central object when it is strategically positioned in the entire communicative map to become an explicit passage point in the communication (denotation) or most meaningfully positioned in the referential structure (connotation). Different segmentations of communicative themes emerge because of the differing patterns of referential relations. The applied automatic methods are trials to imitate the cognitive process of human coders to link related (subject-descriptive) word sets from the flow of text, in order to reconstruct a social meaning.

Visualizing and evaluating the relational pattern of keywords in a systematized way can open up insights and questions beyond an existing statistical or narrative style of explanation. Considering this benefit, my methodological approach and the underlying assumptions can be summarized thus:

- The social frame is constructed by a selective reference between concepts: the smallest instance of coherently contextualized information is formed when two formerly disconnected concepts are related. In this case, these two nodes of concepts allow the interpretation of one in light of the other.
- When such relations become complex, a disparity between the central organizing idea and peripheral concepts emerge. Sometimes this can be intuitively discerned by the density of connections between nodes, but also sophisticated centrality indices can be applied to measure importance.
- By translating the definition of the centrality index, semiotic characteristics can be represented: if ‘denotation’ represents dense traffic (citation) in referential

linkages, ‘connotation’ represents a converging secondary idea stemming from those denotations.

- If semantic categories can be classified by such a pattern of linkage of concepts alongside denotation and connotation, we might be able to derive new opinion groups or multi-faceted personae and their discursive characteristics in more structured way. This does away with the need for pre-categorization of social groups and post-hoc explanation, allowing more flexible interpretation and questioning of socially represented characteristics.

Thus, semantic network analysis is a response to overcome limits of existing quantitative and qualitative approaches, by systematically representing more dynamic linkages of symbols utilized in mass media and people’s utterances, to derive social meanings out of the calculated result (Hellsten, Dawson and Leydesdorff, 2010; Kwon, Barnett and Chen 2009; Carley and Palmquist, 1992).

The trajectory of a developing technique and current limitations

Admittedly, both the method of coding and interpretation in its current form are limited and sometimes problematic. Firstly, there is little consensus on how to code data yet. Carley (1993) proposes a “story-line coding” method that merely links keywords, after deletion of redundant words either manually or automatically, along the flow of sentences. Kwon, Barnett and Chen (2009) and Hellsten, Dawson and Leydesdorff (2010) similarly utilize co-occurrences of words in text and set up statistical and mathematical thresholds to cut off less frequent pairs of words in the linkage between keywords. However, the frequency of co-occurrences of words alone is usually not useful for acquiring counter-intuitive results, and in itself does not reflect the natural flow of wordings. Also the question follows, how does one derive the significant part from the complex network of words? This is one of the technical areas I have explored, and I have tried to make a methodical contribution through various techniques, in the empirical chapters.

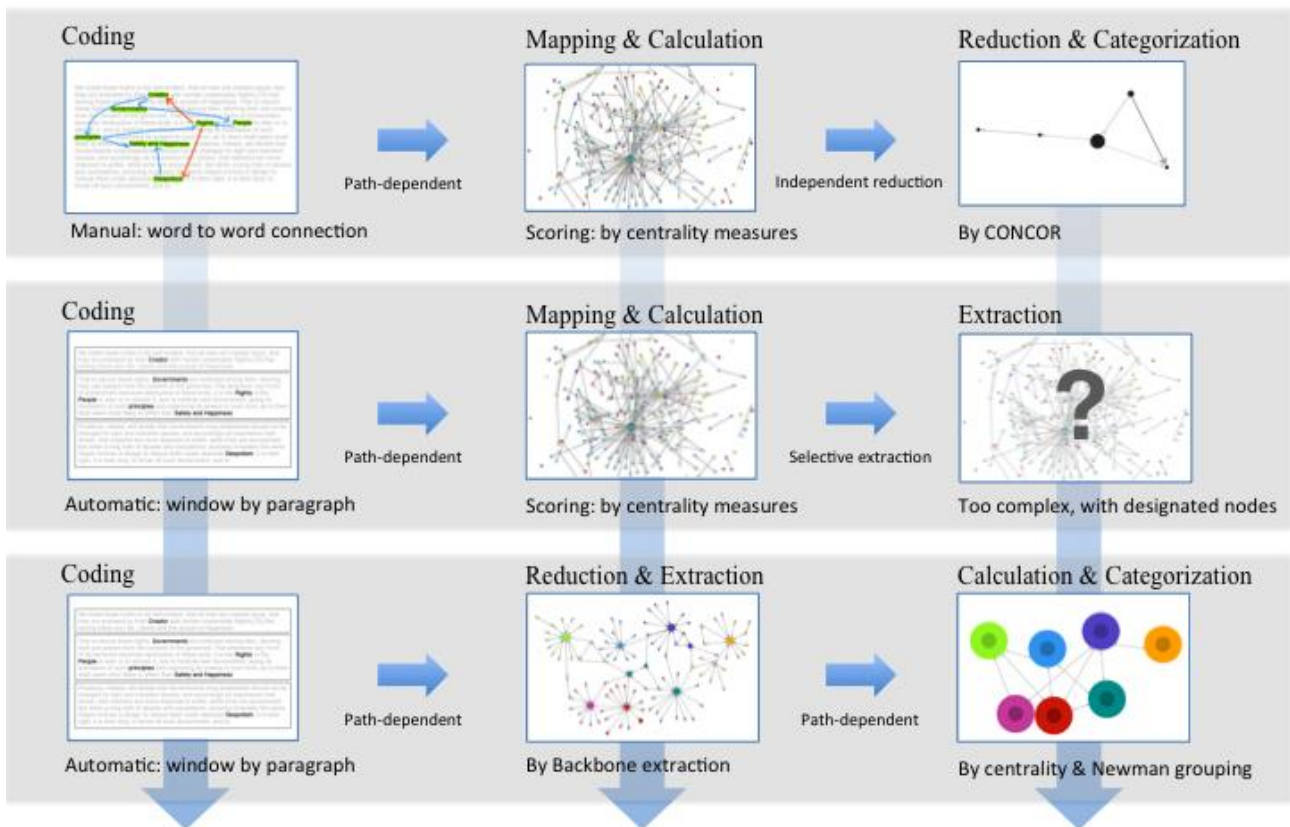


Figure 2.4. Methodical development of semantic network analysis

The chronological development of methods is depicted in Figure 2.4 (from top to bottom). The initially utilized method (top) concerns manual coding of word relations and then automatically measures centralities of words and categorizes word groups. The semi-automated method (middle) used the tool Automap (<http://www.casos.cs.cmu.edu/projects/automap/>) to automatically code, and then produce a semantic network; however, the automatic method of coding will produce very complex syntactic relations between words devoid of their semantic significance, making the network too complex to derive insights. The latest proposal (bottom) has tried to address the limitation and tentatively stabilized the automatic process of coding, by measuring and reducing the core characteristics of textual data, enabling anyone utilizing the new semantic analytics system Optimind to evaluate the text with the same result⁶ in more accessible manner. While this can offer the benefit of representing relational characteristics of signifiers, better theoretical and

⁶ It is a well-known fact among social network analysis researchers that some centrality measures and categorization greatly vary depending on the size of network. Therefore, it is wrong to treat the SNA result as a statistically robust one. From my experience, it is of practical importance to settle on a certain specific procedure to define the size range of nodes and links that are adapted to different genres of texts, most of all, and research purpose. Although vast experiments and the adoption of machine learning algorithms are expected to elaborate and stabilize the process, some caution against the result is necessary for social scientific research.

methodological assumptions will improve its procedure, technique, results and consequently, useful insight.

The applications of technical methods presented in the empirical analyses are not chronologically presented along the chapters. Chapter 6 was my initial trial with manual coding (top row in Figure 2.4) to excavate concepts overlooked by existing studies of public understanding of science in South Korea. Although the derived results from the automatic algorithm by social network analysis tool Pajek were unexpected and interesting, as it seemed to represent overlooked concepts like ‘national trait’ and “competition” (beyond the cliché of “nationalism”), there was a limitation by way of robust, at least in a statistical sense, justification. The work remained essentially qualitative, using a graphical tool to highlight a certain aspect of discourse in public representation of science.

Chapter 4 is intended to address the limited operation of Pajek by utilizing the automatic text-coding tool Automap. But, producing a semantic network based on some quasi-statistical principles of co-occurrence made the links of keywords overly complex. In its application, a very high threshold was inevitably applied to focus on the most salient and representative aspect of keywords for comparison. This experience led me to explore an alternative method of coding and applying a different threshold. I have tried to improve the existing “story-line coding” method by Carley (1993), and develop better algorithms for extracting the semantic map through an automatic process. In Chapter 6, the recent map extracting algorithm of the “backbone extraction model” proposed by statistical physicists Serrano, Boguñá and Vespignani (2009), was imported to address the problem of complex links.⁷

Automatized or computerized methods might easily deliver the image of robust or legitimate research but the social scientific researcher should not be tempted to present the data as if it spoke for itself. The utilization of semantic network analytical techniques are still experimental and provide evidence that on its own, lacks sufficient reliability for the decision making process. The results of visualization are often unstable, i.e. they depend on choices in parameters of coding, extraction, mapping, reduction, and the methods have not yet been used in many studies.

Still, this exploratory approach can shed light on the characteristics of complex networks that are difficult to depict through traditional social research methods, and thus may stimulate further ethnographical observations. As clarified in Figure 2.2, the approach stimulates inference, when adequately supported by background knowledge and insight of the researcher. In this way, the novel methodology helps to explore a pathway to uncover underrepresented causal relationships of actors, symbols and actions, and effectively visualizes these relationships. Semiotic characteristics of life scientific discourses, represented as a network, provide insight into the conduct of conduct

⁷ Technical details are explained in Chapter 5.

(Foucault, 1982) or *habitus* (Bourdieu, 1996) of human life in scientific practices, when considered alongside qualitative studies. For practical applications of network analysis, therefore, we need comprehensive work joining transparent quantitative methods and insightful qualitative interpretation. This is possible only if we put together an integrative theory and practice that above all reconciles the unnecessary tension between qualitative and quantitative approaches. The results of this type of data analysis do not imply a statistical correlation, but more flexible causal relations.

3. Governing Strategies for hESC Research: Korea & UK

Introduction

Since the birth of Dolly the sheep in 1997 and the derivation of the first human embryonic stem cell line in 1998, the prospect of stem cell technology has inspired considerable interest. Subsequent advances include therapeutic cloning, or somatic cell nuclear transfer, which enables scientists to generate cells that are genetically identical to those of the patient, obviating concerns over the rejection of transplanted stem cells by the immune system. Most of the high-profile publicity for stem cell research, including the recent discussions of induced pluripotent stem cells, focuses on the prospect of regenerative medicine, which is expected to cure a range of diseases and serious injuries simply by replacing damaged cells with injected stem cells. Scientifically advanced nations worldwide, therefore, recognise that stem cell research can bring about significant gains in health and wealth, notwithstanding a variety of bioethical concerns.

In line with growing public attention, many studies of stem cell research have focused on regulatory debates and measures (Jasanoff, 2005; Franklin, 2007; Ong and Chen eds., 2010; Sleeboom-Faulkner, 2011). Explicitly and implicitly, academic engagements have challenged the worrisome dichotomy in scientific regulation between Western and Other, developed and underdeveloped, cultured and uncultured. The waning yet persistent dichotomy is worrisome because the regulation of science always evokes a complex actor network of material and subjective elements, producing an unsettling hybrid of modern and non-modern characteristics in every subject in every region (Latour, 1993): nothing is fixed and necessary; some things are just more appealing at that moment.

To avoid a cultural reductionism previously mentioned, I try to seek a balanced view on national characteristics. The national comparison of governing strategy of stem cell research is helpful in this regard. It is important for the researcher not to rely exclusively on the preexisting categories of culture or social/economic development. Any actor's strategies and narratives will interact with his or her environment—often labeled as culture or development—but unpredictable chance events always yield unintended consequences to both reproduce and transform the existing settings. From this perspective, I try to trace the regulatory trajectories of the United Kingdom and South Korea, linking the contingent yet nationally embedded strategies and narratives of some of the key legislative players. In doing so, the chapter provides the governmental and legislative background of stem cell policy in the two countries. Moreover, the chapter also discusses that semantic interaction and media framing have played a pivotal role in driving national stem cell

policy, paving the way to more empirical analyses of such characteristics from comparative perspectives in the following chapters.

A comparison of the United Kingdom and South Korea is significant not only because one is a developed and the other is an emerging biotechnological laboratory but also because it provides examples of a well-regulated case and a failed case (Gottweiss and Triendle, 2006). Although I have not attempted to cover all of the relevant legislative actions, some of my findings that underline contingent characteristics of the legislative process—pointing to deeply unstable underlying dynamics—cast doubts on the notion of fundamental differences among states, supporting the idea that one should speak of national identity becoming rather than being (Hall and du Gay, 1996).

In the early twenty-first century, both the United Kingdom and South Korea have invested heavily in human embryonic stem cell (hereafter hESC) research, in contrast to the rather tentative investments made by the European Union and the United States. Both countries were also keen to develop legal frameworks that would support and stabilize research. In the United Kingdom, Parliament passed a revised set of regulations for the Human Fertilisation and Embryology Authority (HFEA) in 2001, broadening the permissible areas of hESC research first set out in 1990 while prohibiting possible abuses of this technology. For a similar purpose, the Bioethics and Biosafety Act was endorsed in 2003 in South Korea. Public discussions and deliberations by governmental bodies played a pivotal role in shaping both the legislation and public opinion.

The shaping of the HFEA bill has been called a very open process with much public discussion, whereas the shaping of the Bioethics and Biosafety Act ended in a huge scandal since it had been engineered to secure a researcher named Woo-Suk Hwang a competitive edge over foreign rivals (Kang, Kim and Han, 2006; L. Kim, 2008). While such criticisms are accurate, the outcome of the different trajectories presented in this article also reveals a range of unintended consequences. The two situations are far more complex and multifaceted than the proverbial distinction so often made between the ‘successful’ (?) Western case and the ‘modernizing’ (?) country’s less impressive record.

In retrospect, stem cell research has become a quintessential site for observing how governments and stakeholders legislate rules and conduct to maximize the gains from life science research. To frame public opinion and stabilize knowledge, crucial stakeholders devised multiple discursive strategies to bridge the gap between emerging life sciences and society. The divergent conditions that existed in the United Kingdom and South Korea before the emergence of stem cell science played a crucial role, from government’s perception of the state’s identity and its ability to set the scientific agenda, to the interactions of governmental actors, the roles and identities of scientists and other experts, and the standard methods of persuasion.

This chapter traces the process of institutionalization and transformation of the HFEA bill in the United Kingdom and the Bioethics and Biosafety Act in South Korea. By analyzing discursive strategies shown in governmental documents, fleshed out with statements from people who worked on the legislation, I try to elucidate key actors' roles, identities, and interactions, singling out the characteristic discourses used in governance.

As I use it, discourse means not only rhetorical and persuasive strategies employed by actors to frame (Jasanoff, 2005) stem cell research but also a specific way that authoritative power and scientific knowledge are coupled to regulate and define the conduct and capacity of actors (Foucault 1980). I have tried to visualize the discourse of science as a set of frames (Lakoff and Johnson, 1980; Entman, 1993) linked to familiar ideas in the UK and South Korea, so as to unveil the underlying language games that privilege a certain scientific-political concept (Bourdieu, 1991) in legislative discussions. Throughout this article, I argue that this aspect of governance is as important as the formal rationality of the legislative process that guarantees public participation and deliberation.

The role played by the state in stem cell research goes beyond setting and enforcing rules. Countless communicative interactions produce power/knowledge assemblages that then regulate their own conduct. This is not to deny that the governments of the United Kingdom and South Korea played an active and reflexive role (Beck, Giddens and Lash, 1994; Beck, 2005) based on conscious strategies to establish a scientific discourse of stem cell research while maintaining their formal commitments to investment and regulation. Nevertheless, there is always a certain degree of unpredictability and unintended consequences in the actions of actors, and usually the interesting question is not so much of the 'degree of freedom' as of the restless power relations yielding the "deviance".

To trace the whole process, I began by reviewing the relevant governmental documents in both countries from the early 1980s to the year 2008. Then I focused my interest on the 2003 Bioethics and Biosafety Act in South Korea and the 2008 revision of the Human Fertilisation and Embryology Act to permit research on hybrid organisms and chimeras in the United Kingdom. I interviewed several of those who played leading roles in framing the Korean legislation, including Eun-Jeong Park, who participated in drafting the Bioethics and Biosafety Act. For the United Kingdom, I interviewed a key stem cell scientist, Dr. Stephen Minger, who helped revise the British regulations regarding the research on hybrids and chimeras in the wake of the Hwang scandal. I also participated in significant forums that reviewed each nation's regulatory trajectory on stem cell research, including the Genomics Forum's March 2009 Retrospective on the Human Fertilisation

and Embryology Act workshop in London and the April 2009 Parliamentary Life Science Research Forum in Seoul. Even though the people I interviewed do not represent the whole process of complex interaction in regulating scientific work, they produced a narrative common to many experts on stem cell research.

In Vitro Fertilization: Different starts, different stances

The United Kingdom

It was only in 1997, with the cloning of Dolly the sheep, that reproductive cloning was realized, and only around 2000 did the regulation of stem cell research emerge as a significant topic in public debates. However, the legal framework that broadly applies to stem cell research dates back to the introduction of in vitro fertilization (IVF). In 1978, when the world's first test-tube baby was born in the United Kingdom, public concerns attracted the attention of Europe's policy communities. They were forced to take on ethical issues not simply as a function of the medical research process but as a consideration in strategic policy-making. The result was the creation of the Warnock Commission in 1984, tasked with studying the ethical aspects of IVF and related research. The commission offered recommendations on the treatment of embryos for research, but overall it framed permissive conditions for the licenses issued by a new independent authority. It was also the Warnock Commission that proposed a limit on the age of embryos used in research: fourteen days after fertilization (UK Department of Health and Social Security, 1984); the proposal has since been adopted as the standard in many countries, including South Korea. By acknowledging this young entity that was declared not quite a person, research scientists and their political allies could dodge the tactics of the 'pro-life' lobby (Jasanoff, 2005). The very polarized debates that ensued eventually led to the passage of the Human Fertilisation and Embryology Act in 1990, which was a victory for the advocates of the new reproductive technologies (Durant, Bauer and Gaskell, 1998).

The act set rigidly defined boundaries within which research on early embryos was permitted. A section known as Schedule 2 stated that the HFEA could not license any research unless it served one of the following purposes: (1) promoting advances in the treatment of infertility, (2) increasing knowledge about the causes of congenital disease, (3) increasing knowledge about the causes of miscarriage, (4) developing more effective contraceptive techniques, or (5) developing methods for detecting the presence of genetic or chromosomal abnormalities in embryos before implantation.

During the period of debate, the government of Prime Minister Margaret Thatcher did not take a clear position on embryo research, and it was left to Parliament to decide. Since future

advances in human embryology were likely to prompt changes in regulations, the HFEA was instructed to collect such information. Before 1997, the regulations addressing IVF liberally allowed for research that might prove beneficial down the line, without much thought given to the specific product of future technologies. This early framework provided a crucial initial condition for defining the status of the embryo (Sleator, 2000) just as stem cell research came to require quantities of fertilized eggs. Where research was not set on such a clear regulatory footing early on, as was the case in South Korea, medical practitioners envisaged a huge clash between newly adopted regulations and international norms.

South Korea

After South Korea achieved its first birth via IVF in 1985, the technique spread rapidly thanks to a number of flourishing fertility clinics. According to statistics compiled in 2005, South Korea accounts for approximately 20 percent of the babies born worldwide through IVF, and about half of the world's supply of stored embryos, approximately two hundred thousand in total, are found in South Korean fertility clinics (Myoung, 2005). This growth may be attributed to a family-oriented culture, rapid economic development, and a constrained industrial lifestyle that encourages women to give birth 'at the right time.' At a time when practically no regulations stood in the way of fertility treatments or limited the treatment of embryos, South Korean researchers performed experiments at will, accumulating considerable knowledge of late twentieth-century obstetrics and its technical applications (Ha, 2006). Because the growing industry naturally required many experts who could manipulate ova and embryos, veterinarians who had accumulated relevant skills in animal cloning could establish themselves and find new opportunities in research on and treatment of human beings.

The South Korean government realized the growing importance of this emerging field in the early 1980s, but it focused on promoting the new technology while paying little attention to regulation. When the Ministry of Health and Welfare circulated to other departments a draft of experimental guidelines aimed at reducing biological dangers, environmental harm, and ethical problems in 1985, the Office of Science and Technology refused to cooperate on the grounds that any proactive regulation might hamper the early development of South Korea's biotechnology industry. Serious consideration was never given to the utility of appropriate oversight and timely regulation. In spite of this reluctance to set up a regulatory framework that might infringe upon the emerging field, one of the costs of enrolling in the Organization for Economic Co-operation and Development in the mid-1990s was compliance with guidelines for research in a variety of

biotechnological fields (H. Kim, 2005). The first regulatory framework, established in 1997, focused on safety measures; the only mention of 'ethical problems' in the formal document feels forced and rather awkward (H. Kim, 2005).

Evolution of a regulatory discourse

The United Kingdom: Proceeding toward Legitimacy

The Human Fertilisation and Embryology Act permits research on early embryos, but only when the study is strictly dedicated to improving human reproduction or fertility. Thus, the cloning debate that has lasted since 1997 in the United Kingdom has addressed the creation and use of human embryonic stem cells for therapeutic research. After a public consultation on the ethical aspect of animal cloning was set up jointly by the HFEA and the Human Genetics Advisory Commission, the ensuing report (Human Genetics Advisory Commission, 1998) concluded that the Human Fertilisation and Embryology Act had proved effective in dealing with new developments relating to human cloning. In addition, they recommended that the HFEA issue licenses for research on therapy for mitochondrial disease and 'therapeutic treatments for diseased or damaged tissues or organs'.

To assess the anticipated benefits of such research, as well as the potential risks and the ethical and social implications beyond those addressed by the report, and to determine whether any additional regulation of the use of embryonic cell lines was required, the government set up another independent advisory group. In August 2000 the Chief Medical Officer's Expert Advisory Group on Therapeutic Cloning published its report 'Stem Cell Research: Medical Progress with Responsibility,' often referred to as the Donaldson report, which concluded, 'At present the creation or use of embryos for research to improve understanding or treatment of non-congenital diseases is not permitted under the 1990 Act...There is no specific legislation currently in force to regulate research on stem cells once extracted from embryos or research aimed at deriving stem cells from other, non-embryonic, sources such as an aborted fetus or adult cells' (UK Department of Health, 2000: 6). In other words, new legislation was needed.

A number of government officials and professional bodies representing doctors and scientists supported 'therapeutic cloning'; they hoped that the recommendation of the expert group could be included within the existing regulatory framework. This emphasis on continuity muted the ethical debate regarding cloning and stem cell technology. On 17 November 2000, the parliamentary undersecretary of state for health, Yvette Cooper, responded to concerns, voiced by

fellow members of Parliament in the adjournment debate, that the proposed measures to extend embryo research were not receiving the most thorough legislative review:

The issues were fully aired in the House during the passage of the Human Fertilisation and Embryology Act 1990, which provides for such regulations to be made. The responsibility of allowing such regulations to be made was fully debated at that time, so making regulations is fully in keeping with the conclusions that were reached in 1990....Those who oppose the 1990 Act will doubtless oppose the regulation too. Those who oppose any form of research with embryos will oppose the regulations. Those who oppose the creation and, inevitably, the destruction of embryos through IVF treatment will also oppose the regulations. (House of Commons, 2000a: 1175)

While stressing the continuity of the established regulatory regime, this approach to therapeutic cloning echoes the arguments made for basic research. The Chief Medical Officer's Expert Advisory Group on Therapeutic Cloning could justify embryonic stem cell research by saying, 'While the long-term promise of stem cells derived from adult tissue may equal or surpass that of embryonic stem cells, it was probable that scientific advances from embryonic stem cell research would be necessary to understand how to make greater use of stem cells derived from adult tissues' (House of Commons Debate, 23 October 2000, quoted in Sleator 2000: 28).

Consequently, a regulation expanding the permissible purposes of stem cell research to include in the bill the phrase 'increasing knowledge about the development of embryos, or about serious disease, and enabling such knowledge to be applied' was passed on 22 December 2000, just three months after the European Parliament had passed a resolution calling for a ban on all forms of human cloning throughout Europe. During this period, the voices of lay individuals entered the debate over the safety and morality of using blastocysts in research. Nevertheless, the government concluded that 'many saw benefit in new techniques which might be developed to treat serious medical conditions' (Sleator, 2000: 9)—the techniques would not be outlawed any time soon.

The routine emphasis on the value of basic research and the pursuit of knowledge reflects the British experience, where science has long been viewed as the quintessential path to truth, but it also resonates with the collective memory of capital and empire (Franklin 2007) that is bluntly reduced to a nationalistic rhetoric. To give but one example, in the Daily Telegraph of 1 December 2004, a headline read: 'Don't Let Others Steal Our Glory,' with the lead 'Britain leads the way in stem cell research.' The ritual of presenting expert advice by the government on the value of basic research suggests to the citizens that a country with capable experts has the right and the ability to make moral judgments and assert scientific leadership. Thus, when the European Parliament passed

a resolution urging the British government to withdraw plans to allow human embryos to be cloned for medical research, saying the creation of human embryos for research ‘irreversibly crosses a boundary in research norms’ (Nippert, 2002: 58), Yvette Cooper could bluntly respond, ‘Resolutions of the European Parliament have no legal status. We are aware that the European Union has no competence to legislate specifically on embryo research and that strong and deeply divided views are held on this issue in Europe’ (House of Commons, 2000b).

This discourse of continuity based on expert judgment, however, seemed less convincing to those who saw how quickly the field was advancing. In April 2002, the House of Commons Science and Technology Committee concluded that it was necessary to ‘reconnect the Act with modern science’ (House of Commons, 2002: 13). The UK Department of Health ultimately agreed, announcing on 21 January 2004 a review of the Human Fertilisation and Embryology Act. The eventual report, ‘Human Reproductive Technologies and the Law,’ issued on March 2005, laid out the government policy regarding the controversial areas of embryo research, including interspecies transplantation (UK Department of Health, 2005).

The committee noted its support of the Warnock Commission’s approach to the status of the embryo, by then more than twenty years old; this provided the government grounds for not revisiting fundamental aspects of the existing law (UK Department of Health, 2005: 5–8). ‘Human Reproductive Technologies and the Law’ provided a principled rationale for a broad range of new areas of research. As for human reproductive cloning, already banned in 2001, the report states: ‘If there is to be a total prohibition of any form of reproductive cloning, it is important that it is supported by principled arguments why such a technique should be banned even if it were shown to be safe, effective and reliable. Without such arguments, an indefinite absolute ban could not be considered rational’. In other words, mere popular concern is not sufficient reason to rule out an area of research, and ‘alleged harms to society or to patients need to be demonstrated before forward progress is unduly impeded’ (6). As to the emerging issue of chimeras and hybrids, the committee adopted the same line of argument, saying:

The ethical status of hybrids and chimeras is complex. While there is revulsion in some quarters that such creations appear to blur the distinction between animals and humans, it could be argued that they are less human than, and therefore pose fewer ethical problems for research than fully human embryos. We recognise concerns that hybrids and chimeras could be used for reproductive purposes and recommend that new legislation a) defines the nature of these creations, b) makes their creation legal for research purposes if they are destroyed in line with the current 14-day rule for human embryo cultures, and c) prohibits their implantation in a woman.

The call for the approval of research involving hybrids and chimeras became more intense after stem cell scientists from Newcastle University and King's College London applied for licenses covering cytoplasmic hybrid transplants using cow eggs on 7 November 2006. According to Dr. Stephen Minger (interview, 4 November 2008), the decision to replace scarce human eggs was directly influenced by the news that Woosuk Hwang of South Korea had failed to derive a stem cell line after going through two thousand human eggs. Throughout 2006, the UK Department of Health was concerned about how the public would react to its discussion of embryos combining human and animal material. The review of the Human Fertilisation and Embryology Act, completed in December 2006, showed the department's ambivalent position: 'The Government will propose that the creation of hybrid and chimera embryos in vitro, should not be allowed. However, the Government also proposes that the law will contain a power enabling regulations to set out circumstances in which the creation of hybrid and chimera embryos in vitro may in future be allowed under license, for research purposes only' (UK Department of Health, 2006: 25). The Science and Technology Committee was critical of the government's position. Phil Willis, the chairman of the committee, pointed out:

The thing that was the most disturbing was the attitude of the Chief Medical Officer of [the Department of] Health. . . . We found it totally unacceptable for a leading advisor to the UK Department of Health to actually come along to our committee, and say they oppose cytoplasmic hybrid embryo research. When asked why, he/she said it was because of the 'yuk factor.' I think if there is anything that galvanized our Committee more into action, it was the fact that the Chief Medical Officer of Health took such an unscientific point of view of what was a very important potential development. (Willis 2009)

While pressing the government hard to develop a permissive mechanism within existing regulatory practice, the committee also belittled opposition that appealed to 'human dignity' by framing it as unscientific and therefore unprovable:

There is also an argument that research of this nature compromises human dignity, and it is this argument which has formed the basis for much of the opposition evidence we have received in this inquiry....However, what is meant by the phrase 'human dignity' is vague. Professor Raanon Gillon told us that 'the concept of human dignity is a very complex one and people have different accounts of what they mean by it.' The Scottish Council on Human Bioethics (SCHB) told us that 'in this regard, it should be remembered that the

concept of human dignity is not a scientific one. No individual will ever be able to prove whether or not a person possesses human dignity. (House of Commons 2007: 83–84)

Final victory for Parliament, the Science and Technology Committee, and interested scientists came with the passage of the revised Human Fertilisation and Embryology Act on 13 November 2008. As had happened when the 1990 Human Fertilisation and Embryology Act was extended in 2001, the expansion of the regulatory boundary to permit the creation of human-animal hybrid embryos was officially justified as protecting basic science: ‘Research, by its very nature, is aimed at enhancing knowledge. Whilst we recognise scientific debate about the potential usefulness of cytoplasmic hybrid embryos in research, we do not believe that the existence of differing views of whether a methodology is workable before it has been sufficiently tested is reason enough to prohibit such research from taking place’ (House of Commons, 2007: 32).

South Korea: Mobilizing for development

Meanwhile, the cloning of Dolly stirred policy debates in South Korea. From 1997 to 1999, three bills were submitted to the legislature that would have banned human reproductive cloning and established a government department that would function as a medical ethics committee. They were all rejected on the grounds that such comprehensive regulation was premature: the international cloning debate had yet to cool down, and unnecessary laws might impede the development of biotechnology.

The first bill, proposed by Youngdal Zhang, a member of South Korea’s National Assembly, set the tone for what followed. Zhang knew little about science, but he was determined to ban human cloning. When he submitted the bill on 2 July 1997, he mentioned Germany’s Embryo Protection Act, which as its name suggests restricts the use of human embryos. Zhang proposed that seven specific practices be banned: carrying out experiments in human cloning, fusing blastocysts of humans and animals, implanting a human embryo into an animal or vice versa, creating an embryo by extracting sperm or eggs from dead bodies, changing the condition of human eggs or sperm through genetic techniques, manipulating genes whose new attributes might be passed to the next generation, and anything designated by presidential decree.

At the time, South Korea’s only legislation relevant to stem cells and cloning was a biotechnology ‘promotion act’; relevant issues were dealt with by a National Assembly commission devoted to technology and by the Office of Science and Technology. Under the circumstances, the bill was submitted to the Committee on Information Technology as a proposed revision of the

existing Life Science Promotion Act. The committee subsequently decided to table the bill, explaining, 'There is no pressing need to address this issue' (Parliament, 16 July 1997, quoted in Kim, 2005). Naturally, the stem cell scientists who advised the committee had strongly opposed the bill, deeming it overly restrictive. The language of the proposed bill was a weakness: scientific terms were used inaccurately, and the argument of the bill was not entirely coherent. These problems would have made it vulnerable to backlash. But while Zhang's proposal did not find favor, it initiated an official debate on cloning.

In contrast to the United Kingdom, in South Korea scientists muttered about official attempts to regulate human cloning without ever doing any conspicuous lobbying, whereas government officials were inclined to wait for international trends to dictate regulations. Korean officials were neither cheerleaders nor discreet regulators of the emerging science before Woosuk Hwang's alleged success. Throughout the deliberative stage, specific regulations were directly adopted from foreign statutes, but, contrary to the approach of the United Kingdom, scientific terms such as embryo, blastocyst, and human cloning were never defined. It took a while for Korean scientists to intervene, contacting elected officials to explain that the cloning of a human individual and the cloning of an embryo for therapeutic purposes were quite different procedures and should be conceptually separated, as the British had done when distinguishing between reproductive and therapeutic cloning (D. Kim, 2009).

In 2000, the Ministry of Health called on the Institute for Health and Social Affairs to draft a comprehensive bill addressing the use of stem cells in research. After conducting a survey of scientists and laypersons, the institute opted for stricter regulation; it also indicated that the Ministry of Health should lead the legislative process. On 6 December, during a public hearing on cloning and the new biomedical technologies, stem cell scientists clashed with civic groups. Soon the newspapers had taken up the debate, and scientists claimed the new bill would hamper the development of South Korean biotechnology. The Ministry of Science and Technology strongly opposed the proposed bill, not least because of a concern that its regulatory powers would be seized by the Ministry of Health (H. Kim, 2005). Stung, the Ministry of Health retreated, stating, 'The bill is nothing but a consultative report prepared by a mere research institute' (N. Kim, 2000).

Because South Korea's National Assembly was stubbornly opposed to taking the lead on any kind of stem cell legislation, and the Ministry of Health had withdrawn from the discussion, the Ministry of Science and Technology remained, for some time, the sole actor willing to draft a bill. Essentially pro-science, the ministry was under considerable pressure to conform to international ethical standards. To shore up its position vis-à-vis civic groups and the other ministries, it established a Bioethics Advisory Committee; the twenty members included humanities scholars, representatives of nongovernmental organizations, a Catholic priest, biotechnology professors, and

medical doctors. The ministry asked this group to come up with a bill. After holding forty discussions over nine months, the Bioethics Advisory Committee settled on the basic elements of a bioethics bill draft in May 2001. So successful had the Ministry of Science and Technology been in its efforts to create an autonomous committee that this first outline went very much against the ministry's own preferences. Eun-Jeong Park, a professor of law at Seoul National University who served as the committee's 'chief of bioethics,' said in an interview (29 September 2009) that 'we were committed to making a proper law that could encompass a broad range of bioethical standards, providing strict regulations to protect the dignity of all living creatures. After careful study, we relied mainly on the relevant laws passed in the United States, Japan, and Germany. We also sent a member to the United Kingdom to study HFEA regulations for a few months, but we concluded that the United Kingdom's regulatory framework was too permissive.'

The suggestions made by the Bioethics Advisory Committee included the explicit prohibition of any attempts at cloning embryos; stem cells could, however, be removed from frozen embryos created as part of IVF treatment. The committee stipulated a respect for 'all living creatures' in its foreword (Bioethics Advisory Committee, 2001) and entirely prohibited the creation or cloning of embryos for stem cell research; these were met with fierce opposition from the scientific community and the biomedical industry. Representatives of the Korean Society for Reproductive Medicine and the Korean Society for Biotechnology and Bioengineering denounced the bill, calling it 'unprecedented' and declaring that advanced countries offered no equivalent situation, in which science was subordinated to extremely rigid ethical concerns. In a public hearing, the National Assembly sided with these interest groups, asking the Ministry of Science and Technology, 'How can it be that a ministry that should promote biotechnology drafted a moralizing bill that will hamper the development of the industry?' Just like the Ministry of Health, officials in the Ministry of Science and Technology repeatedly emphasized that their advisory committee did not represent the ministry's official position. One official said, 'The ministry has not established its position regarding religious or ethical aspects of this research,' and 'we acknowledge that [the proposed legislation] is irrelevant and will need to spend a great deal of time reviewing the legislative issues.'

The two ministries struggled to take the legislative initiative, exchanging denunciations of each other's proposals (H. Kim, 2005). In the meantime, on 24 July 2002 the American company Clonaid announced that a pregnant woman, having been implanted with a cloned embryo, would soon give birth to a baby in South Korea, inflaming a public scandal. A ministerial meeting was hurriedly convened the next day, and the Office for Government Policy Coordination intervened, decreeing that the Ministry of Health should promptly begin work on a bill with cooperation from the Ministry of Science and Technology. In September of the same year, the Ministry of Health

proposed the Bioethics and Biosafety Act. By a vote of the National Assembly, it became law the next year, on 29 December 2003.

The act called for the establishment of a National Bioethics Committee under the Ministry of Health. It also proposed that four specific categories of experiments should be banned, reproducing the proposal Youngdal Zhang had made in 1997. There was a reasonable suspicion that the law was designed to favor a few researchers, and the inclusion of a special clause that benefited only Woosuk Hwang's research team (it had already undertaken the soon-to-be-forbidden research utilizing somatic cell nuclear transfer) was damning. Eun-Jeong Park, who served on the National Bioethics Committee, recalled the atmosphere of the time:

After all, we [the National Bioethics Committee] were only an 'advisory' body, and it was up to the officials in the ministry to make the final decision. Also, after Hwang suddenly announced groundbreaking scientific achievements—deriving stem cell lines from cloned embryos—it was hard to stand up to the public feeling that we should not affect his research' (interview, 29 September 2009).

The outcome was a hasty compromise between the international pressure to link arms to resist entities like Clonaid and the domestic pressure to protect Hwang's alleged breakthrough. Civic groups that had opposed a permissive bill could not gain leverage—things were happening too quickly (Kang, Kim and Han, 2006).

Strategy and frame

Self-perception

The differences we have seen in the legislative trajectories, forms of argumentation, and public perceptions in these two case studies reflect government strategies shaped by national self-perception. And the efforts made by the governments to maximise scientific and industrial resources to promote stem cell science are framed by political culture. Some points of comparison can be made:

- The legislatures of both countries exercised extensive power to advance or deter the legislative process: the UK Parliament tried to elaborate and extend the existing regulatory framework, whereas Seoul's National Assembly tried to deter the process.

- The rationalization of scientific and ethical concepts and the use of principled arguments constitute the core rules of the game in the United Kingdom, whereas South Korea's legislative process is marked by the focusing of arguments into an ultimate intention and the use of compromise to cope with circumstantial events.
- British legislators set out to provide a legal space for developing the potential of basic research on human embryonic stem cells. In contrast, South Korean legislation is more directly oriented toward encouraging the translation of stem cell research into revenue.

Despite complex variables and interactions, policy makers have given each country's stem cell policy a characteristic direction. The extracted governmental documents reporting strengths, weaknesses, opportunities, and threats (SWOT) analyses of the United Kingdom and South Korea (Table 3.1) help us understand the factors affecting legislative strategy. In the United Kingdom, the government could have taken advantage of world-class academic research, a vibrant climate of spontaneous innovation, and generous funding from nongovernmental bodies (these are among the country's great strengths) to entrench its position as a supportive and consistent regulator. But the government opted just to provide a favorable legal background rather than directly functioning as an investor. Intent on serving as a world leader (here is one of the country's opportunities) in countless areas, Parliament set out stem cell regulations it expected the world to take up. Designing an elaborate regulatory framework means continually focusing on the clarification of scientific terms, concepts, and reasoning. These strengths and opportunities, however, are diluted by the limits in translation of research into enterprise (one of the country's weaknesses) and an unclear strategy in intellectual property rights (a threat). South Korea's great strength resides in the skills of a quasi-industrial workforce based in clinics and laboratories. The country has gained an advantage in cloning techniques, an emerging technology, which is an opportunity that justifies significant public investment. South Korea is very much a developing state whose technological innovations have been severely compromised because of the lack of a basic scientific base (weakness). At the same time, a neighbor like China exploits the loose regulation of clinical trials to push quickly ahead with research with potential technological payoffs (threat).

Table 3.1

SWOT (strengths, weaknesses, opportunities, and threats) analysis of stem cell research in the two governments

A. UK

Strengths	Weaknesses
<ul style="list-style-type: none"> • Supportive and consistent government position • Favorable ethical environment and public support • World-class academic researchers in biology • Strong climate of innovation in the UK 	<ul style="list-style-type: none"> • Unknown business model and return on investment • Gaps in the UK funding for translational Research • Lack of central co-ordinated strategy leading to ‘cottage industry’ approach
Opportunities	Threats
<ul style="list-style-type: none"> • World leadership in embryonic stem cell therapies • Public investment matched by private funding • Drive international agenda • Develop international alliances 	<ul style="list-style-type: none"> • Lack of infrastructure impedes clinical translation • Intellectual property captured in the US and Far East • EU moves to limit stem cell research • UK biotechnology sector weakens

Source: Excerpt from *UK Stem Cell Initiative* (2005, p. 41), Governmental report

B. South Korea

Strengths	Weaknesses
<ul style="list-style-type: none"> • Willingness of government to lead investment • Capable medical workforce • High medical skills in IVF and related clinical trials • World-class research in cloning technology 	<ul style="list-style-type: none"> • Very weak research base in embryology and biology • Lack of infrastructure for clinical trial • Resource concentration on narrow area of research • Lack of international collaboration
Opportunities	Threats
<ul style="list-style-type: none"> • Emerging technology on the horizon • Possibility of creative research • Active interest and investment from people • International expectations on Korea’s research 	<ul style="list-style-type: none"> • Accelerated international competition spurred by permissive regulations • Protection of intellectual property rights • Chase of competing countries including China

Source: *10 Promotive Strategies for Stem Cell Research* [in Korean] (2005, p. 13), Government report

Because of a lack of private investment⁸, the state has had to function as the major investor in human embryonic stem cell research even as it acts as the permissive regulator. This obvious

⁸ In South Korea, the governmental investment on biotechnology amounts approximately \$600 million whereas private investment marks lower than \$400 million in 2005.

conflict of interest goes undiscussed because of weak civil society that might question the deliberative process. There is little incentive to develop indigenous arguments regarding regulation. A lack of international partners and the sceptical attitudes of domestic scientists against the debate on ethical principle contributed to the piecemeal borrowing of regulatory schemes from foreign countries instead of working through protracted deliberations to develop a framework specific to South Korea's situation.

Strategy

While both states wanted to foster human embryonic stem cell research, their approaches and methods are strikingly different. The United Kingdom has consistently rationalized the research object through novel conceptualizations, permitting research on blastocysts rather than embryos, therapeutic cloning rather than reproductive cloning, and the creation of human admixed embryos rather than interspecies embryos (House of Commons, 2007). Conversely, terms such as human dignity and yuck factor, which articulate the sentiments of countless laypersons, were not likely to withstand the withering comments of the scientific community. This semantic game, which privileged scientific speech (Bourdieu, 2004), was possible because of the historical authority of British scientific experts (Jasanoff, 2005), as well as the consistent regulatory frame of embryo research. The existing framework of debate fortified its stance toward legitimate policy, and efficient procedures contributed to the consolidation of knowledge/power (Foucault, 1980) for the directed paths of stem cell research. However, considerations of power and sustainability have been largely confined to the development of basic science, especially compared to South Korea. Whereas the United Kingdom limited its role as a regulatory state, South Korea played a huge role as an entrepreneur investing directly in biomedical enterprises (Table 3.2).

Throughout the South Korean legislative processes that I have sketched, technically nuanced concepts were given significantly less weight because of the paucity of authoritative actors who could claim expertise in this area. Instead, regulations were understood as having fundamental implications for human dignity and the pace of scientific development. While some key actors insisted throughout the legislative process that human dignity had to be preserved, many more rallied to the flag of scientific development, linking it to potential economic development. The government wanted a law that would respond to international pressure for ethical governance while practically focusing on the mobilisation of resources for a promising area of scientific research, hence the government's emphasis on unleashing scientists to lead South Korea to global dominance in an exciting new field.

Table 3.2

The comparison of each government's regulative strategy

Strategy element	United Kingdom	South Korea
Policy objective	Permitting research	Permitting research
Regulatory approach	Rationalization of concepts	Political compromise
Legitimizing method	Scientific authority	Mobilizing sentiment
	Continuity of regulation	Emphasis on urgency
Expressed hope	Progress in basic research	Progress in applied technology
	Progress in medical science	Progress in medical science
Major considerations	Legitimizing policy	Policy guided by avoidance of blame
	Efficient policy procedure	Effectiveness of policy objectives
Implicit considerations	Solidifying knowledge/power	Mobilization of resources
	Sustainable science research	Catching up with advanced competitors
Promotional strategy	Enable and monitor	Select and focus

Frame

In the United Kingdom, the state's strategy, mainly driven by Parliament and other governmental actors, relied on a frame of discourse committed to everyday public speech. Even though the United Kingdom is considered a country that prioritizes 'process' over 'product' (Jasanoff, 2005), at the core of that process is the carefully orchestrated recognition of the legitimacy of governance by authoritative experts. This frame only partly reflects the political push to address the crisis of confidence witnessed during the bovine spongiform encephalopathy crisis and genetically modified food crisis of the 1990s (Parliamentary Office of Science and Technology, 2001). It is more profoundly an attempt by the state to reaffirm its historical and symbolic world leadership by crafting an international standard and setting the agenda in stem cell research. However, this approach overlooks the economic advantages of more concrete marketization. More important, notwithstanding the good formal process of public deliberation and participation, public sentiment tends to be discounted if it is not regarded as fully scientific and articulated with a sense of erudition.

In South Korea, the reduction of arguments into a polarized debate pitting economic development versus fundamental ethical considerations is overshadowed by the state's primary concern with development. From this perspective, the nation is a rapidly growing economy that should compete on an equal footing with China and Japan. The primary task of the state is to make strategic investments in promising research by providing scarce resources to those most likely to

foster industrial development. Long discussions of the value of scientific knowledge weighed against ethical considerations are generally viewed as luxuries: the country is poor in basic science and resources. Cannot regulations simply be adapted from more advanced countries? Consequently, there is little scope for incorporating ethical considerations into cost-benefit assessments and or evaluations of the legitimacy of scientific activities. The paradox of the predominant frame, however, is that it also generates an anti-frame, ethical sentiments that criticize the autocratic characteristics of the development frame. Unlike in the United Kingdom, in South Korea such adverse sentiments are not swept aside by a linguistic game of rationalist one-upmanship (which may not be rational at all). A conflict has long existed between the pro-development forces and ethical fundamentalists.

Consequences

In the two countries I examined, government strategy and the principal frame of the argument largely determined scientific development and regulation. They also influenced the form that debate took. From a strategic point of view, the governments of both the United Kingdom and South Korea endeavored to maximize national strength and opportunities for carrying out stem cell research; they were always aware of the potential threats to development posed by regulation. On the other hand, they did not aggressively address inherent weaknesses: research translation received little attention in the United Kingdom, and no policy makers in South Korea wanted to talk about improving basic science. Throughout the legislative process, political habits led actors to collectively imagine the positive side of national aspirations while overlooking vulnerabilities.

Scientific capacity

Permissive regulation has been a boon to stem cell research in the United Kingdom. Many researchers have traveled there from overseas precisely because of a coherent, and therefore expectedly sustainable, regulatory framework covering all forms of stem cell research in the public and private sector. Despite rapid institutionalization, no one yet knows whether stem cell research will yield significant practical achievements. For instance, when I interviewed Stephen Minger on 4 November 2008 (Fig. 3.1), he reckoned that nothing concrete had yet been achieved:

I think the scientists had a huge role to play that traditionally we wouldn't have. I think we changed the game in some respects. There is a new consensus between science and the

government which I think is going to continue. . . . But although we had the work with the government . . . we are not even funded to do the work yet. In some respects, that's been really disappointing: you've been spending two and a half years fighting for being able to work and your scientific colleagues say: 'Well, so what?' . . . We are not doing any cloning work here at all.



Fig.3.1 Stephen Minger (centre) visiting Woosuk Hwang's team at Seoul National University. On the table are vessels containing ova. [Source: Genomics Forum]

At the Retrospective on the Human Fertilisation and Embryology Act workshop, organised by the UK Economic and Social Research Council's Genomics Policy and Research Forum on 12 March 2009, a question was posed implying that all of the work Parliament had devoted to regulating stem cell embryology had been for naught. In response to the critical question, Phil Willis, the former chairman of the parliamentary committee, pointed out that the job of Parliament was to establish the principle of regulation but not to assess and intervene in scientific development itself. We cannot know whether this remark reflects the typical attitude of legislators, but the government's failure to deliver research funds on time, even before the onset of the global financial

crisis in 2008, certainly reflects the shortcomings of those who follow after legislators. The outcome of science legislation in the United Kingdom ultimately depends on the reputations of scientists and the capacity of private enterprise in the field, as government officials, at least for the moment, avoid making audacious appeals for investment in research.

The situation in South Korea turns out to be the opposite. After the disclosure of Hwang's misconduct—he illicitly collected ova and fabricated his experimental results (L. Kim, 2008; Kitzinger, 2008)—the government acknowledged legal loopholes and tried to effect a compromise by revising the Bioethics and Biosafety Act in 2008. The updated act banned interspecies nuclear transfer and restricted stem cell research utilizing somatic cell nuclear transfer. Only in April 2009 was the first application to carry out therapeutic cloning approved by the National Bioethics Committee.



Fig. 3.2 South Korean president Lee Myung-bak visiting stem cell laboratory at Seoul National University on 16 September 2011 after the resignation of the former chief researcher, Woosuk Hwang. [Source: Yonhap News]

Although some notable South Korean stem cell scientists fret that the country is losing the “stem cell war” (L. Kim, 2009)—and Hwang's disgrace certainly was a huge setback—the regulatory and material environments have not hindered progress. Although the revised Bioethics and Biosafety Act prohibits research utilizing hybridized animal eggs, it was not difficult for the chief researcher in the country's biggest clinical stem cell study—Dr. Hyung Min Chung of CHA Bio and Diostech, Inc.—to acquire more than one thousand human eggs for his clinic. Based on

high expectations for economic translation coupled with the increased use of stem cells by the cosmetics industry and the health service, the state remains an active patron (Fig. 3.2).

The currently on-going massive financial investments undoubtedly create a bubble of expectation propelled by actors that ‘have to play bold’ (Sunder Rajan, 2006; van Lente and Rip, 1998), paying little attention to the pursuit of scientific knowledge or building social consensus on ethical and safety issues. The whole process of research, whether academic or corporate, is also extremely dependent on material resources and the hard work of junior researchers (L. Kim, 2008) and is organised, in classic neoliberal fashion, to maximize competition (L. Kim, 2011a). The mobilisation of tremendous resources to support stem cell research has created a small class of informed citizens who are highly knowledgeable about stem cell research. These public actors have found their voice and now work tirelessly to ensure the sustainable development of stem cell embryology; they may well prove a useful counterbalance to the heretofore unchecked power of the state-industry complex.

Scientific discourse

The stability that has thus far marked the institution and the discourse of stem cell embryology could yield quickly to such events as the strategic mobilisation of the scientific community or a sudden scientific breakthrough or dramatic failure. In the United Kingdom, this was demonstrated by the policy shift regarding hybrid and chimera embryos after an effective campaign by scientists and legislators. There the public sphere functioned at its democratic optimum. On the other hand, despite extensive consultations sought by the government and a scientific community friendlier to public engagement (Burchell, Franklin, and Holden, 2009), I argue that the ‘communicative rationality’ (Habermas, 1991; Castells, 2009) of the British public that is essential for a sustainable knowledge economy has been confined to a small group. Members of that group astutely articulate their opinions, relying on the expert knowledge and specialized terminology needed to excel at this language game, a game that effectively disqualifies conventional public sentiments expressed in everyday language.

For instance, when disagreements flared up during the public consultations and inquiries held in 2005 and 2007, experts routinely labeled such social concerns ethical ‘fundamentalism’ opposed to any kind of embryo research. The pronounced democracy of the invited fostered by authoritative bodies privileges those who employ a distinctively academic discourse to articulate their position in the public arena, while discounting the less richly articulate statements prompted by social concerns. As a “biotechnologising democracy” is born (Levidow, 2007), the gap widens between experts rich in cultural capital (Bourdieu 1984) and laypersons with considerably less.

During the ritual of procedural deliberation, expert groups are constantly laying claim to ‘embedding our science in society’ (Biotechnology and Biological Sciences Research Council 2006). But when we look at what is happening during these deliberations that ostensibly seek to incorporate a broader slice of society and enhance corporate responsibility, the relationship between science and society seems a bit less intimate.

South Korea is much more exposed to risk and repetitive failure than is the United Kingdom. The discourses that segregate economic expectations from risk assessment and ethical concerns, as well as the underlying frame of ‘development versus social reflection,’ reveal the limits of South Korea’s societal reflexivity (Beck, Giddens and Lash, 1994) when matters related to stem cell research are being legislated and the ‘organised irresponsibility’ of governance becomes apparent (Beck 2009). Some notably passionate social movements instigated by the alienated public sprang from irresponsible governance; one can speak of democracy by the uninvited. Still, only a minority of intellectuals explicitly voice criticism of the reductionist frame of development, and South Korea’s extremely polarized political environment regarding the framing of stem cell research (L. Kim, 2011b) makes it difficult to seek a mutually satisfactory middle ground for rationality.

Discussion: Is one state a better locus for deliberation?

A comparison of the trajectories and consequences of stem cell research in the United Kingdom and South Korea reveals that ‘science is always science for a particular purpose, in a particular context’ (Prainsack, 2011: 269). I have noted differences in the most basic regulations regarding the use of human embryos, perceptions of the state highlighting its identity and capacity, the relations among governmental actors, the status and role of scientists and expert advisers, and the cultural narratives used to persuade the public of the importance of stem cell technology. Throughout the comparison, I have made two key points. First, the status and authority of experts have played pivotal roles, yielding different regulatory frameworks and policy outcomes in the two countries. A long and splendid history of scientific achievement in the United Kingdom undoubtedly fortified the position of scientists and their organizations. In South Korea, the weaker position of expert groups, scientists and advisers alike, vis-à-vis the government and the much lower degree of competence among members in the National Assembly to comprehend and discuss complex scientific knowledge encouraged a sharp dichotomy between development and bioethics. In such an environment, it proved extremely difficult to incorporate ethical concerns into a more deliberative risk-benefit assessment. Second, the culturally different ways that narratives are built into public debates convey different policy goals and orientations: whereas the ultimate intention, if

a legislation is beneficial to economic development, of encouraging research trumped logical reasoning during the public debates that took place in South Korea, in the United Kingdom scientific articulation was consistently the top priority. Whereas a “lip service” was always paid by British authorities to the importance of broad participation in policy making, this may not have been sufficient to offset the alienation experienced by those members of the public who found their concerns failing to impress scientists focused on a rather different discourse.

Therefore, it would be wrong to conclude this chapter, and also the following ones, by announcing a “victory” for the United Kingdom. Solid therapeutic achievements from stem cell research have yet to materialize. Although the United Kingdom’s legitimizing process has demonstrated considerable skill of governance in fostering scientific development, the achievement remains largely symbolic. While the emerging biomedical technology depends largely on significant investment and coordinated strategy, regulations have focused, with limited success, on translation to the industrial field (Franklin and Kaftantzi, 2008), and some of the most renowned researchers have already moved their bases from Britain.

In the long run, the new life science will require not only technological and economic capacity but also wider social consensus and legitimacy. Gazing through the window of human embryonic stem cell research, the prospect for national development is still opaque in both countries not only because of the unpredictable trajectory of the science but also because of the undervalued role of laypersons, who have yet to be invited into the public sphere of scientific deliberation. Demand for the ability to deal flexibly with unpredictable contingencies and risks of socio-technological translation will rise. More effective assessment of social effects and enhanced methods of communication with the public remain tasks for the future. Developing a pragmatic approach to dealing with this gap in governance will be a crucial milestone toward realizing both the scientific and the societal potentials of stem cell research. The question then is if the representative parties of elite media and lay perception actually operated in this direction. In the following chapters, I diagnose the state of communicative capability of each communicative arena (Bauer, 2002) from comparative gaze, and try to verify the expressed narratives with some computerized analyses of textual data.

4. Prevalent Framings of Opinion-leading Newspapers

Context for text analysis

In the previous chapter, I have sketched the landscape of governance of stem cell research in South Korea and the UK. As has been discussed, the remit of governance does not confine itself in the formal legislation and policy implementation. More invisible, yet equally powerful semantic apparatus manipulated by elites more often than not delineate what is the appropriate way of articulation, and therefore what to think and express. This characteristic is observable, but somewhat difficult to bring into the domain of concrete analysis.

The analysis of news articles used to be an adequate method to study a traditional source of data in addition to ethnographic studies including interviews, participant observation and other forms of first-hand experience. However, canvassing and analyzing large-sized data is extremely meticulous and labour-intensive as it involves copious reading samples. Hence, the potential exists to use computer-assisted text mining algorithm coupled with natural language processing technologies to process and deal with large sized texts that can hardly be analysed individually in a timely, unbiased and systematic manner (Tambayong and Carley, 2012; Corman *et al.*, 2002). Some data scientists (Tambayong and Carley, 2012; Diesner, Carley and Tambayong, 2012) envision that the advancement of text-analytical technologies will lead to create “Rapid Ethnography Retrieval” (RER) technologies that enable social researchers to rapidly extract from vast quantities of text detailed cultural information in both an efficient and accurate manner. As the proponents of RER are ready to note:

Although highly-automated, RER is not a magical black box – a holy grail – that allows a layperson to analyse the subject of the text set without any ethnography expertise of SMEs. The key point of this method is the increased manageability and standardization of analysis processes in dealing with abundant numbers of texts: it will allow for not only increased efficiency and accuracy but also a better understanding of the analysis as a complement to the traditional ethnography method (Tambayong and Carley, 2012: 2).

Related to the citation, it is important to note that some results can emerge beyond the presupposition of researcher through the systematized process of analysis; and this unexpectedness could become a useful tool to look into some crucial aspects of hidden discourses. Such a method will be aligned with the traditional discourse analysis, but based on reconstructed information that presents a different angle to interpretation. In this chapter, the aim of the following analysis is to

compare media framing of the stem cell debate in conservative and liberal newspapers in the UK (*The Daily Telegraph* and *The Guardian*) and South Korea (*Chosun Ilbo* and *Hankyoreh*) and derive research objects, most of all, prominent concepts and pattern of discourses (depicted in Figure 1.3), to link further studies and discussions. If the initial research, based on the governmental documents, converged on a few hypotheses on typical ways of thinking and expressing, mainly fostered by governmental actors and scientists, now I look into how this might have been taken up by some opinion-leading newspapers and eventually conveyed to the wider public with text analysis.

During the legislative path, the two countries have also competed and influenced each other in the hESC research field. In the UK, the first cloning of a sheep, *Dolly*, in 1997, by Sir Ian Wilmut, triggered scientific and social debates on its implication. In 2004, in South Korea, Dr. Woo-Suk Hwang claimed that he had derived a stem cell line for the first time from a cloned embryo, using the somatic cell nuclear transfer (SCNT) technique that Professor Wilmut developed. Hwang's "success" stirred debates across the world even before he was discredited for scientific misconduct that included unethical collection of ova and fabrication of experiments. Hwang's achievement confirmed the potential of hESC research, and the need for expanded governmental support. However, when it was seen as a success, it heralded a fearful future of "human cloning", and when seen as a failure, confirmed the uselessness of 'unethical' research. The repercussions of the Hwang scandal (see Chapter 6) did not stop with his disgrace. The disclosure of Hwang's technical failure compelled some prominent scientists in the UK to realize that they could no longer rely on utilizing human eggs for research. Hence the scandal became a milestone in the seeking of an alternative in the UK, including a "hybrid & chimera" and iPS approach.

It is important to look into how public representations of scientific developments formed the environment of support or criticism based on national and political context, especially how the significant opinion-leading newspapers mediate a public representation. The mass media has its own story to tell about science, exerting an influence on society while accommodating "news value" (Bauer and Gutteling, 2002: 125). Science coverage in the media not only exposes cultural trends that indicate the changing position of science, but also represents the changing characteristics of society in scientific movement. Each media outlet highlights certain concepts, discussions, events, persons, etc. differently from the others. These outlets also actively respond to the media's and nation's interest while accommodating the expressions of the public readership.

From a comparative angle, certain themes appear or disappear in each mass media. In this sense, the complex web of media narrative also reveals gaps, intended and unintended, of knowledge and ideas, which are produced while reporting scientific events. This simultaneous effect of concealing from and revealing to readers forms a core element of the operation of discourse and power. On the other hand, characteristics and strategies of mass media are affected by

national identities and political constraints. They function as cultural seedbeds of media discourse that confine the willingness and scope of media representation. Therefore, salience and frames of media discourses reflect specific national and political realities.

Cross-national studies on the public opinion of science in Europe and Northern America (Durant, Bauer and Gaskell, 1998; Gaskell and Bauer ed., 2001) have summarised the general features of framing of biotechnology. But they have not explicitly addressed political heterogeneities between liberal and conservative media in each country. In this chapter, I argue that the framing of scientific events reflected the political identity of media. Moreover, the difference in the power relations between conservative and liberal newspapers in the UK and South Korea has yielded diverging national perception of stem cell research.

Objective

In the comparative design, the three main variables addressed are:

1. Political context (liberal & conservative opinion-leading newspapers)
2. National context (UK & South Korea)
3. Crucial events: Three time spans emerging between the years 2000 and 2008

Although the political context in each country would be far more complicated than a simple dichotomy between liberalism and conservatism, I wanted to explore how typical aspects of political ideologies, liberalism and conservatism, could possibly manifest themselves in the life science context. And comparing how both converging and diverging points of political framings between the salient ideologies differ along each national context showed some interesting cultural and discursive characteristics in the UK and South Korea. Nevertheless, these characteristics are not fixed but significantly influenced by contingent events that are both scientific and political (the rationale of partitioning three time spans is explained in Data and Time-Span section). In relation to the three variables above, the study attempts to answer the questions:

- a. What are the similarities and differences between the conservative and liberal newspapers?
- b. Overall, what kind of frames and discourses emerge in driving the public opinion of science by the media?
- c. What kind of national characteristics are observed from the media framings of liberal and conservative newspapers, beyond the legislative trajectories discussed in the previous chapter?

Method

Salience and framing: from a network perspective

The term of “salience” in media studies refers to the coverage of news articles, which indicates the intensity of controversy and interest in scientific issues. Framing, on the other hand, refers to ‘the way a story is told by unfolding arguments, using metaphors and imagery that define a problem, arriving at causal or moral attributions, and prescribing particular remedies’ (Entman, 1993: 52). A frame is the intuitive structure linking metaphors and concepts that decides the relation between essence and meaning, event and fact. The linking activity of metaphors and concepts is the process of perceiving a political and social agenda (Lakoff and Johnson, 1980) that emerges out of the public imagination.

In conventional methodology, measuring salience typically means, in brief, counting the number of articles on relevant issues; a frame is measured through content analysis, the clustering of indices such as main topic, controversy, evaluation, etc. (Bauer and Petkova, 2005: 4). The semantic network analysis follows the existing method for salience but offers a more microscopic and relation-oriented approach for frame. Classical content analysis pre-categorizes a certain index and counts the frequency of those categories in news coverage. Thus the relational structure of a story in the media is segregated and quantified by pre-established categories. The results of analysis tell us little about the frame itself as an aggregated relation of concepts or metaphors. Conversely, relational content analysis based on semantic network focuses on the associated intentions and meanings underlying the selected cluster of concepts, and the discursive strategies behind the arguments.

Data and time-span

The data corpus comprises a systematic selection of newspaper articles published in the UK and South Korea between 1 January 2000 and 31 December 2008. For the binary comparison of political attitudes and for the study of their interactions with science reporting, newspapers were selected that represent ‘conservative’ and ‘liberal’ opinions in each country (*The Daily Telegraph* and *The Guardian* in the UK; *Chosun Ilbo* and *Hankyoreh* in South Korea, respectively). This binary comparison would not define what political conservatism and liberalism in general are. Rather, it attempts to explore what characteristic pattern of discourse of stem cell research is discovered across different national and ideological backgrounds. The newspaper articles were

downloaded from media search engines in the UK (LexisNexis (www.lexisnexis.com/uk)) and South Korea (KINDS (www.kinds.or.kr)). The keyword “stem & cell” (“줄기세포” for Korean search) were applied, and articles with irrelevant topics merely containing the words ‘stem’ and ‘cell’ were removed after a thorough reading. The selection resulted in the collection of 528 articles from *The Guardian*, 508 from *The Daily Telegraph* in UK, 1,065 from *Chosun Ilbo* and 917 from *Hankyoreh* in South Korea, from the year 2000 to 2008.

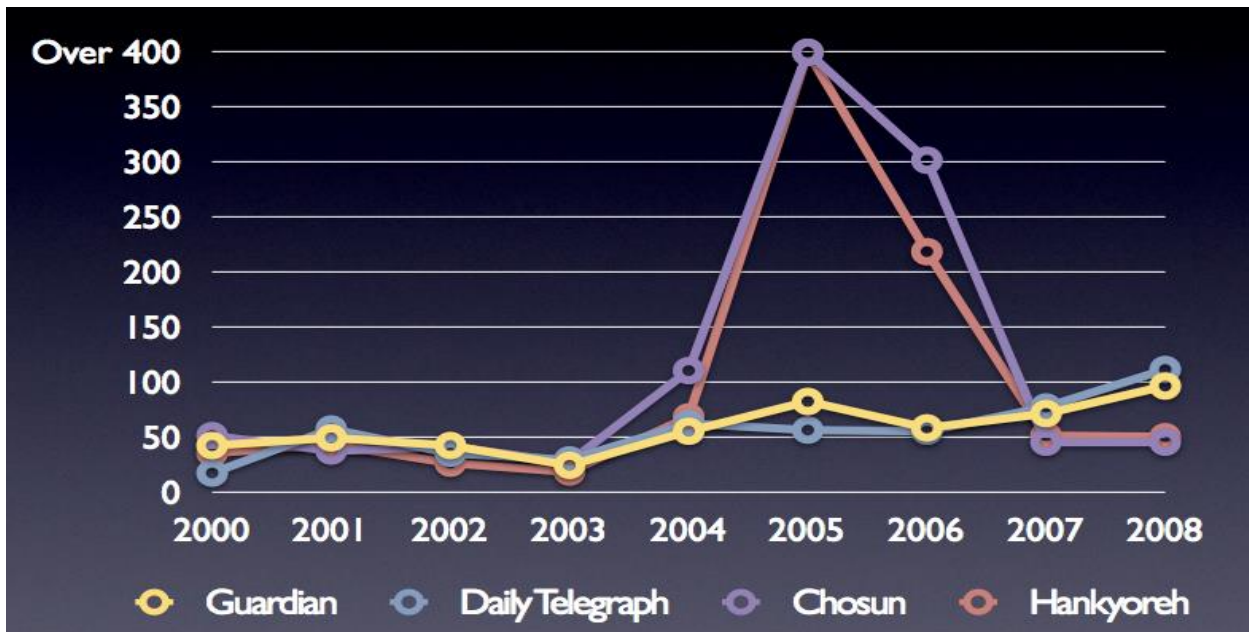


Fig. 4.1. Intensity of news coverage on stem cell

As Figure 4.1 shows, the trajectory of the news coverage on stem cell issues are marked by three major shifts of frequency, or salience, in news reports in both countries. It implies that the data can be segmented by three crucial periods, which respectively correspond to the period before and after major stem cell events, controversy and breakthroughs in the UK and Korea, during 2004-2005. The news coverage of the four newspapers in the UK and South Korea was stable until Dr. Hwang claimed to have realized the theoretical expectation of producing stem cell lines from cloned embryos in 2004. This groundbreaking news created enormous hype and heated debates on the future of stem cell technology, inducing sudden hike of news frequency in South Korea, until the results were finally disproven by the disclosures and investigations of the Hwang team’s stem cell experiment in 2006. Afterwards, along with the legislative debate and call for unhindered scientific progress, UK shows incremental number of stem cell news over a decade. In contrast, the news coverage in the South Korean media plateaued after a surge of reporting during the period of Hwang controversy.

Newspapers and readership

(a) The Daily Telegraph

The Daily Telegraph is a daily morning newspaper distributed throughout the United Kingdom and internationally. *The Telegraph* has the ninth largest daily UK newspaper circulation. *The Daily Telegraph* has been politically conservative in modern times. According to a MORI survey conducted in 2005⁹, 64% of *Telegraph* readers intended to support the Conservative Party in the coming elections. The personal links between the paper's editors and the leadership of the Conservative Party, along with the paper's influence over Conservative activists, has resulted in the paper commonly being referred to, especially in *Private Eye*, as the "Torygraph".

(b) The Guardian

The Guardian had a reputation as 'an organ of the middle class' in the UK. Editorial articles in *The Guardian* are generally to the left of the political spectrum. This is reflected in the paper's readership: a MORI poll taken between April and June 2000¹⁰ showed that 80% of *Guardian* readers were Labour Party voters; according to another MORI poll taken in 2005¹¹, 48% of *Guardian* readers were Labour voters and 34% Liberal Democrat voters. The newspaper's reputation as a platform for liberal and left-wing opinions has led to the use of the phrase "Guardian reader" as a label for people holding such opinions.

(c) Chosun Ilbo

Chosun Ilbo has represented conservatism in modern South Korea that has been generally criticized for the support to general Park Jung-Hee (1962~1979) and Chun Do-Hwan (1980~1987)'s military rule and characterized by strong pro-Americanism, Anti-communism, and recently neo-liberal economic policy. The *Chosun* is the most influential newspaper media in South Korea, and had a certified average daily circulation of 1,699,430 in 2002.¹² Although it is known that the conservative *status quo* prefers *Chosun Ilbo*, the general readership of the newspaper is not as clearly delineated by class division as in the United Kingdom. It can be said that its common readership is formed by a public that shares a nostalgic sentiment about the industrializing period and rapid economic development by military leaderships (from 1960s to 1980s). Relevant science

⁹ <http://www.ipsos-mori.com/researchpublications/researcharchive/poll.aspx?oItemId=580&view=wide>

¹⁰ [International Socialism](#) Spring 2003, ISBN 1-898876-97-5

¹¹ [Voting Intention by Newspaper Readership Quarter 1 2005](#), Ipsos MORI, 21 April 2005.

¹² Korean ABC report (2002) (<http://www.kabc.or.kr/>) [written in Korean]

news is usually framed in relation to national glory, the personal drama of scientists, and success of industrialism.

(d) *Hankyoreh*

Hankyoreh newspaper was founded in 1988, a year after the political democratization of South Korea. The newspaper's official motto is "progress" and "trust", based on the reflection that conventional newspapers did not carry out objective and critical reporting under the authoritarian regimes. Its size of circulation is small compared to major conservative newspapers including *Chosun*, ranking outside of the ten most read South Korean newspapers. But the newspaper has won first rank in media credibility several times from a survey conducted among professional journalists since 2009.¹³ Its general readership comprises a relatively young generation, progressive intellectuals and students. *Hankyoreh* stands for liberal and centre-left positions, and expresses sympathy to new progressive issues such as environmentalism and feminism. It often raises doubts about possible side effects of new science and technology to environment and society.

Data analysis

Merging the psychological tradition's focus on textual information and the sociological concern with the construction of meaning, most contemporary views of framing focus on variations in the semantic context of information (Tewksbury & Scheufele, 2009). In this regard, the main characteristics of the frame can be summarized in three aspects: First, frames involve selectivity, highlighting (only) a few aspects of a salient issue. Second, frames give meaning by following some central organizing idea. Third, frames perform argumentative functions: they define situations, establish causal chains, provide the evaluative standards against which propositions are evaluated, and chart the options for treatment and action lying ahead (Baden, 2010). Insofar as the frames are represented by selective links of concepts, those words and concepts reflect preferences in social and/or political life (Crossley and Roberts, 2004).

There have been vigorous challenges to developing a methodology to represent this kind of discursive model as a visible map, extracted from texts, and analyse and compare these "cognitive maps" that are networks of symbols composed of concepts and keywords (Carley and Palmquist, 1992). Semantic network analysis is a form of content analysis which extracts the network of relations between objects as expressed in a text. Coding texts as maps focuses the user on

¹³ <http://www.mediatoday.co.kr/news/articleView.html?idxno=82278> [written in Korean]

investigating meaning among texts by finding relationships among words and themes, and by identifying central words in specified relations. The union of all statements per documents forms a semantic map of keywords that is equivalent to a network (CASOS, 2007: 5-6).

Automap utilized for text analysis is an automatic and co-occurrence based network tool, which extracts and analyses links among words to model the author(s)'s 'mental map' as a network of links (CASOS, 2007). By operating Automap (and the visualizing tool ORA), text goes through the following stages:

1. Preprocessing stage:
 - a. Stemming of variable words
 - b. Deletion of syntactically functional words including articles, adverbs and verbs.
(Descriptive adjectives are also deleted, except for those forming a new substantive such as "therapeutic cloning" and "reproductive cloning" within the text.)
 - c. Making the list of synonyms and unified thesauri
 - d. Applying a threshold that erases words that occurred less than twice each year
2. Transformation of the remaining text into an adjacency matrix of keywords (.xml file)
3. Visualization and calculation of social network indices by ORA

The visualized semantic map has a coalition of words with hierarchically distributed linkages and locations of concepts. From the semantic network's perspective, the result represents a topological structure by hierarchical centrality measures that privileges certain signifiers and their relations to form both explicit and implicit knowledge and meanings, as reflected in a frame. In the context of semantic network analysis, it is important to identify central keywords and their relations with other words to explore the narrative structure and interpret social meanings. The betweenness centrality index (Freeman, 1979) has been frequently utilized in text analysis (Leydesdorff and Hellsten, 2008; Leydesdorff and Schank, 2005). In the performative communication, interaction between two nonadjacent nodes of concepts is likely to depend on another concept for reference that functions as a "catalysis" to join meta-languages of concepts (Barthes, 1967) or an "obligatory passage point" (Callon, 1986) that enables the translation of key concepts. This function is translated into a node with highest betweenness centrality (see Figure 1.2, p. 16) in the semantic network when the keyword lies on the paths between the trigger of information and referent, bridging different semantic clusters to make sense of whole meaning. In short, the media come to "rely on" the core keywords to deliver their news frame. Bonacich power centrality (Bonacich, 1987), on the other hand, measures the influence of each concept in relation to the neighboring concepts' degree (frequency of linkage) in addition to its own degree centrality. As it takes account

of the relations to adjacent referents and their collective influences, a node with high Bonacich power represents a “central organizing idea” (Gamson and Modigliani, 1987) of the media. Therefore, the trajectory of a concept in terms of Bonacich power represents the change of its influence in the entire network of news frame.¹⁴

Results: Framing of stem cell events

Period 1 (2000-2003): Early hopes and concerns

The emergent social implications of embryonic stem cell research attracted the attention of global media in 2000 when scientists and legislators devised and emphasized the term “therapeutic cloning”, used to combat the public concern that the new cloning and stem cell technology might lead to human “reproductive cloning” (see Jasanoff, 2005). Until 2003, the major news coverage in the two countries was similarly driven by public concerns and debates on reproductive cloning, hope for new medical application, and legislative issues to regulate the research.

In the main component of semantic network¹⁵, both *The Guardian* and *The Daily Telegraph* share many central concepts: 15 words in the top 20 list overlap whereas only 8 words do so in the Korean newspapers (Table 4.1). Public concerns with embryo research occupy a central location in the news frame, along with the fear of cloning humans with the emerging stem cell technology. In *The Daily Telegraph*, the network “reproductive cloning” and “therapeutic cloning” comprises a major cluster of social and governmental concerns (Fig. 4.2). This represents both the societal situation in which the image of stem cell is barely distinguishable from the popular imagination of human reproductive cloning, and the media’s initiation to make a conceptual differentiation. While *The Daily Telegraph* pronouncedly emphasizes objective “research” as a priority, *The Guardian* highlights diverse characteristics of the actor, “researcher” and “scientist”, that also evoke cautionary images with terms like “slippery slope”, “eugenic(s)”, “maverick”, and “cult”.

¹⁴ In comparison to this chapter, the utilized methods in Ch. 4 and 5 differ from the co-word analysis in that they used a sequential coding method that reflects the directionality of linkages between words. At the time I used Automap as the only effective tool, without satisfactory development of natural language processing technology and network data extraction techniques, automatically processed sequential relationship did not produce significant semantic result. The development of technique is explained in the *Methodology* section.

¹⁵ Smaller clusters and keywords that are isolated from the main (largest) network was not incorporated in the analysis. The same applies to Figure 3.3. All the network Figures are drawn by ORA.

a. The Daily Telegraph

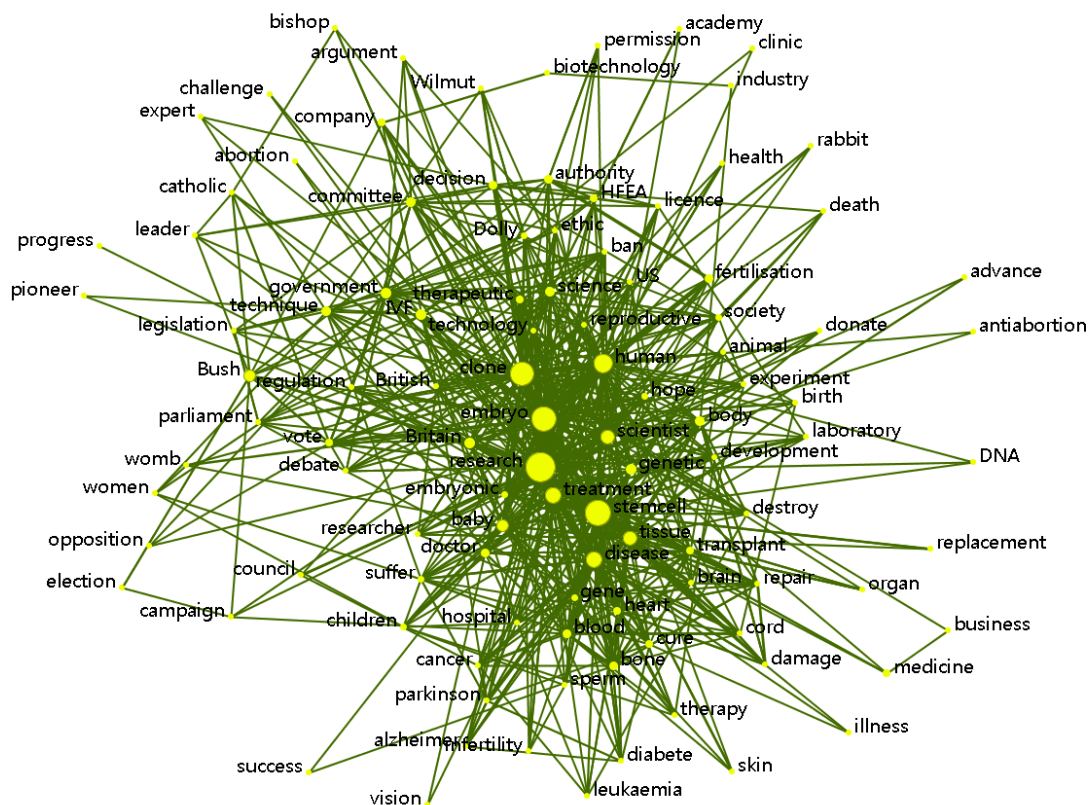
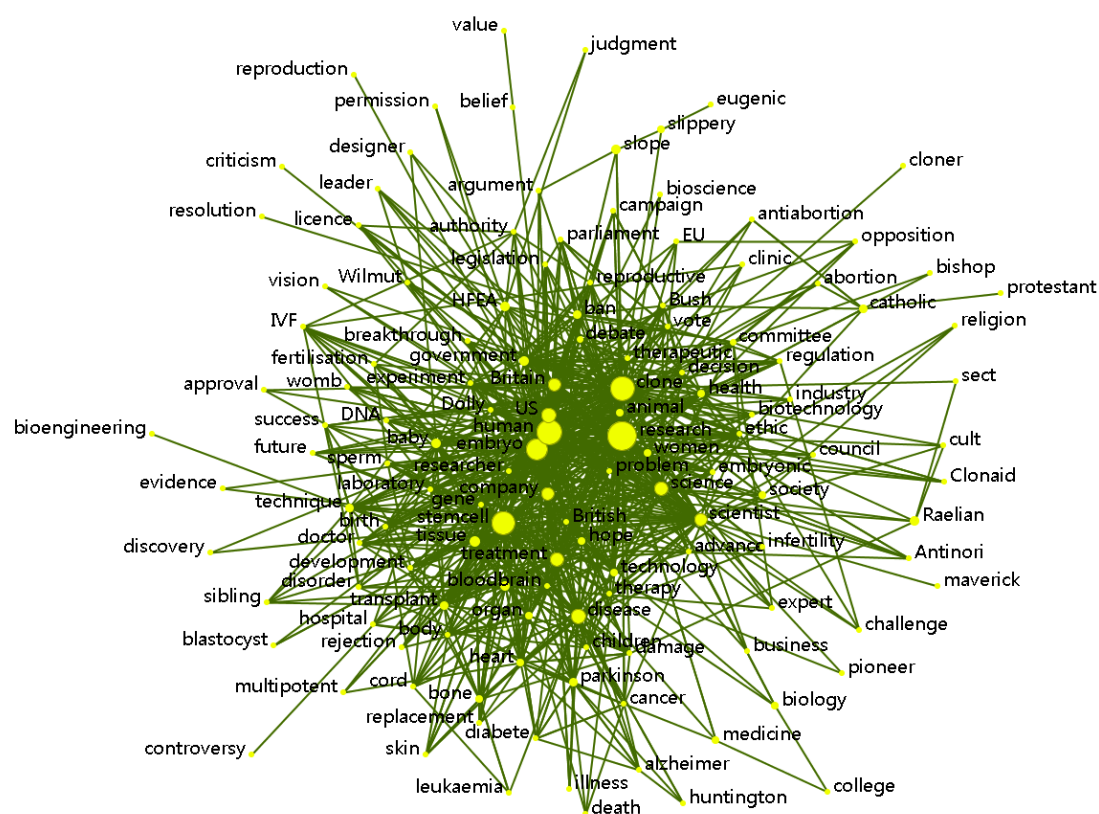
b. *The Guardian*

Fig. 4.2. Networks of *The Daily Telegraph* and *The Guardian* (2000-2003)

* Different size of nodes represent betweenness centrality

Table 4.1.
Betweenness centrality measures (2000-2003)

Rank	Guardian	Telegraph	Hankyoreh	Chosun
1	researcher	research	clone	Clone
2	stemcell	stemcell	biotechnology	US
3	cell	cell	ethic	Ban
4	human	embryo	legislation	stemcell
5	embryo	clone	research	Heart
6	clone	human	embryo	Dolly
7	scientist	scientist	life	PPL
8	US	disease	UK	Dignity
9	science	treatment	committee	bioethics
10	government	tissue	stemcell	Republican
11	treatment	baby	fetus	Clonaid
12	disease	government	SCNT	committee
13	hope	science	gene	Korea
14	Britain	scientist	human	president
15	genetic	Britain	bioethics	Ethic
16	tissue	Bush	safety	UK
17	baby	doctor	society	Embryo
18	company	genetic	animal	Hwang
19	technology	hope	religion	adult cell
20	transplant	body	Dolly	Gene

*Shade: Overlapping words within national boundary

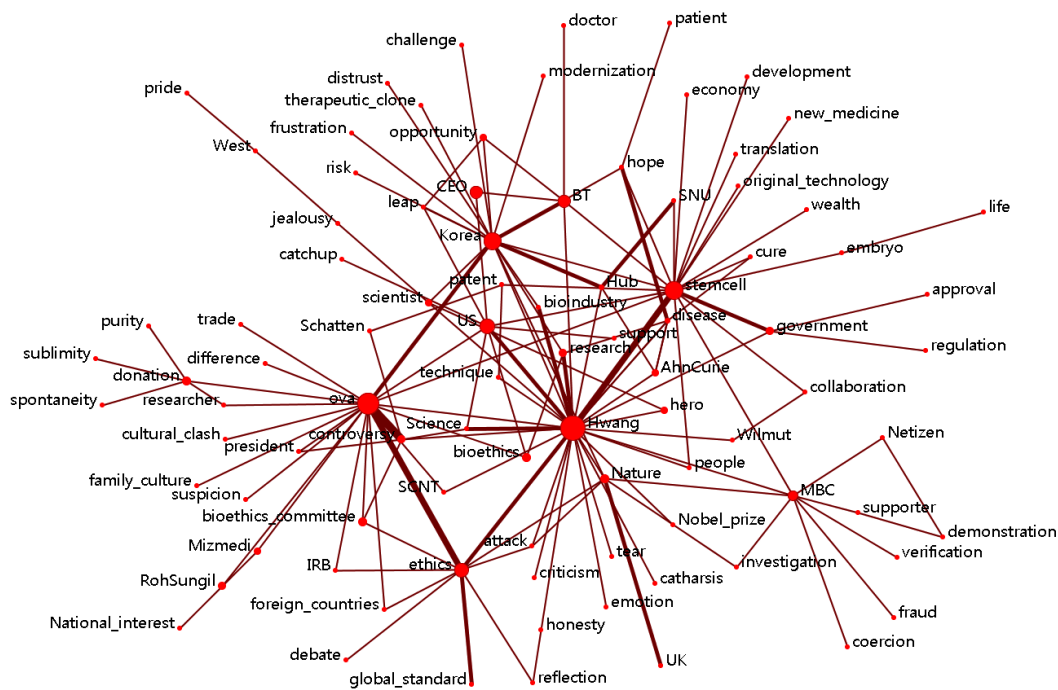
Similarly, the problem of human cloning is the most central concept in both newspapers in South Korea. In the liberal *Hankyoreh*, the term “ethic” is associated with diverse concepts of “society” that refers to “feminism”, “public opinion”, “public hearing”, the prospect of “dystopia” and “biopiracy”. In contrast, the discussion of “ethic” in *Chosun Ilbo* is simply related to the drafting of “bioethical law” and rather vague mentioning about human “dignity”. Both Korean newspapers deal cautiously with the topic of stem cell technology while the new development and following debates appear as foreign achievements and concerns. However, this attitude changes when the development suddenly becomes a national achievement.

Period 2 (2004-2005): Diverging frames

The year 2004-2005 was an extraordinary period for stem cell science, and particularly for Korea. After Hwang announced a stem cell breakthrough that was considered far ahead of research centres around the world, *Chosun Ilbo* reported under the title ‘Professor Hwang’s technology is

subject to patenting' that assessed its economic profit would reach \$300 billion for the next 5-10 years (31 May 2005). This fantasy was soon replaced by disappointment after his scientific misconduct. Before the confirmation of the fabrication of results in 2006, *Chosun Ilbo* actively supported Hwang as the builder of a 'Korea' described as the hub of biotechnology thanks to his achievements.

a. *Chosun-Ilbo*



b. *Hankyoreh*

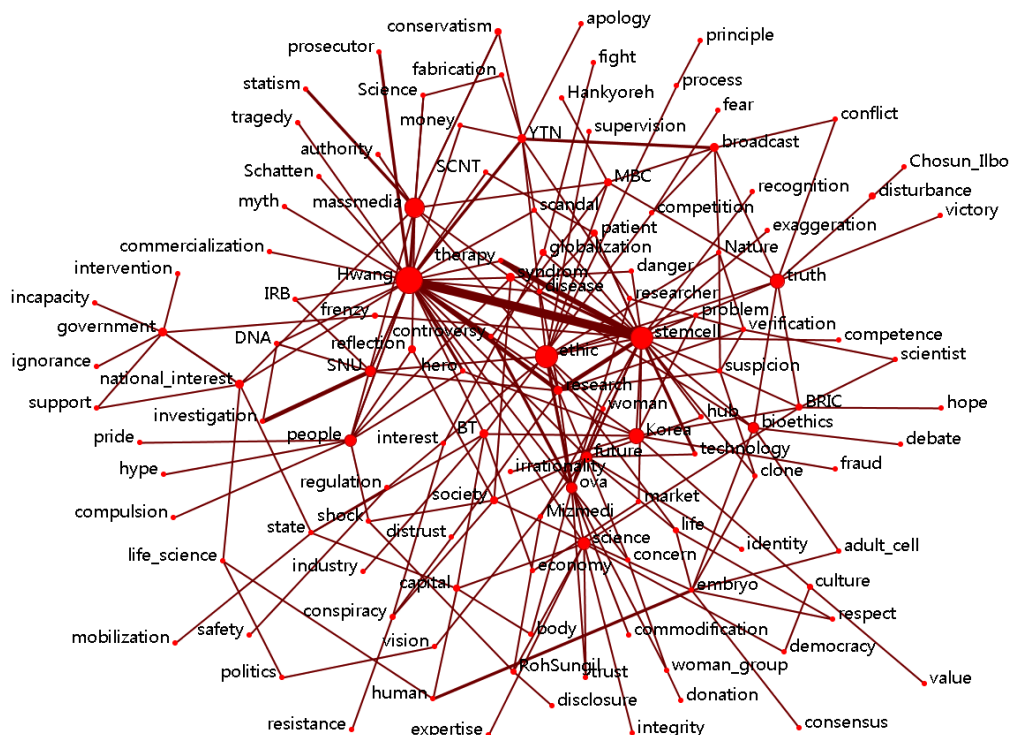


Fig. 4.3. Extracted Networks on the Hwang controversy in Korean media (2004-2005)

The story of the Hwang scandal dominates the news frame of the Korean newspapers. However, *Hankyoreh* sharply differs from *Chosun Ilbo*; it frames the scientific scandal as a typical case calling for a complex reflection on the ‘irrationality’ of Korean society. *Chosun Ilbo* and *Hankyoreh* significantly differ in terms of utilizing central concepts, despite similarity in the scale of their news coverage in the same period. While the central concept “ethic” in *Hankyoreh* explicitly denotes “mass media” difficulties in propagating scientific achievements and of people’s “frenzied” support for Hwang regardless of his misconduct, *Chosun Ilbo* only vaguely refers to the narrowly defined problem of ‘bioethics’.

Table 4.2.
Betweenness centrality measures (2004-2005)

Rank	Guardian	Telegraph	Hankyoreh	Chosun
1	research	research	Hwang	Hwang
2	stemcell	stemcell	stemcell	ova
3	cell	cell	ethic	stemcell
4	clone	clone	media	Korea
5	scientist	embryo	Korea	ethic
6	science	human	truth	US
7	US	science	science	biotechnology
8	human	scientist	people	CEO
9	embryo	treatment	future	research
10	disease	disease	ova	bioethics
11	Britain	Britain	SNU	people
12	treatment	hope	broadcast	committee
13	hope	genetic	syndrom	controversy
14	researcher	government	society	Curie Ahn
15	Bush	tissue	MBC	MBC
16	body	body	irrationality	government
17	tissue	Catholic	frenzy	Nature
18	animal	children	YTN	donation
19	heart	baby	group	Sungil Roh
20	therapy	blood	research	scientist

Reports of the Hwang scandal in the British media often cite “Britain”, which emerges as a dominant concern. Britain is related to biotechnology, company, economy, expert, government, industry, regulation, and glory. The stem cell progress made in South Korea called governmental attention to the support of domestic research through funding and legislation. In *The Daily Telegraph*, the overall concern converges to a question of how to solidify British leadership in the

research with adequate governance, especially when faced with foreign challenges. The science editor Roger Highfield's reports titled: 'Don't let others steal our glory. Britain leads the way in stem-cell research... but, if we do not act now, the benefits of our work could be lost abroad' (1 December 2004) and 'UK research 'tied up in red tape'' (11 March 2005), typically reflect this approach.

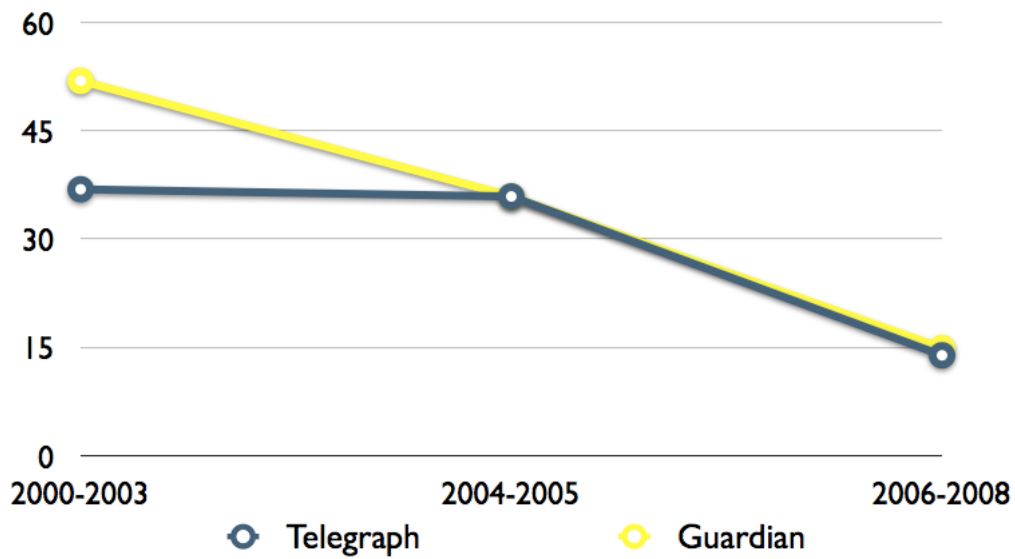
The Guardian similarly links Britain to the issue of leadership while promoting hope of new stem cell developments. In other words, it shares a "British interest" frame with *The Daily Telegraph* as it reflects the growing concerns about British science that needs funding for research in face of competition from foreign scientists. While each UK newspaper maintains its distance to science and social debate, the distance has become extremely polemical in South Korea during 2004-2005 period. In the UK, it becomes visible through the network that the newspapers have come to share a common national frame incorporating the agenda of maintaining research leadership in the UK and diluting the social concerns on reproductive cloning.

Period 3 (2006-2008): Stabilizing frame

In the UK media, the decline of "clone" and a struggle to reposition 'hope' after the Korean debacle forms a common characteristic of frame. While the term clone has been a core signifier embodying public concern, *The Daily Telegraph* and *The Guardian* steadily lower the discursive influence of 'clone' over the periods (Fig. 4.4 a.). In the meantime, "hope" is consistently utilized as a common rhetoric. With introductions of medical achievements and the delivery of emotional stories of patients' sufferings, both *The Daily Telegraph* and *The Guardian* entrench the discourse of medicalized stem cell research that is being conceptually segregated from the public image of human cloning.

In comparison, South Korean newspapers face shrinkage of their discursive networks along with the rise and fall of Hwang issue (Fig. 4.4 b.). The Hwang debacle and prolonged media war between the liberal and conservative mass media (Won *et al.*, 2006) attenuated the media's capacity to cover various aspects of stem cell research; whether to support Hwang or not had become a predominant subject of identity politics that has roughly drawn the line between right wing supporters of the scientific regime and left wing critics against state-sponsored stem cell research.

a. Decline of “clone” in British media (Unit: %)



b. The rise and fall of “Hwang” in Korean media (Unit: %)

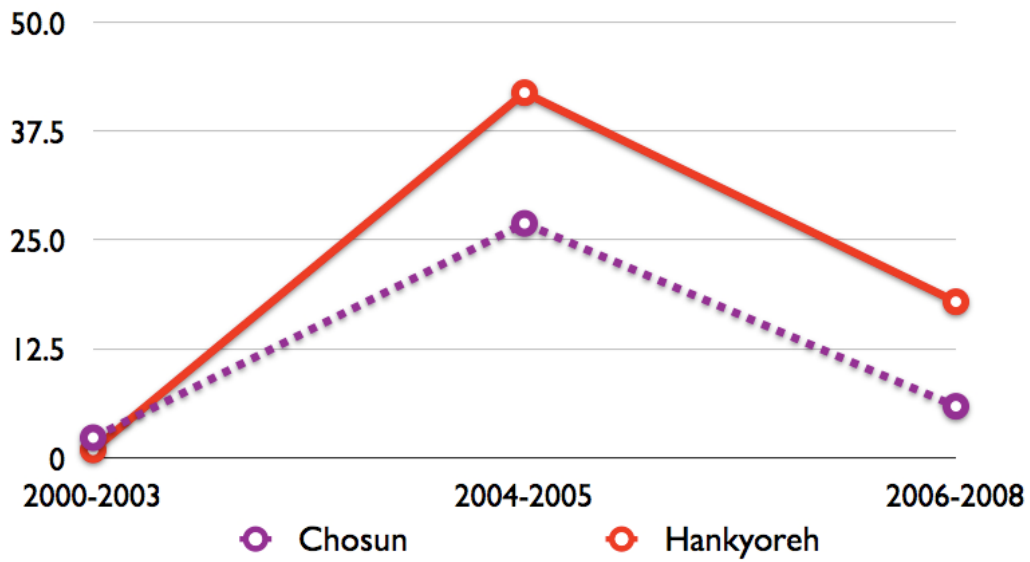
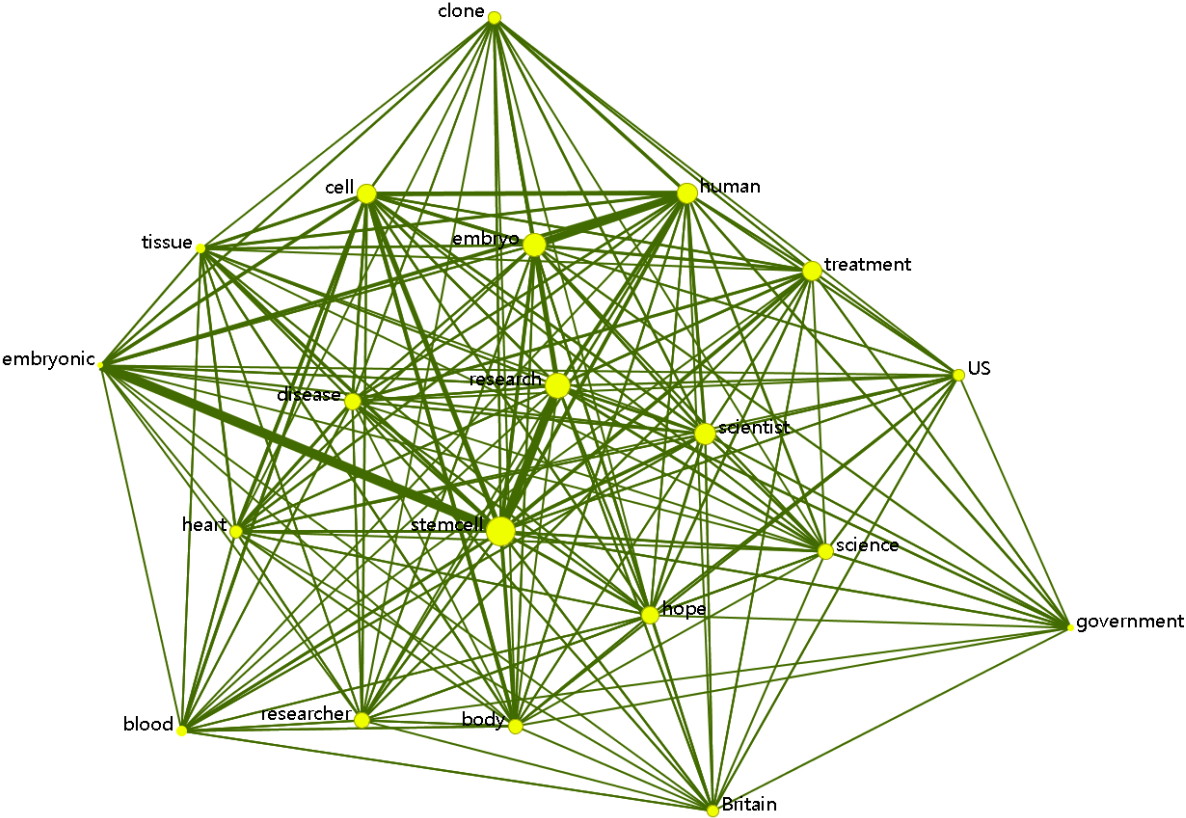
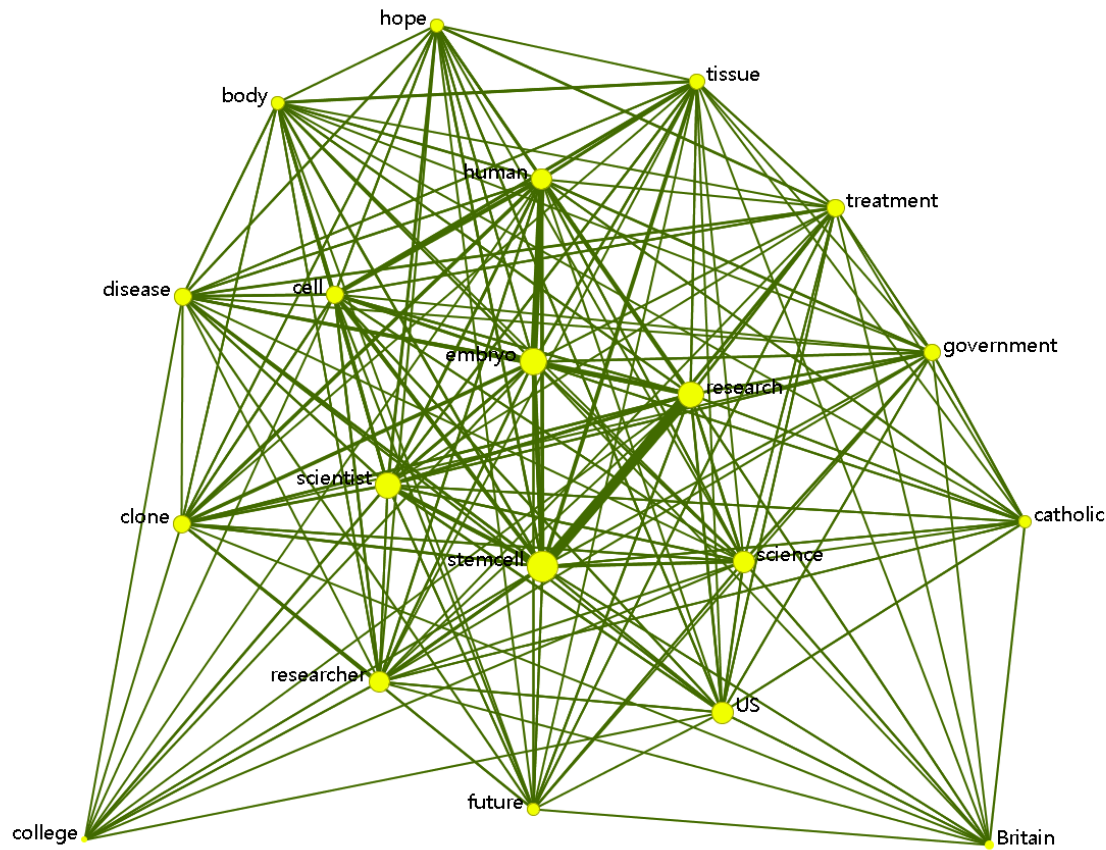


Fig. 4.4. The transformation of central organizing theme in Korea and the UK

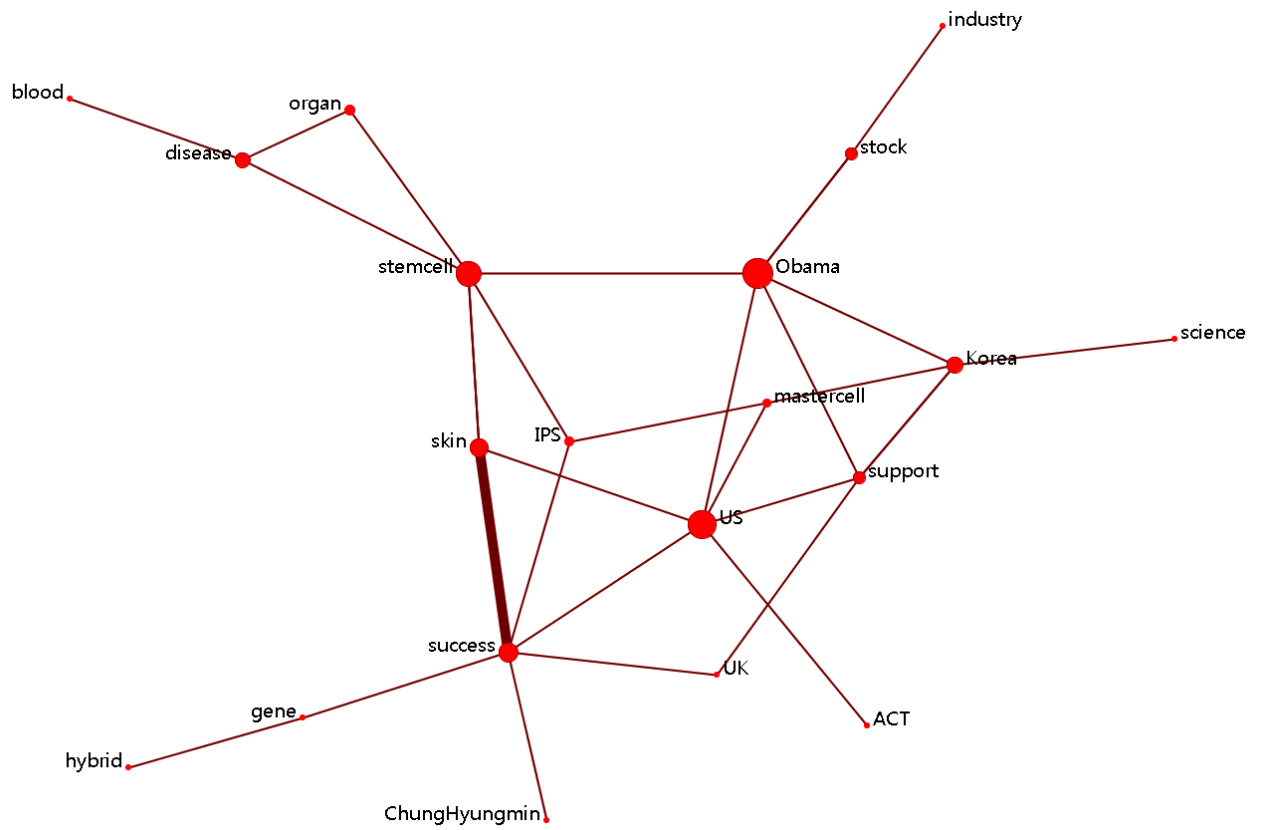
a. The Daily Telegraph



b. The Guardian



c. Chosun-Ilbo



d. Hankyoreh

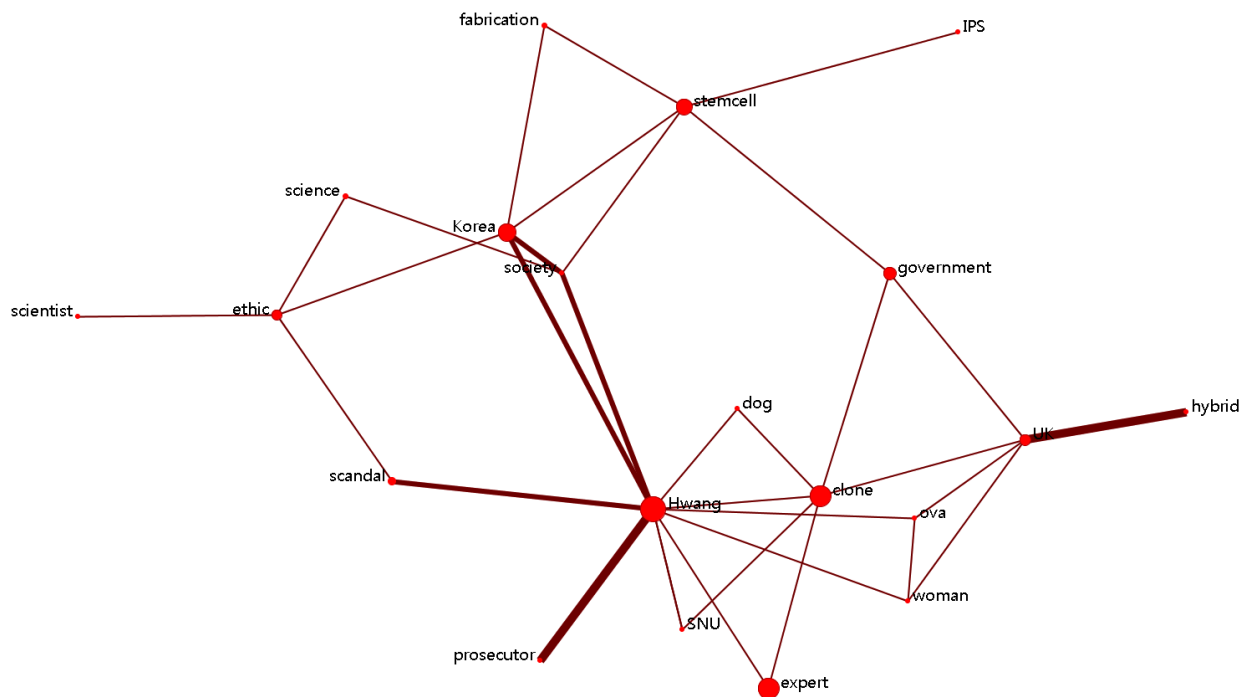


Fig. 4.5. Extracted top 20 concepts and their relationships (2006-2008)

Table 4.3.
Betweenness centrality measures (2006-2008)

Rank	Guardian	Telegraph	Hankyoreh	Chosun
1	research	research	Hwang	US
2	embryo	embryo	stemcell	Obama
3	scientist	stemcell	Government	stemcell
4	stemcell	cell	Korea	Korea
5	cell	scientist	clone	skin
6	human	human	expert	success
7	science	science	hybrid	science
8	US	treatment	UK	organ
9	researcher	disease	fabrication	disease
10	disease	tissue	ethic	support
11	treatment	embryonic	SNU	ACT
12	government	US	prosecutor	master cell
13	hope	Britain	scandal	UK
14	clone	government	science	gene
15	Catholic	clone	iPS	iPS
16	body	hope	women	blood
17	future	blood	ova	stock
18	Britain	researcher	scientist	industry
19	college	body	society	hybrid
20	tissue	heart	dog	H. Chung

After the disclosure of Hwang's misconduct, conservative *Chosun Ilbo* quickly withdraws its support and barely mentions Hwang. Instead, new developments in the US and Obama's new policy to lift the ban on embryonic stem cell research are actively cited to legitimize the technology and its economic prospect. In contrast, many social problems in Korea reflected by the Hwang scandal continue to occupy the main issue frame in *Hankyoreh* newspaper (see Fig. 4.5 d.). This ongoing reflection on the Hwang scandal is predominantly mediated by the question of better governance ("government") that now undertook the task to overcome the traumatic experience and establish new guidelines for stem cell research in South Korea.

While the *Hankyoreh* continues to inquire about the Hwang scandal, *Chosun Ilbo* adopts a defensive exit strategy. Conversely, the two UK newspapers are more homogeneous in frame and become more stabilized in framing (Table 4.3). This is observed by the networks incorporating diverse issues of scientific and social concerns,

but simultaneously placing positive evaluations and objectified reports on medical progress at the core of the discursive network, which hints at a crucial cross-national difference in the media's framing strategies. On the other hand, both the Korean newspapers commonly report the Japanese scientist Yamanaka's development of induced pluripotent stem cell (iPS) with much weight (Table 4.3), but in a rather aloof manner (e.g., *Chosun Ilbo*, 10 Oct. 2008; *Hankyoreh*, 29 Dec. 2008) to state that the new development is free of ethical concern (not using ova), potentially useful for curing Parkinson's and other diseases but still regarded as problematic by experts as it uses retroviruses to inject DNAs into cells.

Summary and discussion

The political and national identity of newspapers operate as important media in framing public perception: while the UK media gradually rationalize stem cell research by conceptually severing its ties from the popular fear of cloning, it evolves as an acute object of political struggle in South Korea. The characteristics of the network structure can be substantiated by other discourse or ethnographical studies. Jenny Kitzinger (2008)'s qualitative media research on the same topic, for example, implies that news frames converge on "rescuing hope" of stem cell research in South Korea after the Hwang debacle; But such a case also emerges in British newspapers, and Korean *Hankyoreh* raises more criticism of scientific governance.

Despite differences in political definitions of liberalism and conservatism in the UK and South Korea, an observed homogeneity and heterogeneity in framing signifies their common ground in science reporting. The marked similarity between "conservative" media, *The Daily Telegraph* and *Chosun Ilbo*, can be found in a typical attitude of showing respect to *scientific authority* while containing wider reflections on its contentious social aspects. Conversely, a liberal characteristic is typically represented by *Hankyoreh*'s stance to incorporate wider social concerns about stem cell research that cover topics related to feminism, rational communication, better governance, etc. In this regard, *The Guardian* is situated somewhere between the two political poles. But it also constructs its frame around "hope" and "medical achievements" in stem cell research.

Table 4.4.
Stem cell frames in UK and South Korean media 2000-2008

Period	UK		South Korea	
	Guardian (liberal)	Telegraph (conservative)	Hankyoreh (liberal)	Chosun Ilbo (conservative)
2000-2003	<i>Early concerns;</i> Fear of cloning humans with emerging stem cell technology. Associated terms: “eugenics”, “maverick”, “cult”	<i>Early concerns;</i> fear of cloning with a focus on social and governmental concerns. Key networks: “reproductive cloning” and “therapeutic cloning” <i>Early hopes;</i> emphasis of term “hope”	<i>Public ethics/ accountability;</i> focus on ethical issues related to “society”, “feminism”, “public opinion”, “public hearing”, “dystopia”, “biopiracy”	<i>Bioethics;</i> focus on the drafting of bioethical laws
2004-2005	<i>British interest;</i> focus on how to promote British stem cell research	<i>British interest;</i> focus on scientific authority and the need for funding for research	<i>Societal irrationality;</i> emphasis of term “ethic” in relation to “mass media” and public “frenzy”	<i>National success;</i> Hwang represented as a success, reflecting the national identity of S. Korea
2006-2008	<i>Medical progress + hope;</i> focus on objectified reports of medical progress, play down the association with “clone”	<i>Medical progress;</i> objectifying medical framing of stem cell research	<i>Social problems and governance;</i> focus on general problems in S. Korea reflected by the Hwang scandal	<i>Legitimization;</i> focus on new developments in the US to justify research into stem cell technology; emphasize scientific authority; Avoid mentioning Hwang

National context influences the political representation of the media and their relations. The dissimilarity between *Chosun Ilbo* and *Hankyoreh* is consistently greater than any others. The well-known hostility between liberal and conservative media in South Korea is also represented by the scientific reporting. The Hwang scandal and related ethical issues were watershed events that polarized the liberal and conservative media. The UK newspapers turn out to be more consistent in constructing core frames throughout the decade. Both *The Daily Telegraph* and *The Guardian* converge on playing down the association of “clone” with stem cell research and emphasizing British

leadership in stem cell research. Consequently, the media socially functions to keep in check social concerns with scientific authority and optimism.

The difference is generally explained by the unequal power relations between conservative and liberal media in the two countries. While the UK shows relatively equal competition between the two political poles, South Korea has been overwhelmed by conservative media in terms of the number of readership, unmatched financial resources, and socio-political influence (Kang *et al.*, 2006; Won and Jun, 2006) until recently. Nevertheless, it is uncertain how the lay public actually evaluate them. Has the British public that participates in the legislative process, for example, acknowledged the “medical progress” frame instead of other social concerns? If there has been a polarized debate between legitimizing stem cell research for economic cause and social cautions against the development in the opinion-leading newspapers in South Korea, how the people would actually react when a notable scientific event occurs? Following chapters try to explore these questions with people’s recorded utterances.

Appendix

Descriptive statistics of networks

Period	Characteristic	Guardian	Telegraph	Hankyoreh	Chosun
2000-2003	N. of articles	161	142	126	160
	N. of words	102,902	75,019	133,610	65,664
	N. of nodes	146	122	156	110
2004-2005	N. of articles	139	120	469	511
	N. of words	98,145	80,149	136,068	199,526
	N. of nodes	175	149	181	128
2006-2008	N. of articles	228	246	322	394
	N. of words	97,044	105,248	80,557	130,885
	N. of nodes	183	167	154	103

5. Implicit Value: Public Representations in the UK

Introduction

On 16 August 2005, the UK Department of Health (DH) launched a public consultation as part of its review of the Human Fertilisation and Embryology Act 1990. The Human Fertilisation and Embryology Act (hereafter HFEA) permits research on early embryos, but only when the study is strictly dedicated to improving human reproduction or fertility. The act was part of a debate ongoing in the UK since the creation of Dolly in 1997 (Durant, Bauer and Gaskell, 1998). After an earlier public consultation on the ethical aspects of animal cloning was set up jointly by the HFEA and the Human Genetics Advisory Commission, the ensuing report (Human Genetics Advisory Commission, 1998) concluded that the Human Fertilisation and Embryology Act had proved effective in dealing with new developments relating to human cloning. The legislative installment, however, seemed less convincing to those who saw how quickly the field was advancing. In April 2002, the House of Commons Science and Technology Committee concluded that it was necessary to “reconnect the Act with modern science” (House of Commons, 2002). The UK Department of Health ultimately agreed, announcing on 21 January 2004 a review of the Human Fertilisation and Embryology Act. The eventual report, “Human Reproductive Technologies and the Law,” issued on March 2005, laid out the government policy regarding the controversial areas of embryo research, including interspecies transplantation (UK Department of Health, 2005; Kim, 2012).

The issues covered in the DH review had been much rehearsed over the years; the consultation was regarded as part of a larger exercise that explored societal views and stimulated debate about ideas such as: the model and scope of regulation; child welfare; the use and storage of gametes and embryos; reproductive choices of screening and selection; information and the HFEA register; surrogacy; legal status of parenthood; regulatory authority for tissues and embryos; and human embryonic stem cell research (PSP, March 2006). In retrospect, the consultation and the summary of people’s opinions, with a few other contemporary surveys, placed a significant milestone: they entrenched the Science and Technology Committee’s view supporting the Warnock Commission’s approach to the status of the embryo (UK Department of Health and Social Security, 1984). This provided the

government grounds for not revisiting fundamental aspects of the existing law (UK Department of Health, 2005, p. 5–8), by stating:

“Human Reproductive Technologies and the Law” provided a prohibition of any form of reproductive cloning, it is important that it is supported by principled arguments why such a technique should be banned even if it were shown to be safe, effective and reliable. Without such arguments, an indefinite absolute ban could not be considered rational.

In other words, mere popular concern is not sufficient reason to rule out an area of research, and “alleged harms to society or to patients need to be demonstrated before forward progress is unduly impeded” (Kim, 2012). As to the emerging issue of chimeras and hybrids, the committee adopted the same line of argument, saying:

The ethical status of hybrids and chimeras is complex. While there is revulsion in some quarters that such creations appear to blur the distinction between animals and humans, it could be argued that they are less human than, and therefore pose fewer ethical problems for research than fully human embryos. We recognise concerns that hybrids and chimeras could be used for reproductive purposes and recommend that new legislation a) defines the nature of these creations, b) makes their creation legal for research purposes if they are destroyed in line with the current 14-day rule for human embryo cultures, and c) prohibits their implantation in a woman. (UK Department of Health 2005: 10)

The government consultation and ensuing report commissioned to People Science & Policy Ltd (PSP) collected 535 responses in total¹⁶, and qualitatively analysed the 408 electronically received consultation responses based on the “Grounded Theory” technique (Strauss and Corbin, 1998). According to the report, the purpose was:

“to attempt to crystallize the key streams of argument around a particular subject and to characterize those arguments into these which then form an overall landscape of the debate around a subject”, while not intending “to quantify frequencies of argument or to generalize about particular actor groups” (PSP, 2006: 1).

¹⁶ They are stored as PDF format and publically accessible in the UK government archive. Link: http://collections.europarchive.org/tna/20100509080731/http://dh.gov.uk/en/Consultations/Responsestoconsultations/DH_4132358

The summary gave an overview of the issues that each topic raised mainly by selectively citing responses, but “no conclusions [were] reached as it was believed more appropriate to give an overview of the landscape of arguments rather than attempt to draw conclusions from such disparate responses” (PSP, March 2006, p. 2). A year later, the consultation was criticized by the OPM in a report titled “Stem Cell Public Dialogue”, commissioned by Biotechnology and Biological Sciences Research Council (BBSRC) and the Medical Research Council (MRC). The OPM report argued that the consultation ‘often conflated opinions regarding embryos for treatment and embryos for research’. The report also noted:

The consultation gives no indication of the numbers of responses on either side of any debate, as the consultation was not seen to be representative. As such, *no overall view can be gained of people’s attitudes* (OPM, 2007 July: 12, emphasis by the original document).

The somewhat predictable criticism expressed by the OPM report, calls for a methodological alternative to revisit the existing data, while not ruling out the traditional qualitative method. In this article, we aim to present a way to combine automated analysis of textual data and qualitative analysis to represent the landscape of public opinion in a more structured way. By examining both the survey responses and the summary of the PSP report prepared for Department of Health, while focusing on the topic of embryonic stem cell research, we attempt to a) “re-present” the overlooked layer of public opinion with respect to embryonic stem cell research, b) reflect on the characteristics of under-represented public opinion, and to c) shed light on potential concerns of the UK public faced with emerging life science policy. From a methodological perspective, I argue that effective use of semantic network analysis could lead to discovery of both general and particular aspects of public opinion, derived from open-questionnaire survey data, that might be difficult to capture with more traditional research methods.

Reviewing research on the public’s participation in stem cell policy in the UK, I want to ask: ‘How much has the public been empowered to articulate their opinions, regardless of the formal institution for public participation in science policy?’ Especially considering Bourdieu (1991)’s discussion of symbolic power or Foucault (2002)’s discussion of power in discourse, I believe that this question can highlight not only the

formal power structure in a society, but the way certain concepts gain weight over others and exercise socio-political power. As will be explained in the Methodology section, the applied semantic network analysis may visualize the assemblage of concepts in a discourse, measuring their relative weights and evaluating their connections.

Review of previous analysis

In the UK government survey, responses to the consultation were many and varied: in total there were 535 responses, including some from organizations/groups and individual professionals involved in medical or legal practice in the relevant area and others from individual members of the public (PSP, March 2006, p. 1). The consultation document covered a wide range of issues and asked 74 specific questions. Among the total of 74 questions of the DH's public consultation covering various topics of life science, 9 questions below are directly related to the issue of endorsing embryo and stem cell research that are subject to our review. During the survey, the respondents, both interested individuals and organizations, were required to respond to the government's current position expressed as statements:

57. In common with the Science and Technology Committee, the Government believes that there is no case at present for either an extension or a reduction to the 14 day time limit for keeping an embryo. Any change would remain a matter for Parliament.

58. The Government believes that research undertaken on embryos using the cell nuclear replacement technique for the purpose of studying mitochondrial diseases should be permissible in law, subject to licensing.

59. Further, the Government invites views on removing the current prohibition on "replacing a nucleus of a cell of an embryo with a nucleus taken from the cell of any person, another embryo or a subsequent development of an embryo" for research purposes, subject to licensing.

60. The Government invites views on whether the law should permit altering the genetic structure of an embryo for research purposes, subject to licensing.

61. The Government invites views on whether the law should permit the creation of human-animal hybrid or chimera embryos for research purposes only (subject to the limit of 14 days culture in vitro, after which the embryos would have to be destroyed).

62. The Government invites views on whether the current list of legitimate purposes for licensed research involving embryos remains appropriate.

63. The Government believes that the purposes for which research using embryos may legitimately be undertaken should, as now, be defined in law and research projects should continue to be approved by a national body in order to ensure compliance with the law, national consistency and appropriate ethical oversight.

64. The Government invites views on what, if any, additional regulatory requirements should apply to the procurement and use of gametes for purposes of research.

65. The Government invites comments on the desirability of allowing the creation of embryos for the treatment of serious diseases (as distinct from research into developing treatments for serious diseases which is already allowed).

After data analysis of the 408 electronically received responses, the PSP report summarized that some responses disagreed with the Government position favoring a 14-day limit for keeping an embryo (Q. 25, p. 66). With respect to the usage of cell nuclear replacement (CNR) technique (Q. 58; 59), the report notes that there were mixed views and some feared that this could lead to human cloning (p. 68). On altering the genetic structure of an embryo (Q. 60), the PSP reported opposing voices: the School of Theology, Philosophy and History and Minister of Religion (p. 68), believing it would result in germ-line alterations and possibly lead to eugenics, contrasted with the Medical Research Council and The Academy of Medical Sciences, (p. 69) believing that advances through such research could be beneficial.

As to the matter of the controversial human-animal hybrid and chimera embryos (Q. 61), the summary describes a number of responses which urged that the law should prevent the creation of human-animal hybrid or chimera embryos for research purposes. The notion of the “special status” of human life as a reason for the prohibition of this research was introduced, as well as fears that a new species would be created; wider social and ethical issues were also discussed (citations from an individual contributor and the Church of Scotland, p. 69). To balance, it notes that those who supported the creation of human-animal hybrid and chimera embryos thought there was potential for developments in research (citations from the Academy of Medical Sciences and another individual respondent, p. 69). For the purposes for which research may be permitted (Q. 62), it concludes that a number of respondents thought that the current list was appropriate; however, many considered the list to be too restrictive, lacking flexibility in a fast moving area of research (p. 70). Finally, as to the essential question of creating embryos for therapeutic purposes (Q. 65), the section closes with comments on the wide ranging

responses about the desirability of allowing the creation of embryos for treatment of serious diseases; many who disagreed with the creation of embryos for treatment disagreed in principle with creation of embryos for research purposes (pp. 72–73). The PSP report did not quantify the responses but merely used terms such as “many people” or “some respondents”.

In order to trace implications from the 408 electronic responses, after preliminary reading of the texts, I categorized the opinions into five characteristic parts (a. entirely agree; b. agree with reservation; c. generally disagree; d. entirely disagree; and e. others) and quantified their proportions. When there was a difference of opinion that seldom occurred (twice), we put them in the category of Others. In general, people’s attitude reviewed in this way turned out to have clear boundaries of opinions. With very few exceptions, it transpired that those who “agree with reservation” do so except for “the creation of human-animal hybrid or chimera embryos for research purposes only” (Q. 61). On the other hand, people who “disagree with stem cell research” disagree with stem cell research but do not explicitly raise dissent or doubt against the 14-day time limit for keeping an embryo and licensing regime for embryo research, whilst those who “entirely disagree” assert that both the 14-day time limit rule (Q. 57) and the government licensing system of the research (Q. 62; 63; 64) are arbitrary, unscientific and problematic. The others are those who refused to answer or did not answer for another unknown reason.

Figure 5.1 shows that only 44 people (11%) entirely agree with the research, 40 people (10%) agree with overall research but disagree with the creation of human-animal hybrid or chimera embryos, 74 people (18%) generally disagree with all the relevant research save the already established licensing regime for the embryo research, and 67 people (16%) disagreed in principle with not only the creation of embryos for research purposes but also related governing mechanism and institutions in the UK. Among those who responded to the statement no. 61 asking “whether the law should permit the creation of human-animal hybrid or chimera embryos for research purposes only”, most (181) said “no”.

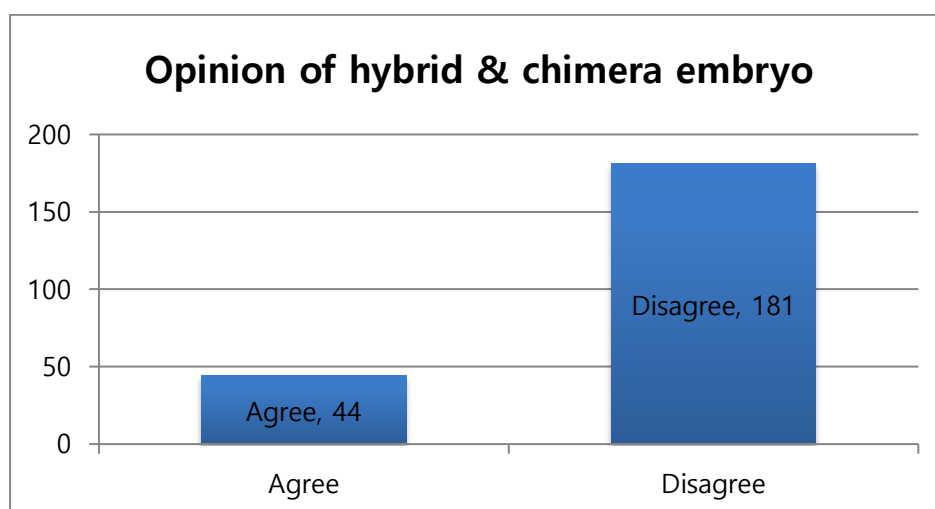
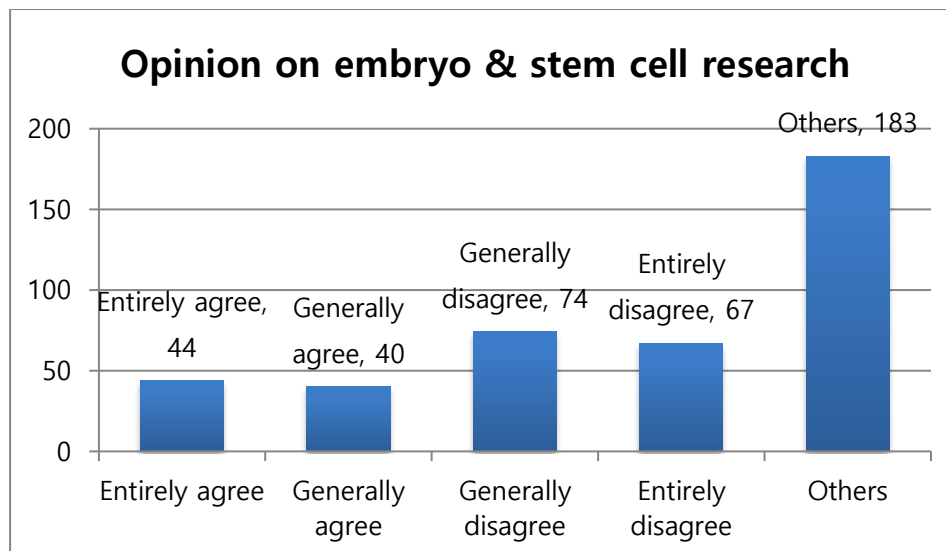


Fig. 5.1. Quantified opinion regarding embryo & stem cell research

There is good reason for the OPM to accuse the authors of the PSP report “conflation” (OPM, 2007, p. 13) regarding embryos for treatment and research, especially when considering the overwhelming disagreement against the hybrid & chimera embryo. The gap between the PSP’s summary and the basic statistics in Figure 5.1 hints at the possibility that the data could yield more, especially regarding people’s understanding and feelings about the emerging life science and their underlying values. What should be investigated further, supported by alternative methodologies, is the overall description of respondents’ core concepts, and the way they frame stem cell research.

An interesting point we can observe from the quantified result is that there certainly is a more notable preference of opinion among the respondents, in contrast to the neutralizing conclusion of the PSP report, in regard to some specific issues. In particular,

the dominant majority disagreed with hybrid and chimera embryo research, but this important aspect was neglected in the previous research. This fact leads to more serious questioning: ‘Was the previous qualitative research sufficient to represent the structured opinion patterns?’ I argue that more intuitive characteristics could be discovered from the existing data, and propose an alternative methodology to derive the pattern.

As Sheila Jasanoff (Jasanoff, 2005:250–256) points out, when discussing the importance of civic epistemology in scientific governance, ‘surveys do not just test respondents’ understanding of science: they simultaneously construct the respondent as a particular kind of knower, or in this case a non-knower’. Some survey methods can be utilized as a device to legitimize assumptions of state elites, whereas some qualitative analysis might reveal relations hidden beneath the spurious categorical relationships. The questionnaires designed by the DH are restrictive in that they represent the established government schemes that require some significant level of legal and scientific knowledge to understand. Therefore, responses are invariably framed within this construction. Still, a certain degree of freedom, despite the constrictions of the survey, may be observed in people’s expressions. I argue that an alternative research perspective could reveal hidden structures, aligning qualitative and quantitative methods.

Methodology

In order to represent the survey answers in a systematic form, I utilize semantic network analysis to interpret the linkage pattern of keywords that was considered to reflect the typical frame of a social group (Tewksbury and Scheufele, 2009; Jang and Kim, 2013). The key semiotic idea is that insofar as the frames are represented by both selective and salient links of concepts, those words and concepts are “ideological units of life that both reflect and refract particular social relations” (Crossley and Roberts, 2004). Coding texts as maps focuses the user on investigating meaning among texts by finding relationships among words and themes, and by identifying central words in specified relations. As shown in Chapter 3, the relative importance of concepts, keywords, can be measured by centrality indices. The iterative and statistically significant pattern of referential linkage between keywords can reveal clusters of keywords that represent common themes. The principle of producing the link is similar to the measurement of co-occurrences: word pairs within a window (a word set that becomes an imaginary unit of

the document in a word x document matrix) can be given a “connection weight”, either equally regardless of a distance or proportionally to how close the words are (Danowski, 1993). The co-occurrence or co-word analysis of text applies hierarchical clustering of co-occurring keywords. In response to the development of co-citation maps during the 1970s by Small (1973), Callon, Law and Rip (1986) proposed developing co-word maps as an alternative to the study of semantic relations in scientific and technology literatures (Callon, Law and Rip, 1986; Leydesdorff, 1989). Since then, these techniques for “co-word mapping” have been developed, for example, into “Latent Semantic Analysis” (e.g. Leydesdorff, 1997). It is assumed that search terms identifying actors or issues that appear close to each other in a text indicate an association between these actors or issues. The drawback of this technique, however, is that it ignores the semantics of concepts, context and expressed relations (van Atteveldt and Takens, 2010), and the links become too complex to concisely denote the relation of reference. Also, co-occurring words in a sentence or a paragraph presupposes that they are closely related to form a meaning, but those words actually do not necessarily form referential relationships each other. Overall, the currently available automated techniques and tools offer limited insight, as they ignore sequential relations between words.

In contrast, my approach of defining the relation of a directed link between two concepts has to do with whether the first concept is seen to have some type of “prior” relationship to the second concept (Franzosi, 1990; Carley, 1993; Kronberger and Wagner, 2007). Various types of prior relationship can be thought of. For example, ‘a implies b,’ ‘a comes before b,’ ‘if a is true, then b is true,’ ‘a qualifies b,’ or ‘a (subject) <verb> b (descriptive).’ This coding directionality can provide information about the way in which the impact of new information propagates through the network and affects decisions, and the structure of meaning (Carley, 1993: 96). In comparison to the existing assumptions and techniques of co-word analysis, the new assumptions and capabilities of semantic network analysis below should be underlined:

- Newly available technologies of natural language processing (NLP) should be able to recognise and process grammatical units, repetitive words and phrases, and the relation of subject-descriptive in natural languages of various texts beyond recognizing the already tagged keywords

- An advanced approach to semantic network analysis should NOT link all the co-occurring words indiscriminately, but should be able to detect their pattern of sequential or hierarchical relations (mentioned above) that clarify the prominence of concepts
- We should pursue an alternative way to categorize keywords beyond factor analysis used in traditional co-word analysis. The quasi-statistical approach to clustering is usually significantly influenced by high frequencies of simple, often syntactical, co-occurrence of words that blur semantic insights.

Based on the assumption and procedure, the keywords in the text were coded and analysed automatically by the text-mining solution *Optimind* (ver. 1.0)¹⁷. Then the extracted nodes of keywords, and links among them, were grouped as homogeneous circles automatically by utilizing the Girvan–Newman model (Girvan and Newman, 2002), which clusters nodes according to homogeneous referential patterns of linkages by iteratively simulating the removal of links from the highest betweenness centrality (Freeman, 1979). This classification of keywords into a homogeneous circle is translated as grouping synonymous words under the specific theme and context.

From the perspective of semiotics, a homogeneous linking pattern indicates identical conductivity of discourse, that is, making a similar reference to form an identical theme or a set of synonymous keywords from the discursive context (Jang and Kim, 2013; Kim, 2013). Then, the emerging theme can be interpreted both by the author and reader who may cross-check the possible common meanings of clustered words. In communication, interaction between two nonadjacent nodes of concepts is likely to depend on another concept for reference that function as “catalysis” to join meta-languages of concepts (Barthes, 1967). This function of “denotation” is translated into a node with the highest betweenness centrality in the semantic network, when the keyword lies on the paths between the trigger of information and referent, performing a mediating role as a semiological facilitator of communication. On the other hand, the “flow” or sequence of denotative communication has an ultimate end(s), which becomes a converging point of connotation. This can be represented as an individual keyword or a homogeneous category of word class that has the highest input-closeness centrality (Kim

² Designed by social network analysis company Ars Praxia (<http://www.arspraxia.com>)

and Kim, 2015; Kim, 2013). In this study, keywords with the highest input-closeness centrality are calculated and highlighted as “connotation” (Barthes, 1967).

To derive a consistent outcome, utilization of an automatic algorithm based on the aforementioned assumption becomes vital. *Optimind* is an automatic semantic network tool, based on the distance and story line model for coding (Carley, 1993), which extracts and analyses links among words to model the author(s)’s “mental map” as a network of links. For the standardized extraction of a core network, the backbone extraction model (Serrano, Boguñá and Vespignani, 2009) was adopted. Unlike Chi-square, mean value, and cosine models, this alternative threshold enables the preservation of statistically significant deviations with respect to a null model that informs us about the random expectation for the distribution of weights associated with the connections of a particular node.¹⁸ An important aspect of this construction is that the ensuing reduction algorithm does not belittle small nodes in terms of frequency while offering a stable automatic procedure to reduce the number of connections by taking into account all of the scales. By operating the computerized system, the text analysis goes through the following stages:

1) Preprocessing:

- a. Checking words and listing context-specific thesauri of synonyms
- b. Automatic lemmatization of variable words (transformation into basic form)
based on the natural language processing (NLP) library and system
- c. Automatic deletion of syntactically functional words such as articles and adverbs

¹⁸ According to Serrano, Boguñá and Vespignani (2009: 6484):

$k-1$ points are distributed with uniform probability in the interval $[0, 1]$ so that it ends up divided into k subintervals. Their lengths would represent the expected values for the k normalized weights p_{ij} according to the null hypothesis. The probability density function for one of these variables taking a particular value x is:

$$\rho(x)dx = (k-1)(1-x)^{k-2}dx \quad [1]$$

By imposing a significance level α , the links that carry weights that can be considered not compatible with a random distribution can be filtered out with an certain statistical significance. All the links with $\alpha_{ij} < \alpha$ reject the null hypothesis and can be considered as significant heterogeneities due to the network-organizing principles. The statistically relevant edges will be those whose weights satisfy the relation

$$\alpha_{ij} = 1 - (k-1) \int_0^{p_{ij}} (1-x)^{k-2} dx < \alpha. \quad [2]$$

2) Processing:

- a. Transformation of the remaining text into an adjacency matrix of keywords, with the window size of every paragraph
- b. Applying a backbone threshold that extracts a core set of nodes (keywords)
- c. Verifying keywords with high centralities with the original texts in which those keywords were used

3) Visualization

- a. Visualization of network by *Optimind* based on the calculation of centrality indices and grouping algorithm
- b. Interpretation of the represented semantic network

In contrast to the relatively simple procedure of inference derived from the correlation between text and research question in traditional content analysis, semantic network analysis goes further, exposing the multilayered contexts of texts and research questions, and proceeds to infer the answer through an active feedback loop between network representation and background knowledge. Therefore, the methodology of semantic network analysis is positioned in the academic tradition of hermeneutics and interpretive sociology, and aims to invoke critical questioning instead of presenting a confirmatory answer (Kim and Kim, 2015).

Compared to previous tools and recent academic works (e.g. Kwon, Barnett and Chen, 2009; Hellsten, Dawson and Leydesdorff, 2010), the latest algorithm of automated semantic network analysis demonstrates a few relative advantages as follows:

- Based on the Natural Language Processing system of *Optimind*, automatic lemmatization and grammatical tagging has become possible, which permits more elaborate and reliable coding and processing of textual data
- Novel and reliable representation of sequential relationships in the co-occurrence of keywords has become possible with automatically applied threshold of links by the backbone model
- More intuitive classification of keywords into themes is presented with the Girvan-Newman model and its description that simplifies complex graph. This

enables the direct depiction of the structuralized pattern of relational properties of emerging themes and their consisting keywords besides relying on centrality measures and the ‘raw’ morphology of the network

My reanalysis of the data proposes a pathway to interpret and represent different contexts of survey responses from the previously discussed report, as I judge the conventional qualitative analysis tended to be overly selective and could not identify salient opinions from an integrative perspective. Henceforth, the representation should undergo a verification process with collected evidence and counter-evidence in the future: encouraging an ethnographical review of related actors and utterers either confirms or denies the interpretation of social context and structure that are mainly inferred by researcher’s experience. Although the answers derived from the review are subjective, the former part of the data processing is an opportunity for the researcher to challenge preexisting notions for interpretation. In this chapter, I try to find the relation of underlying opinion, belief and value of the British public, and especially compare their converging value with that of Koreans for the further argument.

Network results

Figure 5.2 is the extracted semantic map of survey responses that is reorganised by *Optimind*. Different word classes (themes) by the Girvan-Newman grouping method are presented as different circles, and the directed edges (arrows) and their width respectively represent the sequential flow of statements and the total frequency of linkages between the adjacent word classes. For example, the concept of “research” and related words would precede those of “purpose” and “allow” in Figure 5.2. The thickness of arrow represents the total frequency of sequential relations, e.g. how many times “research” and containing keywords preceded those of “purpose”. Among the words in the same circle, the one with the highest betweenness centrality is placed in the centre (for more detail, see Appendix B). In this arrangement, we can detect the core concepts, related words and the sequential flow of identified themes that collectively construct the patterned frame of respondents’ opinion.



Fig. 5.2. Semantic representation of survey responses

Overall, to interpret the diagram, the core construct of themes and their flow discuss the use of “embryo” for “research”, which should be “allow”ed for the “treatment” of “disease” and “agree”ing with the “licensing” “process” in line with the “therapeutic” “purpose”. If approval of the research is strongly associated with the therapeutic purpose and licensing regime, the status of embryo induces more complex reflections. The “creation” of embryo and its “regulation” in the case of “human-animal” hybrid and whether to continue the “prohibition” of “cell” “nuclear replacement technique” emerge as focal points of concerns. The underlying rationale in the discussion of the embryo is found in the thematic circle of “human”, which incorporates “woman”, “body”, “egg”, “part”, “special” and “status” (see Table 5.1).

By referring to the original text, it turns out that a bioethical perspective is notably manifest in the wordings. For example, Philipa Taylor, the Associate Director of The Centre for Bioethics and Public Policy, in answering Q. 64, claims:

...The European Parliament (EP) has consequently reminded the European institutions that the human body should not be a source of financial gain and has condemned all trafficking of the human body and its parts: ‘...particularly vulnerable individuals at risk of becoming victims of trafficking, particularly women...’ The Convention on Human Rights and Biomedicine, not signed of course by the UK, affirms that: ‘The human body and its parts shall not, as such, give rise to financial gain or comparable advantage...’. Similarly, the United Nations General Assembly in its Resolution of March 2005 banning human cloning, referred explicitly to the need to prevent the exploitation of women. As stated elsewhere, to determine whether “good science” is being done, in a way that benefits society, society needs to define exactly what a good end is and what a good means of getting there might be. The “means” here, egg donation, raises significant medical and ethical issues and cannot be perceived as ‘good’.

Table 5.1. Connected keywords and salient frames

Group	Main word	Related words	Salient frame
1	Research	UK, treatment, approval, prevent, ban, legislation, committee	Embryonic stem cell research can be allowed if it is for therapeutic purpose such as to treat mitochondriall disease
2	Allow	country, mitochondrial, disease, reason, scientists, study, treat	
3	Purpose	agree, licensing, process, prohibit, subject, therapeutic	
4	Embryo	case, destroy, genetic, hybrid, limit, way, alter	Various concerns of destroying (human) embryo or creating human-animal embryo
5	Cell	nuclear, nucleus, prohibition, remove, replacement, technique, use	
6	Creation	human-animal, new, permit, regulation, requirement, creation, definition	
7	Human	part, special, status, woman, body, egg	Human should be respected, especially woman’s body part - egg

Josephine Quintavalle, the co-founder of Comment on Reproductive Ethics (CORE), also cautions:

A proper inquiry into the status quo is required, particularly in relationship to oocyte and embryo ‘donation’. Close alliances between fertility centres and research laboratories are undesirable but proliferate, and are a recipe for serious conflicts of interest. It is never in the interests of fertility patients to produce too many embryos, or for a woman to produce excess oocytes. It is, however, of great interest to the research units to obtain as many gametes and embryos as possible.

Under the framework of public consultancy, the current licensing regime of embryo and stem cell research for “therapeutic purpose” has gained the status of an objectified entity. In a sense, it is a deliberate construct of expert discourse, favoring embryonic stem cell research, in order to fend off public fear of “reproductive (human cloning)” (Jasanoff, 2005; Kim, 2011). Despite a number of pronounced oppositions to research and any following utilization of the embryo that were mostly based on religious points of view, they are not represented in the core structure of discourses. It is because their wordings stand alone; and did not connect to other common concepts in the semantic network to make a statistically significant mass. The only exception is when they mention the “special status of humans”, which comes to be identified with the issue of how a “woman’s body” will be treated.

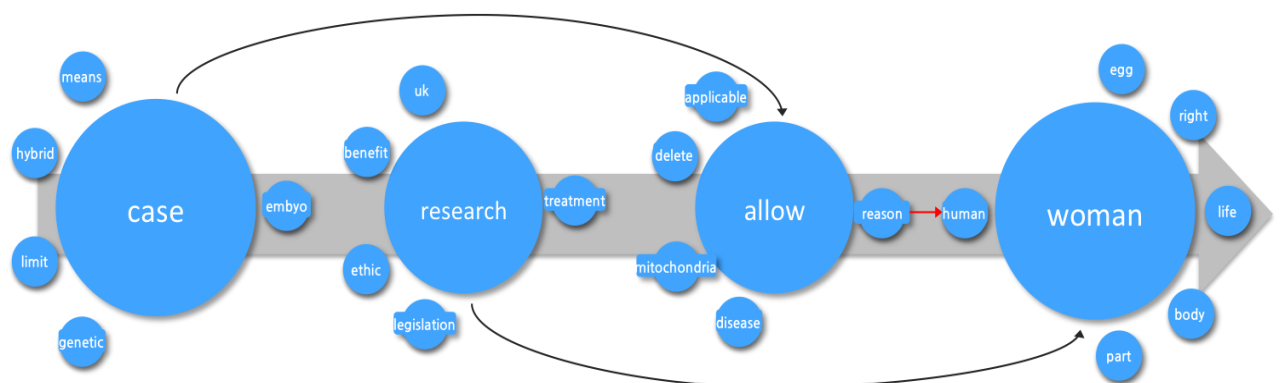


Fig. 5.3. The core story flow of respondents

This semiotic feature is more clearly represented in the “story flow” representation of *Optimind* (Fig. 5.3): It applies the threshold of denotation and connotation measures

(respectively betweenness and in-closeness centralities) and derives hypothetically the most bottom-line discourse that can be rearranged in a single linear flow of statements (for mathematical details, see Appendix II). If the denotative theme of [case] becomes the trigger of the statement, the connotative theme of [woman] becomes the converging point of communication. From the perspective of this backbone structure, this algorithm reveals what bottom line story flow, as a hypothetical statement composed of four sub-themes, will remain as the core discourse after removing all the peripheral words and their relations. Reading from left to right, the main argument starts from the denoted [case] of “hybrid” “embryo” and “genetic” manipulation, then proceeding to the “benefit” and “ethic”(al) consideration of [research] in the “UK” and “reason” to treat “disease”. Finally, the discussions of “reason” converge on the connotation of [woman] that encompasses the issue of her “body”, “egg”, and the status of “human” itself. Thus, in a hypothetical statement, “the case of embryo, including the hybrid, [and] its research is discussed in the UK [in regard to] ethical and beneficial angles, including treatment, [and] the matter of allowing the research with derivative aspects such as its usage in mitochondrial disease [eventually converge] to the matter of a human’s life and rights, more specifically to women’s body parts”.

To summarize, with the most stringent application of the threshold for the filtering of information, three characteristics remain as the core frame of responses. Firstly, responses generally follow the constructed pattern of the questionnaires, converging on the discussion of whether to allow controversial research techniques including cell nuclear transfer, genetic transplantation and human-animal hybrid embryos for therapeutic purposes. In this way, the regulating framework of the existing body (HFEA)’s licensing system and the validity of “therapeutic cloning” become the premises of the debate. Secondly, the exceptional dissent that opposes the established structure of embryo research from a religious perspective gains little semiotic status in the systematized analysis. The disappearance of its semantic relevance, in relation to other secular concepts, provides room to reflect upon the diminishing influence of the essentialist debate on human dignity from a religious point of view, when we focus on the general conductivity of debate: how the concepts tend to connect each other. Finally, the abstract value of the “special status of a human” finds a connotative rationale in the treatment of a woman and her body. In the backbone structure of the discourse pattern, thus, while otherwise docile, the UK public response finds room for subversion, or reclaiming the rights of participation, ultimately in the right of a woman’s “egg”, or the politics of body.

Conclusion and discussion

Bioethical stances differ from country to country, and there are diverse ways of adopting public views of research regulation. As Sleeboom-Faulkner and Huang note (2012: 17), an important question is whether and how discussions are held and shape decision-making, how political mechanisms articulate these as guidelines, and whether or not these guidelines are enforced. In a global atmosphere of increasing standardization and professionalization of bioethics, questions regarding what democratization and public participation mean arise not only in the context of formal processes of participation but also in the context of the mode of semantic representation (Kim, 2012).

Table 5.2. Comparison of extracted opinion, belief and value

	PSP report	Alternative interpretation
Opinion	<ul style="list-style-type: none"> • Emphasis on disagreement with the use and creation of embryos for research • Mixed views regarding CNR • Juxtaposition of pros and cons regarding the human-animal hybrid or chimera embryos • Little changes for the government's list of research purposes needed • Wide ranging comments on the desirability of allowing the creation of embryos for treatment 	<ul style="list-style-type: none"> • Strong central organizing idea that the embryonic stem cell research can be allowed if it is for therapeutic purpose • Salience of various concerns of destroying (human) embryo or creating human-animal embryo • Semantically important opinion that human should be respected, especially when woman's body part (ova) is utilized for the research
Belief	<ul style="list-style-type: none"> • Religious stance against the possibility of eugenics • Ethical stance against creating a child with three genetic parents utilizing CNR 	<ul style="list-style-type: none"> • Semantically weak religious beliefs that disagree with human embryonic stem cell research • Sentiment against the hybrid or chimera should be respected
Value	<ul style="list-style-type: none"> • Precautionary principle for safety • Cure for patients • Scientific enhancement 	<ul style="list-style-type: none"> • Denotative value: research for therapeutic purpose • Connotative value: human right realized through the respect to woman's body

From this perspective, there are points of concern regarding the way the UK government collected and organised the public opinion. It was overly restrictive, and inevitably made the discrete opinions selectively representable. The alternative

interpretation presented in Table 5.2 does not replace the valuable insights derived in the PSP report, as my method delimited itself to focus on the salient form of discourses from the semantic network perspective. They must be mutually complementary. However, the identified gaps also call for more comprehensive surveying and a novel form of analysis in order to map the opinion, belief and value of the “representative sample”, and then engage in a deeper ethnographical reflection in the future.

So far, the UK government has shown a variety of practices committed to include the lay public in the highly complex scientific decision-making process mainly to cope with the “crisis of confidence” after the GM food and BSE crises (POST, 2001). Recent desk research commissioned by BBSRC and MRC (OPM, 2007) identifies five major public engagement initiatives (The Stem Cell Dream, North Cumbria Community Genetics Project, public debate on hybrid embryos and public perception of stem cell research), five main public consultations (including the one described here), and a few other surveys and opinion polls with respect to stem cell research that are conducted either by the government or public organizations.

As highlighted in this research, however, “the ‘problem of legitimacy’ (of experts) replaced by the ‘problem of extension’ of (public participants)” [Collins and Evans, 2002, p. 1] may not lead to simply extending the formal boundary of participants in scientific decision-making. It can raise more profound questions about:

how public issues are framed and thus given meaning, unveiling the neglected questions about how proper knowledge for relatively new domains should be negotiated as matters of “civic epistemology”, and how we have by default allowed previously institutionalised epistemic commitments to be extended to such domains with inadequate collective reflection and debate, shedding new light on its hidden context, public meanings and representations (Wynne, 2002: 402–405).

In this regard, the UK governance process reveals how opposition to embryo research, and hybrid or chimera embryos in particular, has eventually been overrun by the decision-making Parliament and scientific experts (Kim, 2012). And providing therapeutic solutions for the sake of the “common good” has become the dominant discourse. From our analytical perspective, the weakness of the lay public’s discourse in the UK, could be observed in the lack of articulation of “secular” causes and their

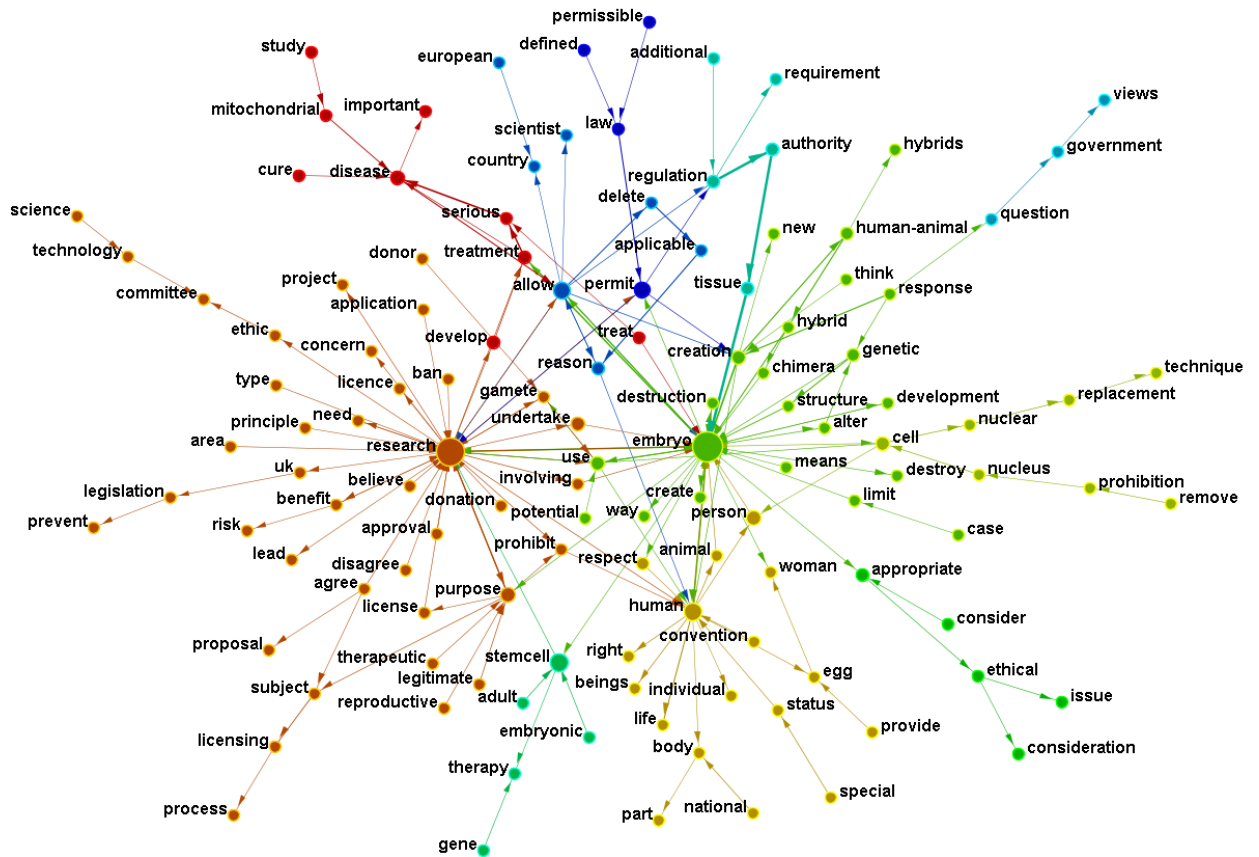
strategic linkages to other social issues. When mainly viewed through the semiotic arrangement of data, the unique issue of a woman's body, and the politicization of ova, seems to represent a socially effective argument. This resonates with Giddens (1991)' classical project of "emancipatory life politics", by means of politicizing the personal body in Western society. In this manner, existing social arguments reappear in life sciences.

As mentioned before, the limitation of my research is that the represented network characteristics do not lead to a confirmatory conclusion. Rather, as implicated in Table 4.2. [value] row, the result recasts the question how to position the denotative value of therapeutic stem cell research within the deliberation of connotative value, that is, human rights concretely realized through the governing of body parts. Although this does not raise any novel question, the result reaffirms the basis of scientific legitimacy at least represented by the Western (British) public, whereas utilizing unlicensed ova did not raise any serious concern among the public in South Korea (J Kim, 2009; L Kim, 2008). When considering the practical pathway of ethical supervision and democratic participation in life science, to paraphrase Sleeboom-Faulkner and Huang (2012: 22)'s comment, the mode of democratic participation including public consultation "may actually be more effective when those engaged with the material and political aspects of human embryonic stem cell research are *practically* encouraged to develop their views and are given serious consideration, rather than by creating a "democratic" system to poll all representative views" (italics inserted by myself). Thus, the professionalization of bioethics and expert-dominant culture witnessed in developed countries evokes the question: 'Are those who speak really able to legitimately say what they mean to deliver?'

The methodological efforts to uncover different aspects of social characteristics, I believe, should be able to respond to the question. The undergoing social-psychological effects of such political and semantic exclusion in the process of scientific governance eventually turn out be more interesting, partly because of the suppressed and twisted characteristics of social representation that had been dominated by both government's and elitist media's discourses on surface. In the next chapter, I discuss the problems with the case of "Hwang fandom" in South Korea.

Appendix I

The original backbone network of Figure 4.2



* Graphic produced by ORA

Appendix II

The mathematical representation of ‘story flow’ model (see Figure 4.3)

1. Let $B = (V_B, E_B)$ denote backbone network where V_B is a set of vertices in B and E_B is a set of edges in B .
2. By Newman-Girvan method, each vertex in V_B is assigned on i th group, where $i = 1, 2, \dots, n$. n is the total number of groups. Then define a set of nodes S_i as $S_i = \{v \in V_B | v \text{ has group number } i\}$. Also, we can define weighted edge between S_i s. Let E_S be a set of edges $e_{i,j}$ between two groups of nodes S_i and S_j , such that

$$e_{i,j} = \sum_{x \in S_i, y \in S_j} \begin{cases} e_B(x, y) & \text{where } e_B(x, y) \in E_B \\ 0 & \text{otherwise} \end{cases}$$

Surely, E_S is not symmetric.

3. Let flow denote F as;
 - (a) $F = (V_F, E_F)$ where $V_F = \{S_{i_1}, S_{i_2}, S_{i_3}, S_{i_4}\}$ and $i_1 \dots i_4$ is in $\{1, 2, \dots, n\}$
 - (b) $S_{i_4} = \max_{k=1, \dots, n} \text{Input Closeness}(S_k)$. If $\max_{k=1, \dots, n} \text{Output Closeness}(S_k)$ is connected with S_{i_4} , then $S_{i_1} = \max_{k=1, \dots, n} \text{Output Closeness}(S_k)$. Otherwise S_{i_1} is chosen by next maximization step.
 - (c) With fixed i_4 , $\|F\| \geq \|(V_{i,j,k,i_4} = \{S_i, S_j, S_k, S_{i_4}\}, E_{i,j,k,i_4})\|$, where $i \neq j \neq k \neq i_4$ and $\forall i, \forall j, \forall k \in \{1, 2, \dots, n\}$

$\|F\|$ is 1-dimensional norm, defined as $\|F\| = \|S_{i_1}, \dots, S_{i_j}\| = \sum_{k=1}^{j-1} (e_{i_k, i_{k+1}} - e_{i_{k+1}, i_k})$
4. Define $OC(x)$, $IC(x)$ and $BC(x)$ as;
 - (a) $OC(x) : S \rightarrow R^+$ where S is a set of sets which contains vertices in Network, and R^+ is a set of positive real number. A range of $OC(x)$ is a set with one element, which is Output Closeness of x .
 - (b) $IC(x) : S \rightarrow R^+$ where S is a set of sets which contains vertices in Network, and R^+ is a set of positive real number. A range of $IC(x)$ is a set with one element, which is Input Closeness of x .
 - (c) $BC(x) : S \rightarrow R^+$ where S is a set of sets which contains vertices in Network, and R^+ is a set of positive real number. A range of $BC(x)$ is a set with one element, which is Betweenness Centrality of x .
5. In each S_i in flow, choose its representative vertex such as

Case of S_i	Representative vertex
S_{i_1}	$\max_{x \in S_{i_1}} OC(x)$
S_{i_2}	$\max_{x \in S_{i_2}} BC(x)$
S_{i_3}	$\max_{x \in S_{i_3}} BC(x)$
S_{i_4}	$\max_{x \in S_{i_4}} IC(x)$

6. Also, choose 10 vertices(words) in each S_i of flow such as;

Case of S_i	10 Vertices
S_{i_1}	$\{x_{j_1}, \dots, x_{j_{10}} j_k \text{ is descending order of } OC(x)\}$
S_{i_2}	$\{x_{j_1}, \dots, x_{j_5} j_k \text{ is descending order of } OC(x)\} \cup \{x_{j_1}, \dots, x_{j_5} j_k \text{ is descending order of } IC(x)\}$
S_{i_3}	$\{x_{j_1}, \dots, x_{j_5} j_k \text{ is descending order of } OC(x)\} \cup \{x_{j_1}, \dots, x_{j_5} j_k \text{ is descending order of } IC(x)\}$
S_{i_4}	$\{x_{j_1}, \dots, x_{j_{10}} j_k \text{ is descending order of } IC(x)\}$

Each 5 vertices appear in both side of a vertex in flow and represent their edge if they exist.

6. Deprived Dreams and Missing Values in South Korea

Introduction

Unlike the British public audience that was more or less actively invited to present views on emerging life science and stem cell research, ordinary Korean people, in a sense that they were not affiliated with any stakeholder groups including NGOs, had been widely excluded from the public deliberation until the Hwang debacle that broke out in 2005 forced some social scientists, in particular, to reflect on the cause. Actually, the Hwang affair was unprecedented in science history not only in the magnitude of misconduct and the global impact but also in terms of the South Korean public's 'extraordinary' response.

In February 2004, Professor Hwang's Seoul National University team published a ground breaking paper in the journal *Science*, announcing the successful derivation of a single stem cell line from a cloned human embryo. In the following year, Hwang reported an even more stunning accomplishment, namely the derivation of 11 'patient specific' stem cell lines, which were seen as bearing witness to strikingly improved levels of efficiency in using human eggs. However, what was celebrated in South Korea as the nation's scientific triumph was soon undermined by allegations of ethical misconduct in acquiring human eggs from women in disadvantageous positions, and then followed by accusations of scientific fraud. What brought about the international attention was not Hwang's fraud alone. In November 2005, the South Korean broadcaster the MBC reported Hwang's unethical collection of ova, and questioned the authenticity of his experiment. After the broadcast, tens of thousands of angry South Korean people posted comments on the MBC's web page fiercely criticizing the broadcasting. Online communities of Hwang fandoms each composed of thousands of members boycotted television commercials and organised massive demonstrations in front of the MBC building.

In response to the threat and animosity felt throughout the country, the MBC dissolved the 20 years' long-lived investigative program *PD Notebook* without any promise of return – until anonymous scientists on the Korean website of the Biology Research Information Center (BRIC) started to post evidence of Hwang's fabrications. Meanwhile, a truck driver set himself alight in protest over the charges against Hwang,

claiming Hwang was the victim of a conspiracy and unjustness in Korean society. The public protest went on even after, in 2006, Seoul National University and the Prosecutor's Office investigated the affair and concluded that Hwang had fabricated evidence and behaved unethically (see Appendix I).

The frenetic support of a star scientist and violent activism, even after the disclosure of his misconduct, seems hardly imaginable in other parts of the globe. The phenomenon unveiled a variety of interesting characteristics for researchers in social science as well as experts in the public understanding of science. Firstly, people's support for Hwang and their attack on the MBC through internet media was a new form of social movement that proved the effectiveness of utilizing information technology. Living in one of the most densely wired (with optic fibers and Wi-Fi nets) countries in the world, South Korean citizens spontaneously initiated their social engagement in scientific affairs through online websites. They successfully mobilized a "cyber attack" that immediately brought down one of Korea's major broadcasters, the MBC, which had raised questions on the unethical collection of ova and the fabrications in Hwang's laboratory. Secondly, the demonstration was unprecedented because supporters refused to conform to official verdicts of Hwang's fraud. Somewhat paradoxically, they actively mobilized social criticisms against state institutions and expert groups by exploiting nationalist rhetoric originally produced by the government and the major mass media to encourage science for national growth. Thirdly, the campaign was not driven by an "underclass" or "scientifically illiterate" people. The movement consisted of a wide range of sympathetic and conscious actors including some intellectuals and activists who were willing to fight for a 'just cause' (Kang, Kim and Han, 2006; Kim, 2009).

Previous studies provide some clues for this phenomenon. To counter explanations that de-contextualize or stigmatize the public as merely "irrational", some sociological studies focused on the intricate logic of the public's feelings about science. There was a story of Hwang that a number of Korean people readily approved of: a humble boy who had grown up in a poor rural family yet had established himself as a diligent global scientist, always pronouncedly displaying modesty and patriotism. This dramatic personal life also epitomized people's pride in the contemporary history of South Korea, a nation that has risen from being one of the poorest countries to one of the most industrialized countries in half a century. Meanwhile, many media reviews and social science studies have mentioned the lack of accountability of responsible institutions, which undoubtedly

aggravated the public's distrust, whilst Hwang's story stirred the pathos of nationalism (Kang et al., 2006; Won and Jun, 2006; Kim, 2009).

Nevertheless, the "blind nationalism" thesis requires a more elaborate substantiation, running short of explanations when questioned: a) Can people showing support and sympathy to Hwang and his stem cell research be reduced to a simple nationalism as a formal ideology? b) If not, which connotative elements associated with people's lives, feelings, and social context drove them to violent activism? and c) What explicit and implicit frames used by supporters might be captured by an alternative analysis?

The majority of South Koreans are known to be very nationalistic. However, this does not mean that these people necessarily follow the formal ideology and cultural hegemony that had been associated with Korean nationalism since the colonial modernization from the early 20th century (Shin and Robinson eds., 1999). Even under the rigid hegemonic authority structure (Kim, Jung and Park eds., 2003) as witnessed in Hwang's own laboratory just like other parts of Korean society, the concerned actors applied adept tactics to incorporate, appropriate, and twist the cultural rules of the game for their own interests, finally betraying their master – Hwang (Kim, 2008). This fact leads us to ask:

- What was the narrative told in the public discourse following the MBC broadcast and expert groups' investigations?
- Why did Hwang's case attract such dogged support? What kind of underlying desire was expressed in the public discourse?
- What was a core motive to the discourse underlying the denoted nationalism; was it purely a collective patriotism coupled with the prospect of 'holy grail' of embryonic stem cell research, or something else?

The semantic analysis of the general public's internet dialogues on the scandal attempts to excavate different answers to these questions. In contrast to a nationalism frame argued by existing literatures (Kang et al., 2006; Won and Jun, 2006; Gottweise and Kim, 2009), public anger swelled not only from Korean patriotism, regarding Hwang's confession of his misconduct as dissolving national research capacity. As I argue in this chapter, people were also upset because of Hwang's humiliation and his public disgrace; these were

believed to be typical consequences of social mobility in South Korean society. In the eyes of the general public, the personal tragedy was imagined to be motivated by jealous rivals who plotted to embarrass and subdue a gifted individual who rose from a humble, innocent, social status. The feeling of shared sympathy for Hwang and deep distrust against expert institutions lingers on in the networked semantic representations, with changing objects of blame.

Research object and methodology

Research object

My target of analysis was the general public, not the official groups of Hwang supporters. I chose to study broader public dialogue on a website for two main reasons. Firstly, the majority of South Koreans, independent from official supporters' activism, have been in favor of Hwang despite his misconduct.¹ Secondly, this general support through the internet not only created a sympathetic national environment for Hwang but also provided grounds for public engagement that led to thousands of people demonstrating in public places. For similar reasons, I chose a general and open discussion website in South Korea (*Daum Agora*) to analyse the uploaded dialogues. *Daum Agora* is a South Korean website for open discussion that has more than 30 million affiliated members in which both pros and cons freely express their opinions on controversial issues. In the Hwang supporters' official websites, opinions were unilateral and the members usually did not allow dissenting voices to be posted on their boards. In comparison, supporters' discourses in *Daum Agora* tended to be more persuasive, more often than not trying to make sense of their ideas rather than merely bursting with emotion. This provides a researcher with an advantage for systematic coding of their statements.

The duration of the data coding is separated by three main events, starting from 25 November 2005 to 9 January 2006; from 10 January to 14 May 2006; and from 15 to 31 May 2006. The online debate initially exploded after Hwang made a profuse apology at a press conference on 24 November 2005. Hwang admitted his unethical collection of ova from purchase and from junior researchers in his laboratory. November 25 is one day after; 10 January 2006 is the date the verdict was made by the Auditing Committee of Seoul National University on Hwang's fabrication. 31 May 2006 is two weeks after the

Prosecutor's Office announced Hwang guilty of fraud and embezzlement of research funds.

Manual coding and derivation of key themes

As I have presented in previous chapters, a network such as a cognitive map (Carley and Palmquist, 1992; Park and Leydesdorff, 2004; Hellsten, Dawson and Leydesdorff, 2010) is not usually based on manual extraction of concepts but automated co-word mapping. Automatic coding and representation, as seen in the previous Chapter 4, enables one to identify and measure implicit as well as explicit concepts in the communication through their position emerging from their pattern of referential linkages to other concepts in more stable manner. The coding choice I made in this chapter, is to merge the two approaches of manual coding of co-occurring words and the automatic analysis of centralities and patterns of linkages. The main reason is that this work predates other developed semantic network analyses I presented in my thesis. In this initial work, my main motive was to represent sequential linkage (see Chapter 4) other than simple co-occurrence models used in existing academy. As explained in *Visualizing and measuring discourses with semantic network* section (pp. 17-18), it is important to preserve the traditional manual technique focused on identifying a key associative thematic relation between two concepts of keywords in each posting, summarized as an 'a refers to b (a→b)' connection, that are relational rather than frequency based analysis. As to the automated categorization of themes, the method of blockmodeling (de Nooy, Mrvar and Batagelj, 2005) in some ways elaborates the co-occurrence approach based on the same principle of hierarchical clustering, but with incorporated patterns of directionality that are more explicitly considered (see Appendix II).

As the textual data were in Korean language, a few moderations were made in manual coding. I initially identified all the "substantives" in the text. This inevitably filters out adjectives, adverbs and verbs that do not contain substantives in their form. The aim is to focus on "what" topic people talk about, instead of "how" they describe it with more subtle expressions that are hard to standardize in coding. This feature, however, can vary across different languages. For example, "exercise" in English can be either a verb or a noun, but the verb "exercise" in Korean is composed of the substantive "sports (운동)" and the descriptive verb "do (하다)". In this case, the substantive part "sports (운동)" is

incorporated into the coding whereas the verb “do (하다)” is omitted from the word “sports-do (운동-하다)”. Then I linked the substantives from left to right direction, adapting to the so called natural language flow, by applying a storyline coding method. The stop unit is each paragraph of people’s postings. When the adjacent word or concept is not directly related to the prior word in meaning, unlike automatic coding, I skipped the word and link to the next with the same principle, taking more consideration on their semantic relatedness.

Collecting “smart” samples out of big data

Applying the search keyword “Hwang Woo Suk” (‘황우석’) in an IT/science discussion room, out of 12,278 postings in public discussion website *Daum Agora* (<http://agora.media.daum.net>), I collected 200 postings and divided the data according to the three different phases: 100 for the most controversial first period and 50 each for the subsequent two periods. The reason and criteria for selecting relatively small sample out of numerous documents (postings) needs to be explained: First of all, despite a number of postings, there were significantly fewer documents that contained well-addressed arguments to support professor Hwang; and most contained burst of emotions and abusive words. Secondly, I wanted to focus on some qualified arguments that might shed light on underlying concerns of people rather than to highlight formal statistical results out of the total data. In other words, I regarded the collected data not as a representative sample, but a data corpus (Bauer and Gaskell, 2007) akin to a transcription of a sizable focus group interview (FGI) of discussants that has occurred online. Therefore, the data do not mechanically ‘re-present’ the population of discussants and the frequency of their opinions; but alternatively aim to open up an opportunity to engage in a systematized analysis on the core feature of discussion. And this choice represents my methodological opinion how the method of network analysis should be aligned with existing qualitative methods and the selection of data.

Network representation

The communication between science and lay people is not a simple flow of information from top to bottom. It embodies a complex structure of co-dependency and interaction between different value systems. In the public sphere of science, overlapping representations constructed by various social groups mediate actors' own desires. The representations reflect their social life, and influence the feedback process between science and social practice. Although discourses as effects of communication are operations that cannot be observed directly (Luhmann, 1995), one can make inferences about them by testing hypotheses against the observable interactions among the agents. Communications and agents are structurally coupled in the network form of communication, which can be used as indicators of the evolving communication processes (Leydesdorff, 2006). Likewise, popular opinions about the Hwang scandal undergo a process of selection and expansion over time, which forms a network of meaning, a system interconnected with other representations. Looking at the frequency of postings, 68.7% are concentrated from November 25 to December 2005 (3,544) and January 2006 (4,890), the periods when the public inquiry into Hwang's misconduct and the investigative announcement by the expert committee at Seoul National University (SNU) were made, respectively. After the SNU team's investigation, the number plummets; and continues to decrease after the Prosecutor's Office accused Hwang in May 2006. This flow generally captures the change of public climate. The lay public's demonstration of support declined rapidly after the SNU announced fabrications in Hwang's experiments. However, the figure may deliver a misleading image that people's general 'feeling' of support also proportionately declined. As observed in recent polling (see Note 1), it is the form rather than the content of support that changed, which can be understood as a transformation from explicit support to implicit sympathy.

The semantic network analysis tries to capture the content and meaning of unchanged support through their narrative structures. Figure 6.1 shows the illustrated outcomes of semantic networks in the three phases. The computerized network analysis tool Pajek visualizes the positions of keywords as nodes in the network, and the frequency of their relations as link width. This also locates the most central keywords in the centre of the map, and peripheral nodes in the periphery. The mutual distance among the nodes of keywords roughly reflects a proximity in their referential linkage. Finally, the nodes are grouped together as denoting the same theme by blockmodeling.

Period 1: Surging controversy (25 November 2005–9 January 2006)

In Figure 6.1, the node “national interest” is positioned in the centre as it is linked with more neighbouring concepts than others, which is strongly linked to the expectation of “royalty” [of patent] that is anticipated to come out of Hwang’s experimental achievements in the future. The concept of “moral relativity” is also frequently mentioned to exonerate Hwang’s misdemeanor; that scientific fraud is a blurry concept in actual scientific practice and unethical collection of ova could be pardoned because the “national interest” to build a scientific capacity is the most important national agenda instead of caring about ethical concerns voiced by “stupid civil groups”.

A. Period 1: 25 November 2005–9 January 2006

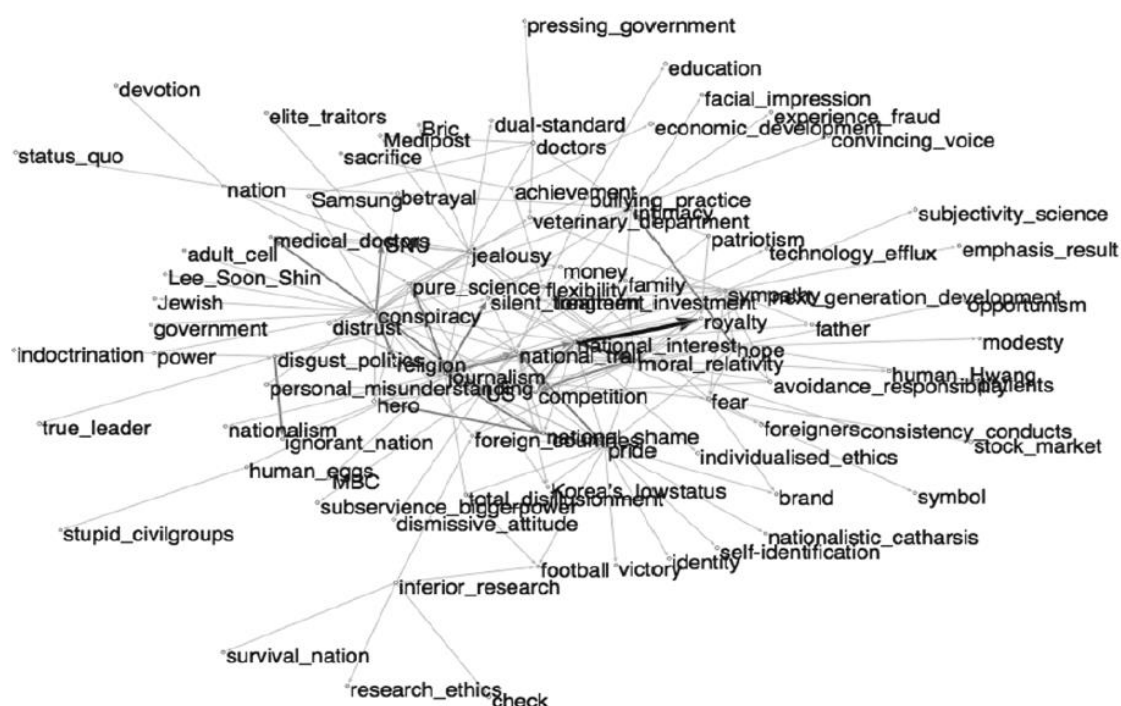


Fig. 6.1. Semantic network

To study the structural pattern of the discourse, we need to reduce the complex network into a visible relation of subthemes. The blockmodeling method categorizes a group of “structurally equivalent” (Wasserman, 1994) nodes that have a statistically similar linking pattern with other nodes. In other words, structurally equivalent words in a group have identical referential (linking) patterns and therefore they are functionally

identical one another in representing a common theme. For example, the Class 3 in Table 6.1 comprises “national interest”, “US”, “journalism”, “pure science”, “hero”, “personal matter”. These words are structurally equivalent or functionally identical in so far as they have similar linking pattern with other words, and intend to deliver an identical message that is a defending logic of protecting Hwang from any accusation. In this manner, six thematic subgroups emerge: while people’s minds are categorized by a strong feeling of 1) <pride> and 2) <conspiracy> on Hwang’s scientific accomplishment and the scandal, 3) <defending logic> on the need to protect “national interest,” the people’s “hero” and “pure science” from the plotting of the “US” and “journalism”, or an attempt to trivialize the scandal as a “personal matter”, which led to their constructing a common motivation for the support of Hwang, 4) <conspiring elements> as “national trait” is grouped together with “jealousy” and “competition”; actors such as Seoul National University (“SNU”), competing medical doctors (“MD background”), “government” and “foreigners”. 5) <Korean identity> felt through sympathizing both Hwang and Korea’s low status that had to bear the worldly humiliation, and 6) <emotional feelings> with keywords like “distrust” and “national shame”, and terms expressing support for Hwang with feelings of a “father” or “intimacy” about him, while criticizing the “bullying culture” aligned against him (Table 6.1).

Table 6.1. Classified keywords and representing theme

Period I

Class	Representing theme	Keywords
1	Pride	pride
2	Conspiracy	conspiracy
3	Defending logic	national_interest, US, journalism, pure_science, hero, personal_matter
4	Conspiring elements	national trait, jealousy, competition, SNU, government, MD background, foreigners, etc.
5	Korean identity	identity, nationalism, moral relativity, world_cup, low_status_of_Korea, etc.
6	People’s feelings	distrust, national_shame, patriotism, family, father, intimacy, bullying_culture, catharsis, etc.

On the other hand, graphically reducing the network into the core themes by merging the keywords into a thematically labeled node (Figure 7.4(a)) provides an intuitive way to learn how these themes are interrelated to form a collective narrative and

how they make the logic of reference. Supporters' pride in Hwang's stem cell achievement produces a strong relation with their self-identity and defending logic; and the defending logic refers to some conspiring elements as their explanatory objects. Likewise, the notion of conspiracy presents numerous explanations for various conspiring elements. In short, Korean people's pride in their scientific achievement needs a defending logic for the shameful charge against Hwang. And the defending logic induces a drive to find conspiring objects in order to support a conspiracy theory.

Period 2: After the investigation (10 January 2006–14 May 2006)

The report of Seoul National University's investigation on 10 January 2006 cast more suspicion rather than bringing an end to the scientific controversy. The represented network (Figure 6.2) demonstrates people's shift of focus toward general feelings about Hwang's identity and suspected plots against him.

B. Period 2: 10 January 2006–14 May 2006

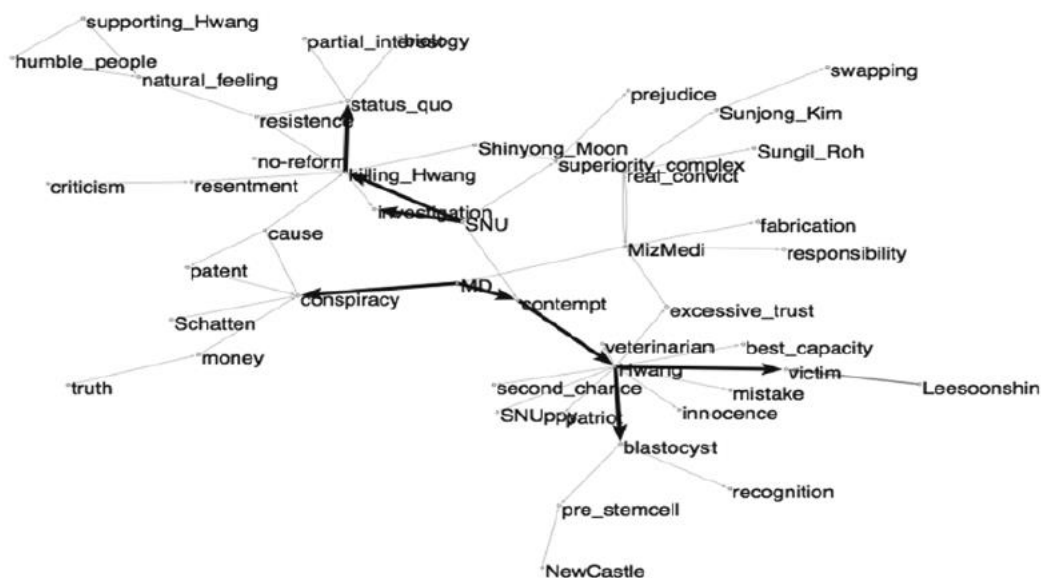


Fig. 6.2. Semantic network

Hwang's ability to produce a 'blastocyst' with his unique somatic cell nuclear transfer (SCNT) technique is consistently emphasized. Meanwhile, Hwang himself is portrayed as a victim of hostile rivals such as more privileged medical doctors ("MDs")

who are known to “despise” Hwang who is from a less prestigious academic (veterinarian) background.

Table 6.2. Classified keywords and representing theme
Period 2

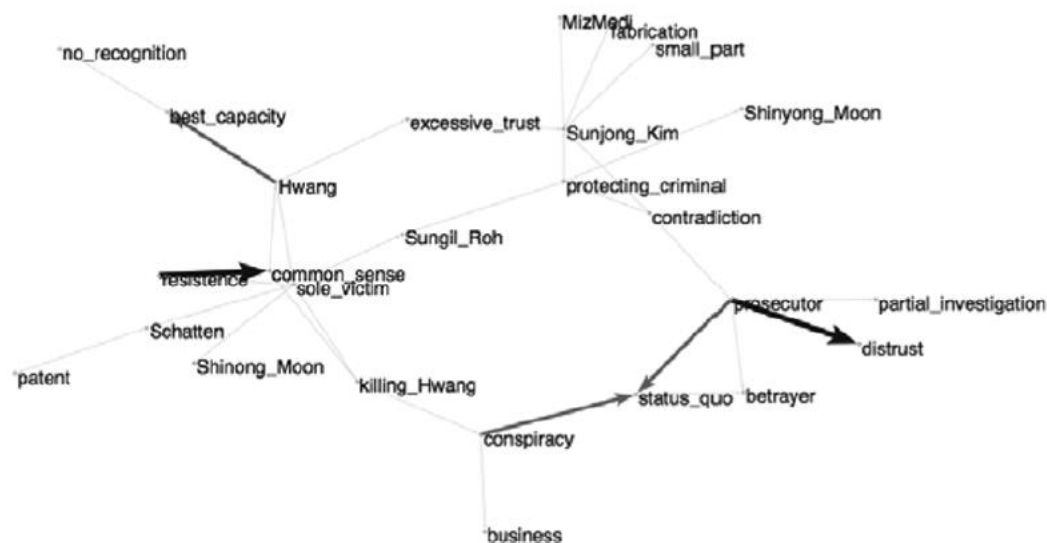
Class	Representing theme	Keywords
1	Hwang	Hwang
2	Hwang's identity	veterinarian, mistake, no_responsibility, blastocyst, patriot, SNUppy, second_chance, victim, best_capacity, excessive_trust
3	Conspiracy	conspiracy
4	Conspiring elements	essence, money, patent, MD
5	People's feelings	prejudice, superiority_complex, contempt, SNU, investigation, killing_Hwang, responsibility, real_convict, Mizmedi, Sunjong_Kim
6	Schatten	Schatten

With the manual reading of original postings that contain those searched words, it generally appears that people frequently argue that emotional elements such as “contempt” and “prejudice” coupled with the “superiority complex” of “MDs” have subdued Hwang who is from a humble social background. Participants in the *Daum Agora* discussion iteratively state that this “scapegoating” is related to a conspiracy, which is essentially motivated by “money” or a “patent” issue. In this typical discourse, contrasting Hwang’s humble identity against a conspiring status quo with pejorative motives produces a typical narrative of a fallen hero – from humble origins.

On the fraud issue itself, posted statements do not consider Hwang as mainly responsible for the misconduct. People are aware of the fact that Hwang’s own contribution to the experiment was limited to the somatic cell nuclear transfer stage, while the rest of the process – culturing inner cell mass extracted from the blastocyst and deriving stem cells – was undertaken completely by external collaborative teams including Mizmedi hospital, the medical researcher Sunjong Kim, and other domestic and foreign collaborators. Therefore people come to inquire, ‘Where are others’ responsibilities, as they also shared fame and interests?’ As demonstrated in the network, people’s resistance against the experts’ decision springs from this often cited ‘common sense’ doubt. This doubt not only justifies people’s feelings about the Hwang scandal but also compels them to identify a “real convict” such as Sunjong Kim and the American

collaborator Gerald Schatten (Figure 6.4(B)) who had been a co-author of Hwang but announced the severance of his ties immediately after public suspicion arose.

Canvassing through the postings before the prosecutor's official judgment, many expressed the view that the prosecutor's investigation could answer the unresolved question of the responsibility of the other researchers. The prosecutor's announcement confirmed that Sunjong Kim brought already established stem cells from Mizmedi hospital and reported to Hwang that he had derived the stem cells. Hwang then asked Kim, initially believing Kim's report, to exaggerate the number of derived stem cells to highlight the efficiency.



The internet participants' general reactions to the report are critical. The aggregated postings claim that the prosecutor's conclusion was a "partial investigation" or even a "contradiction" that is "protecting the [real] criminal" and concealing a "conspiracy" while not recognizing Hwang's innocence (Figure 6.3). Supporters question why Sunjong Kim was not convicted for the grave crime of fabrication, while Hwang was charged with the relatively minor transgression of embezzling research funds. From a

legal perspective, it made sense that Kim was only charged for the minor “obstruction of work” and not for the “fraud” in legal terms. But people found it hard to accept that this enormous scandal had been reduced to a transgression by one junior researcher, while Hwang had been charged with other, trivial affairs.

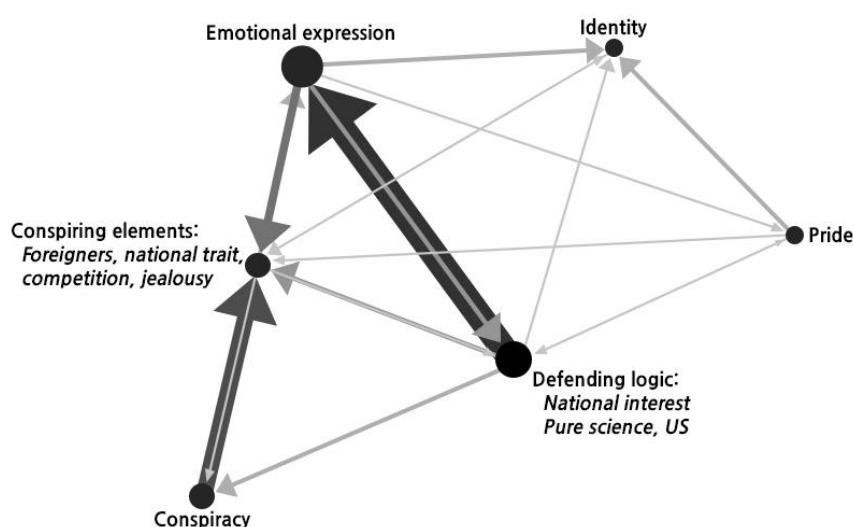
Table 6.3. Classified keywords and representing theme

Period 3

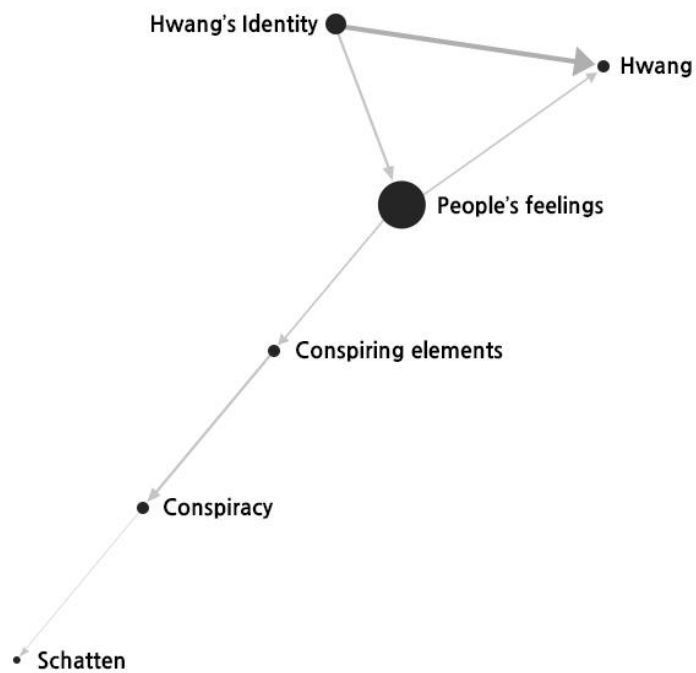
Class	Representing theme	Keywords
1	Public perception	common sense, Hwang, killing_Hwang
2	People's feelings	contradiction, protecting_criminal, distrust, partial_investigation, status_quo, prosecutor, conspiracy, no_recognition, etc.
3	Sole victim	sole_victim
4	Objects of resistance	resistance, Moon, Roh (Mizmedi), Schatten

As the evolving map (Fig. 6.4) signifies, Hwang continues to be the sole victim of the complex and ambiguous crime in the eyes of the public. Consequently, this dissatisfaction compels people to seek objects of resistance that include Hwang's other collaborators who evaded collective responsibility for the misconduct. In other words, the objects of accusation, Moon, Roh and Schatten, become mediated objects of resentment and distrust, which is finally pointing at the status quo represented by prosecutors, major media and other scientists.

a. Period 1: 25 November 2005 – 9 January 2006



b. Period 2: 10 January – 14 May 2006



c. Period 1: 15 May – 31 May 2006

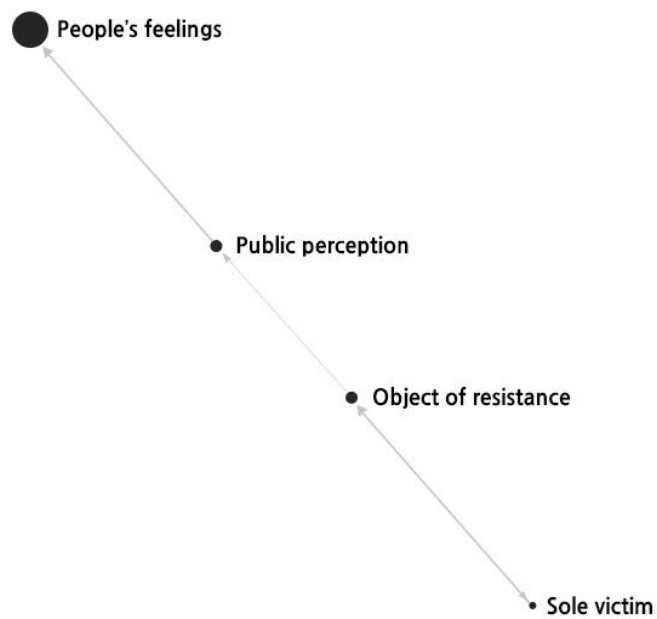


Fig. 6.4. Reduced discursive structure

*Pajek's graphical result redrawn with illustration

Analysis of discourse

Denotation and connotation

The trajectory of Hwang supporters' dialogues shows a narrowing of theme: from national pride and conspiracy theory to a personal sympathy for Hwang, suspicion of his collaborators, and distrust of authority. In contrast to the conventional view that depicts the supporters as irrational, the studied discourse demonstrates a certain rationality of "collective intelligence". The participants quickly find logical loopholes in official explanations and request more information. Similarly to Jong-Young Kim (Kim, 2009)'s argument after his ethnographic study on the Hwang supporters, it is inferred that people's resentment comes from an institutional vulnerability: that the institution in question is incapable of handling "information and legitimation deficits" (Bauer, 2002). Through collective sharing of knowledge and information in the web space, Hwang's supporters gathered a number of, if not always accurate, pieces of scientific information related to the debate. In contrast, the Investigative Committee's accounts did not fully respond to the people's demands, eager to know the truth on every point of the issues. Because Hwang was charged with the fraud of the stem cell experiment that he himself did not conduct at first hand, public suspicion was directed at the role and the responsibility of Schatten and other colleagues. The sudden denouncement of Hwang alone provoked predictable public resistance. And the expertise of the SNU and of the prosecutor was seriously questioned or denied.

Both in off-line interviews of supporters (Kim, 2009) and the web postings, the discourses of personalised drama represented as Hwang's rise and fall, people's highly emotional attachment to the narrative and anger against the rather vague "status quo" or "authority" are commonly witnessed. And it becomes important what this kind of discursive characteristics might explain beyond "blind nationalism" thesis (Kang *et al.*, 2006; Gottweiss and Kim, 2009) that solely highlighted people's willingness to conceal any misconduct of Hwang for the sake of national interest. Besides studying the thematic categories of keywords and their linkages, the analysis of the position of individual keywords unveils their functional and discursive importance. Betweenness (denotation) and In-closeness (connotation) centrality each identify critical signifiers that have central positions in the semantic interactions. While the former represents a denotative character

by mediating both triggers of information and referents, the latter represents a connotative concern where keywords eventually converge in the semantic network.

As Table 5.4 summarizes, most denotative arguments in the first period mobilize “national interest” as a rationale and blame “journalism” and “conspiracy” that worked against Hwang. On the other hand, the most prominent concept that is located in the connotative frame is “national trait” (gookminsung). From people’s written explanations, this trait is interpreted as a shared national sentiment, describing reluctance to recognise another individual’s success and a collective attempt to destroy his reputation out of jealousy.¹⁹ The theme of severe “competition” is also closely linked to this expressed frustration. These concepts may reflect people’s core anxiety felt in their daily lives, the downside of the national trait, as well as a rationale to compete with foreign countries by any means and devoid of just principles in scientific practice. Meanwhile, Hwang is often referred to as a “father” of a “family-nation” who should not be disgraced in such an open manner, revealing a family-oriented Korean culture pervasive in public affairs, amounting to a “silent treatment” of the Hwang scandal.

Table 6.4. Denotation and connotation of public responses

Period	Denotation (Betweenness)	Connotation (In-closeness)
1	Journalism	National trait
	National interest	Competition
	Conspiracy	Silent treatment
2	Hwang	Conspiracy
	Medical doctors	Medical doctors
	Contempt	Schatten
3	Common sense	Shin-Yong Moon
	Hwang	Sung-il Roh
	Sunjong Kim	Sole victim

¹⁹ Several notes could be made that jealousy is not a Korean characteristic alone. In an interview with the American stem cell scientist Stephen Minger, he expressed a similar belief that the Hwang scandal was aggravated by colleagues’ malignant disclosures. Dr. Minger said that he was certain that colleague scientists’ jealousy did play a part, as he frequently observed such sentiment in his working environment as well (Dr. Minger was employed as a full-time professor in King’s College then). What is interesting in the public response in South Korea is rather that people readily expressed strong resentment against the possibility of a “back-stabbing”, as if it was easily observable in their daily lives.

The core concern in the second period is a personal struggle between medical doctors and Hwang. The word “medical doctors” is one of the most important keywords in both denotative and connotative framing that is represented as a subject of “contempt” and “conspiracy” against Hwang. In the last period, supporters finally take recourse to “common sense” while defying the verdict of the prosecutor. As the institutional decisions of fraud stand against the people’s common sense or belief system, Hwang would finally remain the unfortunate victim of the “mysterious” tragedy.

Understanding the resistance

Particular institutional conditions and performances that failed to gain the public’s trust led the public to coin unofficial interpretations that spurred resistance. No wonder, since the most representative institutional authorities, depicted as the *status quo* by the public, i.e. the government, the scientific community and the press, lost credibility because of what the public saw as their inconsistent, opaque and dishonest responses to the Hwang affair (Kim, 2009). However, the institutional failure does not fully explain the unprecedented degree of public hype, personal aspiration and subsequent frustration that escalated into a self-destructive social movement.

The results of the analysis of the semantic networks imply that public responses were neither purely cognitive nor really concerned about the validity of the experiment. They were rather tied to people’s emotional motives, reflecting their own daily experiences. The public image of a fallen hero, Hwang, subdued by a conspiracy of the status quo, is consistently related to the people’s implicit concern for matters of recognition and disrespect. For instance, the director of the Investigative Committee, Myunghee Chung, inflamed the public when she bluntly denounced Hwang’s capacity to produce a stem cell line in the public announcement. Although it was clear that Hwang did not produce any stem cell line, Koreans nonetheless highly regarded his team’s skill in animal cloning and also felt that having developed quite a number of human blastocysts was already a great achievement. A number of people even called this blastocyst stage “pre-stem cell”. Therefore, the committee’s total denial of Hwang’s potential was received as an obscure motivation of other jealous scientists to “killing Hwang”.

Moreover, the centrality analysis of concepts suggests that there is ambivalence in the notion of a “nationhood”. In contrast to claims that the “Hwang fandom” was simply motivated by a culture of nationalism, the represented frame of the network discloses that

both “national interest” as a rationale of the movement and disgust at the “national trait” coexist in the supportive discourse. More crucially, the absence of salient concepts related to serious debates on ethical transgression or the possibility of fabrication suggests that neither the ethical issue of collecting ova nor the authenticity of Hwang’s research itself really mattered to the public at all. In brief, the source of public anger over the scientific event lay elsewhere.

The characteristic of public hype on embryonic stem cell research preceding the Hwang scandal offers a clue to my different interpretation. Before the scandal, the South Korean government zealously propagated the prospect of Hwang’s success to justify the elaborate level of state support of the life sciences. Resorting to deeply rooted nationalism was a means of delivering this justification symbolically and emotionally. And Hwang’s success fitted well into this symbolic demand for dramatization (Kim, 2008: 402–403). In general, people accepted this symbolic mobilisation of national projection, but the cause of their personal enthusiasm and the sentiment of attachment came from elsewhere. As mentioned, people favored the Hwang story because his skyrocketing success from an institutionally humble status inspired aspiration. Living in a rapidly industrialized nation where achievement motivation used to be emphasized as a *raison d’être* to survive severe competition, people identified Hwang’s success story with the projection of their own success, while conforming to the official discourse of national glory won by scientific success. When Hwang’s sudden failure and the subsequent institutional charges against him were reported, people were ready to react with accusations against frustrating institutional environments where ‘pure effort’ is thought to be hampered or betrayed. Out of this sentiment, a number of South Korean people firmly believed that resisting the official verdicts of fraud was a civil commitment, in order to restore a sense of justice. An interview on condition of anonymity with a professor of pharmacology in South Korea implies that this public sentiment is not confined to a scientifically illiterate group of activists or “non-experts”:

It is obvious that jealousy was involved in the killing of Hwang, as it happens all the time. Those medical doctors and other academics who barely make any efforts on their own scapegoated a person like Hwang who had made such sincere efforts to position himself on the international level. Hwang was destined to fall after acquiring such huge fame, and this really is a problem of our national trait. (Interview with a pharmacologist, 5 March 2010)

Therefore, it is logical to conclude that the Hwang supporters' denoted nationalism was only one side of what was expressed. The other side was the connotation of frustration, born of watching Hwang's success slide into failure. Having projected their own aspirations to succeed onto Hwang, his supporters identified with his failure, thus energizing their defense of the "fallen hero". To a certain extent, this kind of Janus-faced representation may reflect the historical background of Korea. This background is one where knowledge, and science, have been typically defined narrowly as a means to gain status and recognition in a highly stratified society (Kim, 2008: 399–401) rather than a pure pursuit of truth. Whereas the fact that popular resistance could occur only when coupled with the rhetoric of "national interest" reflects Korea's history of modern state-building and industrialization with a recursive, and coercive, emphasis on nationalism for mobilisation by military regimes, while suppressing individuals' desires to 'stand-out' in public affairs.

Summary: implications for the mode of public participation

My analyses and conclusion differ from existing literatures in two key points. First, the nationalism frame suspected as the cause of public activism embodies a duality, as it also contains a feeling of disgust against a negative side of the national trait. Second, this feeling of disgust as a source of anger is related to people's frustration over barriers to personal success, imagined to be confirmed by Hwang's disgrace. From this perspective, the public protest in support of Hwang functioned as an opportunistic event for people to express their latent desire and frustration, with little consideration of the scientific issues or the misconduct itself. In a cultural context where scientific progress was thoroughly framed and dramatized as an individual's success, spurred by institutional propagations, there was little room for rational assessment or ethical deliberation on the topic of governance of human embryonic stem cell technology. Institutional incapacity to respond to people's suspicions after the scandal also provoked a conspiracy theory and activism.

The "active participation" of the public in the Hwang scandal leaves room to reflect on desirable modes of public engagement in science communication. Neither the deficit model (Wynne, 1992) nor romanticization of public participation seems to be a viable solution, as both reify the actors as value-laden social entities without questioning their social capacity to reflect on the science. Reflecting the South Korean experience,

how to engage expert knowledge and its underlying logic of debate into everyday dialogues, and construct a “socially deliberative subject” of communication in the public sphere, seems to be vital for safeguarding against ‘miscommunication’ that sprung out from a DAD (Decide, Announce, Defend) science policy.

If public participation is not a panacea to the challenges in science policy, we need to have a closer look on how the governmentality (the way governing operates) of life science has encouraged a certain strategic behaviour, and what choice actors engaged in the biopolitics (life scientific decision-making and subject’s strategic choice) has actually made. So far, we investigated the media framing and people’s perception in the UK and South Korea to identify the national discursive characteristics and key interests of people. As mentioned in Introduction chapter, analyzing what kind of salient discourses are currently circulated in the society, what others are being silenced, and how they collectively influence people’s behaviour in regard to the scientific knowledge and practice are important to reflect on the condition of governmentality. Based on the reflection, the next chapter explains how they have constrained individual scientist’s behaviour, and discusses what alternative biopolitical strategy could be possible when observing the clashes of power and ensuing fractures in the network.

7. Science in Discursive Action and Social Constraint

Context of problematization

So far, I have sketched the process of governmental legislation on human embryonic stem cell research in Korea and the UK. A few critical national distinctions emerged from the initial investigation. Then I proceeded with empirical analysis of the semantic characteristics of opinion-leading newspapers and peoples' expressed perceptions in the two countries in order to clarify the previously discussed points. There is a notable discrepancy between opinion-leading newspapers and the informed public in South Korea, the former concerned with what to deliver and the latter with what to know about scientific facts. This discrepancy raises a question: how do scientists participate in the semantic sphere of public opinion? And what kind of societal "staging" constrains their action, discourse and mode of thinking? Study of this aspect is expected to reveal how knowledge itself is regarded and negotiated over in the public domain. This is because a social and cultural environment predefines the way the concerned actors typically present themselves with a theatrical performance, in order to gain social recognition (Goffman, 1959).

In this respect, the stratagems – material and symbolic – of notable scientists draw particular attention. The 'Hwang scandal' is less surprising when considering the complex dynamics of an actor-network, and the way relations in the network might be managed and pursued. From this perspective, the South Korean event(s) that is (or are) extraordinary on the surface, reveal characteristics of daily life that might in fact be "ordinary" in social and scientific atmospheres.

In this chapter, I describe the crucial elements affecting the scientific malpractice that has occurred even after the Hwang scandal, in the same department of Seoul National University, by considering its social construction. I address how the discursive atmosphere, constructed by the interaction between government, media and public framings, determined the strategic behaviour of concerned scientists who wanted to secure research funding, public recognition and power for survival. I also visualize characteristics of human interaction by social network analysis to find clues in the behaviour observed in South Korean stem cell laboratories. Then, I utilize my qualitative

analyses to fill the gap between such descriptions, and discuss how we could seek change in the scientific arena - discourse pattern and human relations.

Constructing an interpretive bridge between ethnography and network analysis

This chapter is composed of four parts: a) events: describing what happened during the Hwang scandal; b) narratives: mobilized cultural symbols and images; c) reflections: of related scientific problems and salient issues raised by multiple actors; and d) two implications: a summary of the social elements that constrained actor's strategic choice.

The first part mainly describes what happened during the Hwang debacle and afterwards, especially around the veterinary department of Seoul National University (SNU) where not only Woo-Suk Hwang's team, but also other prominent, independently operating stem cell research teams have faced a series of similar accusations of scientific fraud. The second part combines interview data with a social network visualization of the microscopic aspects of biopolitics. I interviewed Mr. Eui-Myung Park who was the chief investigator of the Hwang case for the National Board of Audit and Inspection 3 months prior to the Prosecutor's legal investigation in early 2006, a few anonymous MA and PhD students in stem cell labs in SNU, other scientists (also anonymous) in the department of biology in KAIST and medicine in Seoul National University and Dr. Gil-Ah Kim, the chief researcher of the biotech company Celltrion. Their testimonies complement the visualized social networks of Korean stem cell scientists (Figure 6.2; 6.3; 6.4), substantiating the underlying meanings, conflicts and concerns.

The third part mainly reflects my personal experiences of participating in public scientific (stem cell) and higher educational policy discussions. This part includes my interaction with major science policy makers such as Dr. Young-Chan Bae who is the former Chief Advisor of National Science and Technology Council (NSTC), Eun-Nyung Huh, the advisor of National Economic Advisory Council (NEAC), and other senior and mid-level officials (anonymous) in the current Ministry of Science, ICT and Future Planning (MSIP). I expand on these discussions to consider the national agenda of making science more accountable and creative. Also crucial have been comments from a few distinguished foreign scholars who have been engaged in newly founded departments in Korean universities to develop novel forms of cutting-edge technologies. For example, the

contribution of Dr. Heinrich Bühlhoff, the director of Max Plank Institute for Biological Cybernetics, has helped to substantiate my understanding of the Korean case and to extend my argument of ‘constrained knowledge’ that culturally affects scientific action and discourse in South Korea. Typically observed characteristics seem to intermittently reflect the logic of biocapital (Sunder Rajan, 2006), but also operate independently from structural economic demands.

Differences between conclusions drawn from formal data analyses and ethnographic approaches are complementary rather than contradictory. As I clarified in the Methodology section (Chapter 1), the visualized data does not speak for itself. The shared experiences, voices and views of various actors obtained through interviews, participant observation and collaborative works might add meanings to the represented data.

In this vein, my analysis aims to incorporate the traditional discussion of “collaborative culture” into a set of behavioural patterns in the domain of hESC research that are subject to both quantitative and qualitative analysis. The expected optimal pattern of cooperation, the broad narrative of ‘tit for tat’ (the strategy of reciprocity), and its social implications (conditions for emergent cooperation) have been vigorously discussed by the classical works of Axelrod (1984; 1997). In sociology, Fukuyama (1996) highlights the value of “trust” embedded in national cultures that can minimize the cost of monitoring and increase the efficiency of resource allocation and cooperative activity, eventually bringing institutional and national success. In regard to collaboration in the life sciences, Parker, Vermuelen and Penders (2010) collate a number of pieces of research that specifically study the nature and constraints of collaboration in various life scientific projects covering genome sequencing, ecology and environmental science, systems biology, bioinformatics, global networks, and so on. Parker, Vermuelen and Penders (2010) quote Hackett’s definition of scientific collaboration as: ‘a family of purposeful working relationships between two or more people, groups, or organizations. Collaborations form to share expertise, credibility, material and technical resources, symbolic and social capital’ (Hackett, 2005: 671) that looks natural and valuable in its own right. However, some researchers (Vermuelen and Penders, 2010: 7; Shrum, 2010: 247-258; Vermuelen, 2009) also note that the recent collaborations in the new life sciences are encouraged and shaped under impending demands of “supersizing science” (Vermuelen, 2009) that focuses on quickly building up an interdisciplinary research team, which is not without cost.

The emergent hESC research has been a grand, interdisciplinary endeavor. Ian Wilmut's proposal of a cell nuclear replacement technique opened up an avenue for other disciplines like veterinary science to actively engage in human embryonic stem cell research, that otherwise would be left to medical doctors. Interdisciplinary collaboration was perhaps inevitable, but it did not automatically translate into reciprocal cooperation. The case of Hwang's failed collaboration with medical doctors revealed the difference between cooperation and collaboration. As Shrum (2010: 257) explains:

Collaboration is not the same as cooperation. In the latter, people take each other's interests into account – the goals may change as people cooperate and the social dynamic has greater fluidity. In collaborative social arrangements goals have greater importance and actors who no longer subscribe to objectives may leave or cause trouble.

In the Korean stem cell field, the collaborative network changed over time; however, cooperative mindsets and bolstering cultural elements were too weak to sustain any interdisciplinary collaboration. As I will argue, Woo-Suk Hwang and other scientists' continuing misconduct was not only composed of individual misdemeanors, but also a social symptom of failing cooperation in collaborative work. To understand this underlying dimension, both an ethnographic approach to understand the actors' perceptions and an analysis of related actors' networking structures are important. If the former approach reveals hidden meanings of social behaviour, the latter method, social network analysis (Kim, 2011; Swan, Mcdermott and Khalfan, 2007), represents a specific behavioural pattern of trust between actors, and embedded strategies to acquire recognition, resources, and power. The two approaches to inquiry can either mutually supplement or contradict each other. Even in a contradicting situation, the tension prompts the researcher to seek a more comprehensive interpretation with additional data.

To analyse the critical characteristics of collaboration, I rely on the aforementioned interviews of crucial actors but also compare their testimonies to the evolution of a collaborative network in South Korean stem cell research by studying national R&D collaboration and a selected co-authorship network as revealed by the SCI(E) (Science Citation Indexed (Extended)) journals. The raw data used for the R&D network coding were collected from official documents stored in NTIS (National Science and Technology Information Service; <http://www.ntis.go.kr/>) in December 2012. For the

collection of co-authorship data of SCI(E) journals, Thomson Reuters's Web of Science (<http://thomsonreuters.com/>) was utilized in the same period.

From the perspective of the development of the sciences as communication systems (Dutton, 2008), co-creating activities (e.g., joint writing and experimenting to develop new knowledge) comprise the crucial outcome, because they facilitate cooperative work toward shared goals. The two represented datasets, national R&D collaboration and journal co-authorship, respectively reflect people's typical behavioural patterns to attain "resources" (R&D budget) and "recognition" (co-authorship links); they collectively represent ongoing power relations (De Nooy, Mrvar, and Batagelj, 2005) among the academic actors engaged in the symbolic game of competition and cooperation. Especially in an emerging biomedical field such as stem cell research in South Korea, the allocation of governmental R&D budgets has been a decisive factor to ensure the sustainable organization of laboratories and experiments (Kim, 2012). On the other hand, co-authorship relations have most often been used as a formal indicator of recognition and power relations in academia (Leydesdorff, Wagner, Park and Adams, 2013). Publishing research output in an international journal included in the Web of Science (SCI) is often indicative of top researchers and institutions in East Asia, particularly in South Korea (Park and Leydesdorff, 2008). Therefore, research collaborations frequently lead to co-authored papers in South Korea. As I will demonstrate in the following sections, each sub-network for resources and recognition is expected to supplement the other for a while, but eventually will fail to do so, if certain circumstances arise. Along with the data analyses, I discuss explanations based on interviews with Korean academics.

Events

In February 2004, Dr. Hwang's Seoul National University team published a ground-breaking paper in *Science*, announcing the successful derivation of a single stem cell line from a cloned human embryo (Hwang, 2004). In May 2005, Hwang reported an even more stunning accomplishment, the derivation of 11 "patient specific" stem cell lines, seen as evidence of strikingly improved levels of efficiency in using human eggs (Hwang, 2005). However, what was celebrated in South Korea as the nation's scientific triumph was soon undermined by allegations of ethical misconduct, followed by accusations of scientific fraud.

According to the South Korean prosecution's report, two kinds of scientific fraud are believed to have happened independently (Prosecutor's report, June, 2006). Hwang's senior medical researcher, Sun-Jong Kim, fabricated the initial results of the study, claiming that he had succeeded in establishing two stem cell lines. Originally accepting his researcher's claim, Hwang allegedly ordered him to further exaggerate the numbers. Something similar had happened the previous year when former senior medical researcher, Jong-Hyuk Park, fabricated 'evidence' for the first stem cell line derived from a cloned human embryo in 2004.

In reacting to the accusations, Hwang initially insisted that he had not been aware of any fabrications of data by his researchers (Hwang seems to have realized that the original results had been forged some time after Kim's false reporting of establishing stem cells). Hwang used illicit means – including political pressure – to block the South Korean broadcasting company MBC. MBC at first inquired about the unethical collection of women's eggs in his laboratory, and then went further to question the authenticity of the team's scientific results. Then, Hwang mobilized sympathetic media reporters to incite public protest over the way he was being treated. This only aggravated the situation.

The eventual dismissal of Hwang has brought little change in terms of scientific governance and repeated misconduct in the South Korean stem cell field. A bad sign emerged in 2006 when the Ministry of Government Administration and Home Affairs officially refused to reward MBC producers for their initial report on Hwang's misconduct, using 'predominant national sentiment' as an excuse. Even worse, the whistle blower, Dr. Young-Jun Ryu, who had collaborated in Hwang's laboratory in 2004 and informed MBC of the fabrication issue was condemned as a "betrayers" in the Korean public sphere; he and his wife were fired from their workplaces and have been frequently threatened by Hwang's supporters. A "systemic oblivion" (Kim, 2007: 116), a socially represented will not to acknowledge related actors' responsibility, operated in the country, only to hurriedly erase the shameful memory of Hwang.

Perhaps not too surprisingly, a series of charges of misconduct and controversy followed in the same veterinary department of SNU. In April 2007, Byung-Chun Lee, the ex-junior partner of Hwang in the same laboratory, was detained for exaggerating research results by manipulating statistical data after he published: "Endangered wolves cloned from adult somatic cells" in the journal *Cloning and Stem Cells*. A few years later, in 2012, Professor Soo-Kyung Kang in the veterinary department of SNU was suspected of fraud in 14 papers published in international scientific journals, out of 25 co-authored

articles with her senior colleague Professor Kyung-Sun Kang in the same department. In 31 January 2013, the Seoul National University Audit Board confirmed the fraud. Soo-Kyung Kang's case is currently referred to the disciplinary committee, but the more senior Kyung-Sun Kang was exonerated from the charges of deliberate misconduct. The Audit Board decided that the senior colleague was "only responsible as corresponding author" whereas Soo-Kyung Kang had been the first author, who took main responsibility for the experiment and the active role in publication.²⁰

A few media sources came to question why the same pattern of misconduct has been repeated in the same department, despite strengthened regulation and official supervision (Kyunghyang newspaper, 4 June 2012). At present, there is a scarcity of academic reflection, properly aligned with theoretical perspective, on the systemic background of such repetitive failures and misconducts.

Narratives

A few points have been made to explain the South Korean government's desire for increased national prominence through scientific achievement (L Kim, 2008). Firstly, despite the nation's recent economic success in certain sectors, such as electronics and IT, many South Korean people remain of the view that their nation is not as highly regarded as it should be on the global stage. Some sources of recognition other than material wealth were needed, and achievement in basic science could be one of them. Secondly, contemporary South Korean society also experiences competition within the rapidly rising economic and political prominence of many of its Asian neighbours, leading to a sense of being 'squashed' in the midst of the competition in East Asia. While its overall technological competence did not match Japan's, China's rapid growth was quickly eroding the relative advantage of South Korean manufacturers at the time (Maeil Economy, 19 February 2004). Given this competitive environment, a scientific breakthrough delivering the "Holy Grail" of stem cell derivation would provide much needed scientific and technological credibility for the nation politically as well as

²⁰ Criticism can be levelled against this kind of exoneration, although none of the Korean newspapers, to my knowledge, raised a question. After the Hwang debacle, for example, professor Schatten had to resign from his academic post at the University of Pittsburgh, to take responsibility as a coauthor of the 2004 *Nature* article.

economically. Concerning stem cell science, then, there were many powerful national figures who would have wanted to utilize Hwang's "breakthrough" in this way. The South Korean president Moo-Hyun Roh (2003-2007) was but one, describing Hwang's research as "magical". Following a visit to Hwang's lab, the President declared:

I felt that it (Hwang's scientific achievement) was not a technology but a sort of magic! I certainly discovered the possibility and hope of a new era of East Asia, and the achievement of over 20,000 dollar per capita GNP...Now I'm so deeply moved that my body trembles as if I had received an electric shock. (President Roh's speech (translation by myself), 10 December 2003, after visiting the laboratory of Professor Hwang at SNU)

While identifying Hwang's breakthrough with the glory of the nation and the "hope of a new era" (and notably tying its success to regional dominance and a higher per capita GNP), the president went on to declare his commitment to overcoming any obstacles that might impede Hwang's progress, including any ethical concerns:

The state will effectively manage the many controversies concerning bioethics, so that they won't hamper the great scientific research and advancement. (President Roh's speech (translation by myself) in 19 October 2005; quoted from Kang (2006), p. 56)

For President Roh the prospect of Hwang's success alone justified the high level of state support of the life sciences in the name of national economic prosperity. Although often speculated to be the new economic engine, after IT, this adventurous investment in biotechnology, compared to the more traditional chemical, electronics and IT industries, remained unjustified. Resorting to deeply rooted nationalism was a means of delivering this justification symbolically, and emotionally (if not financially or with certainty), and Hwang's success fitted well with the symbolic demand for dramatization. On Hwang's part, as well as many other actors in South Korea, he knew very well how to utilize these sentiments (Figure 7.1).



Figure 7.1. Hwang posing in front of the commercial Ad in Incheon Airport, appearing as if the background was provided specially for Hwang (Credit: *Yonhap News*)

As represented in Figure 7.1, the collective imagination of culture is mobilized through a set of key symbolic metaphors. The “steel chopstick” thesis provides a case in point. After the announcement of the stem cell ‘breakthrough’ in 2004, Hwang claimed that the South Korean people’s skilful use of chopsticks had contributed to their highly sophisticated capacity to manipulate human eggs:

Who else in the world but Koreans can pick up beans with metal chopsticks? When I show American researchers videos of my graduate students working with the micro-manipulators, they are absolutely flabbergasted at their skill. (Interview with *Los Angeles Times*, 17 February 2004)

As summed up by David Plotz, the Deputy Editor of American on-line journal *Slate*:

The Chopstick Theory of scientific supremacy goes like this: Koreans eat with narrow, metal chopsticks. Nabbing grains of rice with slippery, steel sticks requires a surgeon's dexterity. That's why Koreans have mastered

extraordinarily precise ‘micromanipulation’ of eggs and embryos required for stem cell and cloning research. Westerners with their clunky forks—and even other Asians with their thick, grippy wooden chopsticks—can't hope to compete with the dexterous Koreans.

Through the chopstick analogy, South Korea’s technological superiority is already implied, both in terms of the material (steel) and the manual dexterity that is emphasized as habitual. The Chopstick Theory provides a means of justifying the “natural” success of the team, in the face of possible suspicion about South Korean experiments raised in the West. Internally, the chopstick analogy functioned as a good narrative to convey the sense of a home-grown or indigenous technical prowess conferring a ‘natural’ cultural advantage in the stem cell race, and indeed even a sense of manifest destiny. It further signifies the need for continuous manual labour combined with precision, dedication and perseverance. Of course, biology is an arduous discipline that requires endless repetition of the same experiments in order to fight the “probability game”. As noted by a senior biologist interviewed at the South Korean Institute for Advanced Study, the value of ‘good hands’ for the laboratory remains high even in the most advanced fields of the life sciences:

When I see the new juniors who came into the lab, I can instantly tell if they can carry out experiments well simply by glancing at their hands... In our days there is no machine that can manipulate subtle experiments comparable to a hand. (Interview with Won, a senior biologist in the South Korean Advanced Institute of Science and Technology, 3 March 2006)

According to David Plotz, Korean scientists aren't just more technically skilled, they are also more diligent: ‘Korean scientists work much harder than Americans...In some branches of science—such as pure math or theoretical physics—this mania for work wouldn't matter much, but in stem cell research, it's incredibly valuable. This research is repetitive, tedious, and factory-like. It rewards the persistent. Hwang's lab cloned and transferred more than 1,000 embryos into 123 dogs to make a single cloned puppy. ‘That tells you how single-minded they are. If it was me, I would have given up at the 10th transfer’, says Hwang collaborator Cibelli’ (Plotz, 2005).

South Korea's relatively low position in the global division of labour in relation to the "knowledge economy" at the time – in comparison to the "First World" – explains only one side of the emphasis on manual skills and hard work. In South Korea's extremely hierarchical institutions and culture, junior researchers are called on to do most of the hard work, more often than not without adequate payment. In other words, the chopstick narrative also justifies the institution's reliance on young juniors' hard work, rather than trying to encourage more creative research environments in which individuals can rise through the ranks. This encouragement of hard work, and the emphasis on "toeing the line", were both significant factors as the Hwang controversy approached its climactic denouement.

From this internal perspective, the "steel chopstick" can be read as a fitting metaphor to predefine the research method, and to draw a line between those who have to endure hard labour and those who will gain from it. Moreover, the emphasis on manual dexterity functions to overshadow the moral issue of using human eggs. For instance, celebration of the enucleating technique developed by Hwang's team of gently squeezing the eggs with "chopstick skill" effectively diverted public interest from concerns about utilizing human eggs.

The powerful role of cultural symbolism in the creation of "imagined communities" is at the heart of Benedict Anderson's argument concerning the origins of national identity (Anderson, 1983). Fragmented elements are deliberately brought into public awareness in order to serve a social function of cohesion, justification and direction. The reproduction of culture depends on common dreams and symbols, and this has been shown to be especially true of national identities. Nevertheless, a sociological account would also emphasize that national identities are a dynamic result of political manipulations and economic motivations mediated through narratives, rather than a single representation of society. To cite Stuart Hall's (1996) famous words, it is the identity of "becoming", rather than static "being". Various tactics of adaptation to the structures – be it conformism or rebellion – are applied among actors, coupled with self-interest, in the process of forming a collective identity. Then the questions arise: what elements do people selectively "choose" to define their own identity and for what interest? What kind of result emerged from analyzing the micro-politics of individual actors?

Reflections

Many commentaries have tried to make sense of the scandal and its broader implications. As *Nature* put it, the drama of the Hwang scandal was “Shakespearean” in both its tragic and familiar aspects (Editorial, 2006). It reiterates the core components of a tragic drama depicting a fallen hero. As we have seen in Chapter 4, media commentary has changed over time in both tone and focus. Initial criticism attributed the Hwang scandal to “non-Western” characteristics of the academic and research ethics system and “developmental” problems (Gottweiss and Triendle, 2006) or accused Hwang’s team of turning “good” science into a “bad” enterprise (Fox, 2007). More recent commentaries recognise “universal” elements in the story (Haran et al, 2007; Bauer, 2008; Kitzinger, 2008). The Hwang scandal was seen to carry global implications for research ethics and the practice of peer-review.

My recapitulation of the scene, after a series of interviews and data analysis, boils down to the question: In South Korean stem cell research, how did various actors strive for recognition and power? As I argue, their strategies generated particular science-related discourses, which constituted the background and content of the Hwang scandal. Moreover, this shaped public debates on regulatory apparatus, ethical oversight, and scientific reason, while silencing potential criticism. The absence of a critical public and, perhaps more importantly, a critical mind-set regarding scientific action remains a salient feature of the Hwang scandal that reflects the context in general.

Throughout the period of industrialization, South Koreans have aimed to improve processing techniques through a concentration on applications, fearless, massive investment and real hard work that enabled rapid and remarkable success. Consistent with past practice, since the resources and scientific base were limited, the state applied a “select and focus” strategy to support a few “star scientists” in stem cell research when the emerging technology looked promising. The government decided to encourage specific horizon techniques such as somatic cell nuclear transfer (SCNT) in which South Korea was believed to have advantage over other competitors, especially in manipulative skills (Maeil Economy, 2006). At the same time, South Korea had to be responsive to the emerging call for regulation from the outside world. As we have seen in the Chapter 2, the South Korean legislative body dealt with the problem by endorsing the *Bioethics and Biosafety Act*, which came into effect from 1 July 2005, while deliberately designing loopholes in the act to allow Hwang free, and exclusive, access to embryo research. The

legislative process could be interpreted as having been designed to assist in the implementation of a government policy that was largely regarded as beneficial to the nation's economic growth. The desire to support a national policy of increasing the competitiveness of the life sciences was overtly expressed in government policy documents, which explicitly targeted "increasing the number of SCI papers of scholars" (The Ministry of Science & Technology, 2006) and "encouraging biotechnology to create national wealth after the IT business" (Government Report, 2006).

Meanwhile, scientific autonomy to pursue independent research has been limited, reflecting the historical background of South Korea. Added to the long tradition of political control through knowledge structures, modern science can be considered a tool for the state to facilitate industrial development (H Kim, 2006; L Kim, 2008). Woo-Suk Hwang was the star scientist the South Korean government desperately needed to justify its support to life science. The public hailed a scientist devoted to achieving economic developments, or a national hero who would augment the symbolic status of South Korea, when Hwang began to announce his research successes in 2004. Neither the regulatory governance nor the social implications of stem cell research were critically examined, because there was no reason to do so: Hwang's scientific discoveries were already playing their expected role to deliver what the public wanted – international recognition, scientific progress, technological superiority, and prospects for economic gain.

Perhaps the only exception to the majority sentiment in South Korea, the counter-framing of progressive media such as *Hankyoreh* newspaper (see Chapter 4), was unsuccessful. Whereas the success story of stem cell research and its utilization consistently survive at the core of the conservative competitor's frame, *Hankyoreh* did not provide an alternative value or ethic to compete with the desired success. As Lakoff (2004) argues, a frame becomes successful only when it is effectively repeated and delivered as a simplified concept to people's pre-existing cognitive schema. In this regard, the social-psychological process of anchoring (Moscovici, 2000) can be observed in the discourses of the dominant conservative media in Korea, most notably through 'development' and "success". These anchors consistently and successfully summon the embedded collective memory of Korea's industrialization, overlapping with the legacy of dictatorship. Contending voices such as *Hankyoreh* might provide sound reasoning but they lacked the connotations to arouse public sympathy, which mattered in the 'frame war'. Consequently, one might suspect that the much discussed reason(s) for ordinary Korean peoples' resistance to the elite media's discourses, be it conservative or progressive, and their

support for Hwang (see Chapter 6) in the controversial period, may be related to this absence of an effective “counter-frame” to challenge the dominant frame of ‘successful industrial development’.

At any rate, scientists have to make choices for their social survival. As some of the following interviews reveal, Dr. Hwang made one that was neither unusual nor unexpected. On 28 May 2009, I interviewed Mr. Eui-Myung Park who had thoroughly investigated Hwang’s affairs a few years before. Park assumed the task of the chief investigator of the Hwang case in the National Board of Audit and Inspection immediately after the SNU Audit Board announced Hwang’s fabrication of scientific results in January 2006. During his investigation, for two months, Park summoned Hwang almost every day mainly to find evidence of Hwang’s suspected embezzlement of public research funds. Park asserted, ‘nothing further was investigated by prosecutors after our own investigations, only to reconfirm our findings’. According to Park, Hwang was very modest and supportive to the investigation from day one: not only did he willingly cooperate with the investigation, rather frankly admitting his illicit administration of financial resources, e.g., confiscating his MA and PhD students’ research grants to his personal bank account after falsely reporting due allocations to the administration office, et cetera, but also Hwang occasionally openly revealed his experiences and feelings.

Hwang’s laboratory was well known for its massive size by the time he published his article in *Science*. It started with only five researchers in 1986, increased to 23 by 1999, and finally became a “clone factory” with 60 employees by 2005. The main stimulus for this expansion was the news of the cloning of Dolly the sheep in 1998. After this groundbreaking news, many people immediately saw the future potential for applications of somatic cell nuclear transplantation (SCNT). Until 2005, the main source of funding did not come from stem cell research grants, but instead from the already established animal cloning technology grant supported by the government (G. Kim, 2007: 139). Thus, the team had to appropriate other short-term grants, and make a strategic alliance with another group already granted government funding for stem cell research, the medical team of Dr. Shin-Yong Moon based at Seoul National University. As the Korean government applied a ‘select and focus’ strategy to support profitable scientific research (L. Kim, 2008), only one group could secure a sizable grant for the project. According to Park, this competitive atmosphere encouraged Hwang to proclaim unfinished results as a novel scientific feat even before the publication in *Science* in 2004.

In a recent interview with *Hankyoreh* (5 March 2014), Dr. Young-Jun Ryu who reported Hwang's stem cell fabrication to MBC recalls:

[Two months after joining Hwang's team], I requested an experimental note to my colleague who had been in charge of cloning Hwang's famous Korean ox. His reply, with a deep sigh, was that there was no such thing. Later, another team member told me that he had asked Hwang why he made the false claim, and Hwang responded, 'It would have been the end of our career if we had not been considered as the first to clone the ox [in the animal clone competition in Korea]. We can make the real one after accumulating research capacity.' (translation by myself).

Instead of simply criticizing such false reporting as blatant fraud, it is interesting to observe a prevailing mentality of the team that they should survive in the "winner takes all" competition above all, albeit with illicit means, and then could be pardoned if they eventually were to make the real product later. In many ways, the team's strategy is similar to how some of competitive businesses might work, by proliferating fundamentally false yet successful advertisements of innovation and only then starting to make the expected product. Mr. Park stated that the "same habit" of doing science operated when Hwang decided to plunge into the stem cell research field. According to Park, 'Woo-Suk Hwang knew utterly nothing about stem cell. As Hwang had a specialty in animal cloning, however, he thought he was in an advantageous position to occupy the terrain of human embryonic stem cell research with the SCNT technique. The following task then was to make an effective alliance and recruitment'.

Hence, Hwang's team had to rely on other experts from MizMedi hospital and SNU medical teams for the derivation of stem cells. The contribution made by Hwang's own team, having a veterinary science background, was limited to the SCNT process, whereas other procedures, such as extracting the inner cell mass and culturing stem cell lines, were left completely to experts at the MizMedi hospital. It was these medical researchers, Jong-Hyuk Park and Sun-Jong Kim, who fabricated the results in 2004 and 2005. According to the prosecutor's report (Prosecutor's office, 2006), the main motive of the medical researchers' initial fabrication came from the great pressure exerted by Hwang to produce results, and to derive cloned stem cells, as soon as possible. Sun-Jong Kim testified that he was sceptical whether it was feasible that the seeded blastocyst

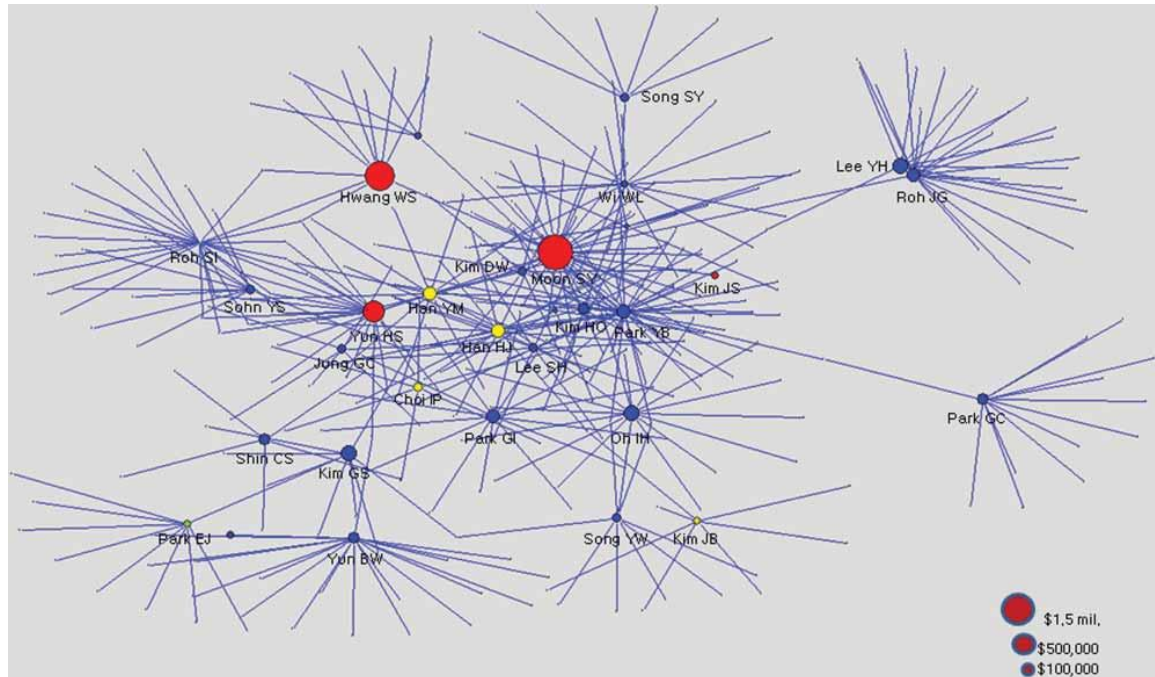
would grow to form a colony. Kim reported to Hwang that he derived stem cells from the inner cell mass, but the cell was replaced with the stem cell line brought from MizMedi. Mr. Ryu stated in *Hankyoreh* that the successful derivation of a stem cell line had to be based on Hwang's baseline work, that is, cell nuclear replacement. So, when Ryu told Hwang that even though the stem cell line was created by parthenogenesis, it was an achievement that was publishable in *Science*, Hwang refused to disclose the cause, retorting that it meant nothing to him if had not been derived from SCNT. Immediately after the publication in 2004, Hwang was in a great rush to produce results as soon as possible, even if it meant fabrication. While Hwang's ambition and "habit" may be reasons for this, his structural location in the South Korean stem cell research community, as revealed in the social network analysis diagram, may provide another clue for a sociological explanation.

Figure 7.2 illustrates the networks of stem cell researchers who collaborated in the state-funded stem cell research projects. As the main source of research funding comes from the South Korean government, the figure reveals researchers' collaborative strategy and their structural location in the field, both of these playing a decisive role in an expert's career.

As illustrated in Figure 7.2 (a), Hwang's position is relatively peripheral to his ally Moon, who is positioned at the centre of the network. At the time, Moon was the chief director of the Cell Application Project Team under the governmental 21st Century Frontier Entrepreneurial Scheme, so Hwang could secure his position only through the strategic ties made with him and Sung-II Roh, the director of MizMedi hospital, who provided experimental staff and resources.

The situation noticeably changed in 2005, after Hwang acquired international fame by publishing his 2004 article in *Science*. Hwang started to receive unprecedented amounts of research funding (Figure 7.2 (b)). It also meant, however, that he had to legitimate his newly acquired status with new and better results. Hwang's team had few external collaborators, and Young-Jun Ryu who had been managing the stem cell team left in dissatisfaction with Hwang's method of research.

a. Stem cell network in 2004



b. Stem cell network in 2005

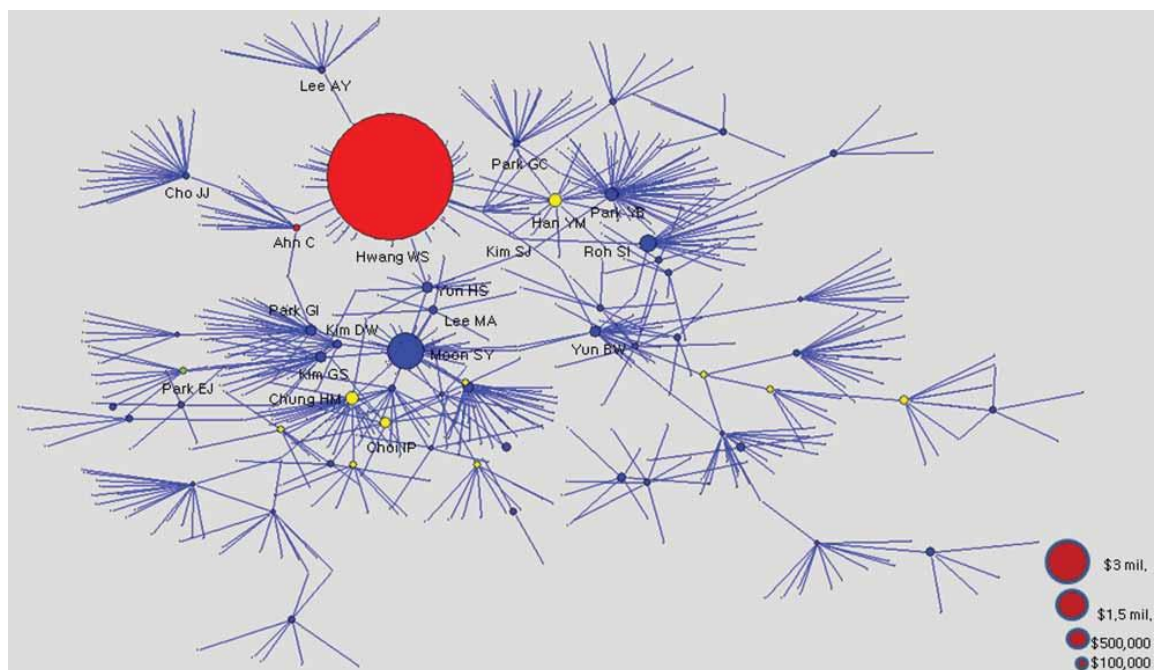


Figure 7.2. Stem cell network in 2004-2005 (graphic by Pajek)

Red: Hwang and allies; blue: medical doctors; yellow: biology; green: bioethics.

Source: Collaborators of state funded research data acquired from NTIS

In order to overcome his precarious situation among his academic peers and to justify support from the government, Hwang used his charismatic influence and position to make his junior researchers work even harder. One might conclude that repeated failures of communication and collaboration often embed coercive measures and

inefficient methods of research. Instead of trying to improve fundamental knowledge and techniques, Hwang's team mobilized a maximum number of human and material resources to produce greater outcomes. In a sense, this strategic choice was not only inevitable – because of a limited scientific foundation in South Korea – but also workable thanks to Korean researchers' highly disciplined work ethic and technical skills, making them prone to repetitive practice. This limited atmosphere contributed to the results-driven mobilisation of labor and the cloning of Snuppy the dog, but researchers were deprived of scientific inspiration and academic passion. Thus, one of Hwang's postgraduate students described his five years of laboratory life as: 'the coldest days in my life; I was never more admonished or learnt more than in this period, in which I experienced the most gloom in my life' (G. Kim, 2007: 135). Hwang's success in cloning a dog and his failure in human embryonic stem cell research, represent both the potential and the limitations of the labour-intensive strategy he adopted under constrained circumstances, that is, intensely competitive circumstances in which micro-strategies and resources as well as scientific achievements can play a key role. However, the shrewd strategy also heavily depended on political favors granted by external actors. To win these favors required a talent for gamesmanship, which eventually diluted the capacity for sustainable study.

A growing tension between Hwang and Moon led to them parting ways in 2004. The impending pressure for another breakthrough, especially after the cessation of cooperation from Moon's team, seems to have seriously affected Hwang's overall position in 2005. From the network perspective, Hwang was isolated from the principal network led by the administrative figure Moon and the medical doctors. According to Mr. Park and Hwang's own testimony in the court (Sohn, 2008), it turns out that Moon's team made very little, if any, contribution to the research, though Moon listed himself as a corresponding author in the 2004 *Science* article. On the other hand, medical doctors in Moon's laboratory later complained to Park's auditing team that they were frustrated by Hwang's "greed", which would have led him to encroach upon their area of research: the derivation of stem cells. Hwang suffered the doctors' pejorative attitudes to him as a veterinary scientist and their uncooperative behaviour during the research process (interview with Park, 28 May 2009). Regarding the characteristics of the 'ego fight' between scientists, Park also made an interesting comment:

In the eyes of those interviewed medical doctors, the veterinary department was placed at the bottom of academy. The score of the entrance examination in each department when Hwang entered SNU was...[To my surprise, Eui-Myung Park enumerated exact figures of the cut-line score for the entrance of each department of SNU in the 1970s!] So, his profession was the lowest of all in the area of natural science. How could the doctors from the department of medicine in SNU that had been at the top tolerate a person from such a humble background suddenly become a globally recognised scientist? And dare to encroach their own medical territory? A sense of common disgust was easily felt in their expressions (Interview with Eui-Myung Park, 28 May 2009).

However, a high schooler's grade-hunting mentality, very prevalent in Korean society, was not entirely to blame for the damage to the research and collaboration. Ascribing the failure of scientific cooperation to the struggle between medical doctors vs. veterinarians might mislead and conceal more important factors: at least one such factor is resource allocation. Only a few players in embryonic stem cell research receive state R&D funding (as witnessed in Figure 7.2 (b)), thus creating a monopoly of scientific power by a few senior members, a hierarchical structure within the laboratory and a narrow perspective on scientific research.

After the Hwang debacle, the succeeding government (2008–12) applied various measures to encourage more effective collaboration, both domestic and international, among the core researchers, to retrieve South Korea's edge in the stem cell race (Korean government 2008). As Whitley (2007: 9) points out, highly project-based funding regimes, in which scientists have to seek funds for each new project from state agencies on a competitive basis (as was the case for Hwang and others), shorten the feedback loop between research performance and resource allocation and increase the costs of project failure. The governing scientific experts seem to have been aware of the problem after the disgraceful failure. According to Professor Young-Chan Bae, the former chief advisor of the National Science and Technology Commission (NSTC), modifying the method of budget allocation was among the viable ways to effectively influence the research network for the succeeding government. He noted that the Ministry of Education, Science, and Technology was committed to allocate budgets in a more egalitarian manner so that a wider range of actors could benefit and mitigate unnecessary tensions (private talk with Young-Chan Bae, 6 December 2012).

As shown in Figure 7.3, the R&D collaboration network in 2011 appears to embrace numerous researchers who are from various public (university and national research institutions) and private (corporate research labs) institutions, albeit in the absence of biologists, with dispersed research budgets and enhanced cooperative ties when compared to the year 2005.

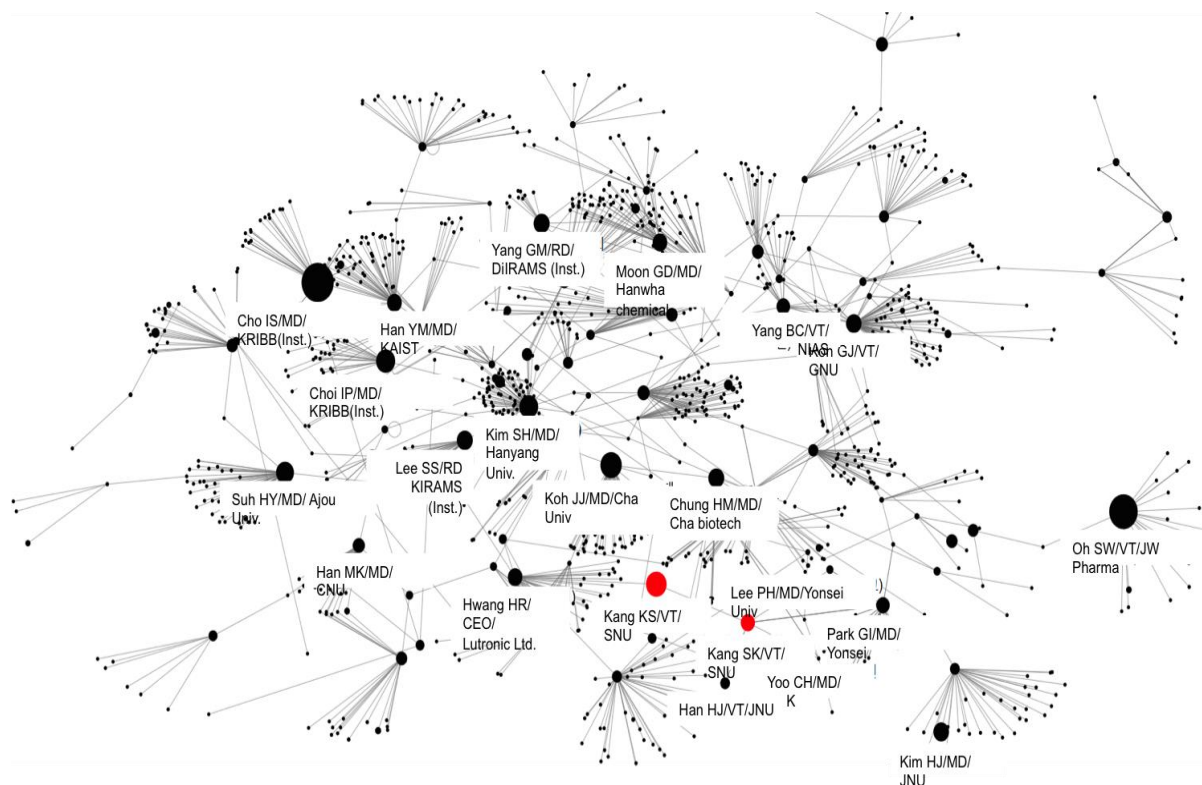


Fig. 7.3. South Korean stem cell R&D network in 2011 (Graphic by NodeXL)

* Circle size corresponds to the amount of allocated R&D fund

** Background: MD: Medical / VT: Veterinary / RD: Radiology

To make more a precise comparison, Table 7.1 clarifies the structural transformations of the national stem cell R&D networks. To compare overall network properties, the number of nodes (researchers who received the governmental grants) increased from 668 in 2005 to 1,288 in 2011. The stem cell network in 2011 has become relatively more dense than that of 2005, owing to the increase of links, but essentially more sparse as the average path distance between actors drastically increased from 1.7330 to 7.1538 and the average clustering coefficient (namely, a probability that A linked to B and C linked to B would be also directly linked each other) fell significantly. In other words, researchers who received governmental grants in 2005 knew one another very well.

Moreover, most of the researchers were close to either Hwang WS's or Moon SY's faction, making the average path distance somewhat closer to 1.0 (a direct connection).

Table 7.1. Properties of stem cell R&D networks in 2005 and 2011

R&D network in 2005		R&D network in 2011	
No. of nodes	668	No. of nodes	1288
No. of links	1346	No. of links	1404
Density	0.0015	Density	0.0017
Avg. path distance	1.7330	Avg. path distance	7.1538
Avg. clustering coefficients	0.0099	Avg. clustering coefficients	0.0003

Moon's and Hwang's centripetal forces, as indicated by the shaded actors in Table 7.2, derived from their monopolizing of research grants. In contrast, the top ten central actors and the top ten grant recipients do not overlap in 2011. As funding sources have diversified after 2005, spurred by the founding of bio-venture firms, and as the top three recipients in 2005 (Hwang, Moon, and Roh) were cast out from the field, only Dong-Wook Kim (Kim DW) continues to be in the top ten grant recipients' list in 2011.

Table 7.2. Top 10 central actors and grant recipients in 2005 and 2011

R&D network in 2005		R&D network in 2011	
Top 10 Central actors	Top 10 Grant recipients	Top 10 Central actors	Top 10 Grant recipients
Moon SY	Hwang WS	Lim JY	Cho IS
Yun HS	Moon SY	Chung CH	Oh SW
Hwang WS	Roh SI	Lee HG	Kim HJ
Baik SH	Park YE	Lee J	Koh JJ
Wang GC	Han YM	Roh JG	Park SR
Yun BW	Chung HM	Kang JJ	Kim DW
Kim SH	Yun BW	Ye SG	Choi IP
Chung HM	Park GI	Seol YJ	Kim SH
Oh SH	Kim GS	Kwon SM	Suh HY
Park GI	Kim DW	Lee ME	Lee JS

* Shade: Names that are both top listed in central actors and grant recipients

** Central actors are calculated by closeness centrality index

Despite the “rehabilitated” network, the nature of cooperation has never ceased to be of public concern. Recently, a few domestic bio-venture firms have formed and are investing huge amounts of money for research; this “biocapital” (Sunder-Rajan 2006), in

addition to depending on public hype and marketing, also requires academic recognition: publishing a number of articles in reputed international journals has become an important means to increase the stock market price of those venture firms with which quite a few scholars are affiliated.

As a side effect of these academy-industry ties, some academic entrepreneurs appear to exaggerate, if not fabricate, their experimental results to embellish their research and prompt market hype (Kim 2012: 222; Sismondo, 2007). This kind of ‘entrepreneurial academism’ has been often neglected in some innovation studies literature (Viale and Etzkowitz 2010) because the influence of one domain, be it academia or industry, upon another is often assumed to generate new ideas and formats for high-tech development in developing and transitional countries (Shapiro, 2011). Thus, while the network ties in 2005 typically represented a few institutional actors’ intrusion into the scientific field to monopolise resources with strategic alliance and competition, the meaning of linkage has become more complex in 2011. For some actors, as the newly discovered case of year-long misconduct by the two Kangs (red nodes in Figure 2) indicates, the ties in the R&D network might also imply an asymmetrical power relationship that cannot translate into sustainable research.

Mr. Lee (Alias), former PhD student of the veterinary department of Seoul National University, testified that Soo-Kyung Kang, who recently forged results, was under heavy pressure to fulfill her seniors’ expectations, especially because Professor Kyung-Sun Kang had appointed her as a lecturer in SNU from the regional university of Busan, where she previously worked. According to a news report (Chosun ilbo 5 June 2012) and the interviewed students who insisted upon anonymity, one motivation to appoint the junior S.-K. Kang was the senior K.-S. Kang’s desire to increase the number of publications and boost his reputation, thus enhancing his commercial prospects. In this manner, publication has become a currency in the economy of expectation and in academic evaluation, but little has yet been publically discussed with regard to how to conduct sustainable academy-industry relationships and invigorate more reliable scientific explorations.

Meanwhile, the technology of both embryonic and somatic stem cell have a long way to develop. Gil-Ah Kim, the Chief R&D director of Celltrion (one of the biggest producers of biosimilar medicine in Korea), explained to me how he evaluated K S Kang’s formal presentation of his company to Celltrion in order to attract investment:

As I studied somatic stem cell for my PhD and now work as the chief researcher in the competitive commercial market, I was assigned to evaluate the work of Kang's team in the early 2012. Their prospective product, the stem cell derived from umbilical cord blood, still has a long way to stabilize into a marketable one. In contrast to reality, their proposal contained a time schedule to develop regenerative medicine for rheumatoid arthritis, diabetes, cancer, myotrophic lateral sclerosis, Alzheimer, etc. by 2015, starting from 2011. I rejected the offer because I knew the proposed time line was far too short and highly unrealistic. But they might have secured investments elsewhere since Kyung-Sun Kang is a well-known professor in SNU. I wondered where they would choose to go through all these clinical tests in such a short time. Perhaps China, but would they be able to go through licensing in Europe and US? I don't think so (Interview with Gil-Ah Kim, 12 January 2013).

The plan of Kang Stem Holdings, the venture biotech company founded by K.-S. Kang in October 2010, was ambitious. In the introductory leaflet of Kang Stem Holdings, mainly distributed to potential investors and handed to me by Gil-Ah Kim, the company aims to have a market share of 2 billion US dollars immediately after its foundation, 10 billion in five years and then over 100 dollar in ten years. The presented rationale, the core competency, includes a higher success rate of derivation of cord blood stem cells, 80% compared to the 30% figure of competitors, a significantly larger quantity of cultivated cells (1 trillion compared to only a million) and an ensuing lower price. Professor Kang also introduces himself as an inventor who holds the third largest number of patents in the world. Gil-Ah Kim pointed out that such numbers, no matter how superficial, mattered in securing credit not only in the entrepreneurial world but also in the academy in South Korea: there are few peer reviewers who would intervene to correct the false scientific claims of his colleagues, and in-depth knowledge in basic science to initiate serious academic debate is often missing. Consequently, the conflated numbers, i.e., money, patents and publications, and the appealing academic image, such as university title, really mattered to the majority of the South Korean population, without serious consideration on scientific capability.

Implications

Findings from the network data analysis imply that questions of conduct and governance should represent more than a simple manifestation of ethical values. It requires a far more concrete and systematic strategy to ensure collective responsibility and trust. This might take shape in monitoring the networking activities practiced in governmental, academic and industrial fields. Particularly in the East Asian cultural context in which human relations tend to be hierarchical, formal linkages of cooperation might imply a multiplicity of relationships that also suggests asymmetry in power relations, if not always coercion, and ensuing adversities in collaborative behaviour as demonstrated in the aforementioned two cases.

Although culture itself is an important variable, it is also important to remember that the systemic intersection of actors' interests, organizational power structures, and local strategies of socio-economic survival articulate national characteristics and form a feedback loop with the cultural environment. As Ong (2010: 33) puts it, an anthropology that stays close to practice should also 'stay close to the politics and pathos of how people meet challenges and resolve problems within given conditions of possibility'. Ethnographical descriptions of culture should also recognise that individuals are not homogeneous subjects, especially in contemporary society, and be careful not to describe overall national characteristics as determining individual choices (Kim, 2008). Flexible tactics of both conformism and rebellion construct the dynamic network of a path-dependent possibility.

The mode of scientific production, micro-power relations between people and the way such power is exercised seem to reproduce Foucault's "conduct of conduct" (Dreyfus and Rabinow, 1982; Kim, 2011: 214) in the national context. Therefore, the solution might be found either in institutional sanction or in an incentive system to induce change in the structured modes of conduct. From this perspective, I have shown that one way to pragmatically discuss culture can be to produce an acute representation of social network data analysis, coupled with other ethnographic and sociological approaches.

The boundary of possible action for scientists, a miniscule element of biopolitics, in South Korea has been predefined by a set of opportunity elements as well as constraining structures. As depicted in Figure 7.4, which summarises core discourses and circumstances discussed in previous chapters, an individual actor (scientist) in the field would perceive typical circumstances and salient discourses as given elements.

Historically in the scientific field of South Korea, elements such as international collaboration and basic science have been weak; however, discursive elements like the autonomy of the scientist, pursuit of knowledge for the sake of knowledge itself, and ethical considerations have seldom been pronounced [Weakness]. On the other hand, domestic and international competition became severe while bureaucratic influence and hierarchical relationships remained (and remain) intact. The discourses of competition and survival, and personal frustration become a noticeable narrative [Threat].

Notable individual actors avoided making serious effort to compensate for the [Weakness], i.e. improving basic science, seeking scientific autonomy or engaging in ethical deliberation, but tried hard to utilize advantageous circumstances of [Strength] and [Opportunity] dimensions by mobilizing both resources of governmental support, IVF technique, workforce, ova, and so on, and mainstream public discourses of achievement motivation, nationalism and economic desires. This rush to mobilize, rather than to address weak elements, seems to be explained by impending [Threat] elements: most notably “competition” and “frustration” that are both objective circumstances and powerful frames of cognitive awareness. Thus, actors chose material and discursive elements that fitted their interest, consciously or unconsciously. Their choice was made within the boundary of available discourses and resources. The selected way of resource mobilisation and public communication connotes subtle power struggles among actors who mobilise available material and symbolic resources. Socially induced action in South Korea was familiar with a maximal resource exploitation (of labour and ova) and rent-seeking behaviour by conflating the symbolic power of scientist. As discussed in this chapter, the state’s more egalitarian R&D fund distribution can have a significant influence on scientists’ networking. However, subtler causes of misconduct might persist despite state regulation and the current incentive system. Therefore, how to form the spontaneous “conduct of conduct” remains an important task that is closely related to the formation of an alternative subject. In short, we need to re-produce different actor(s), who is equipped with a different set of *habitus* (Bourdieu, 1988) and knowledge-power relationships (Foucault, 1980) that are vital to more reflexive and truly capable scientific endeavor.

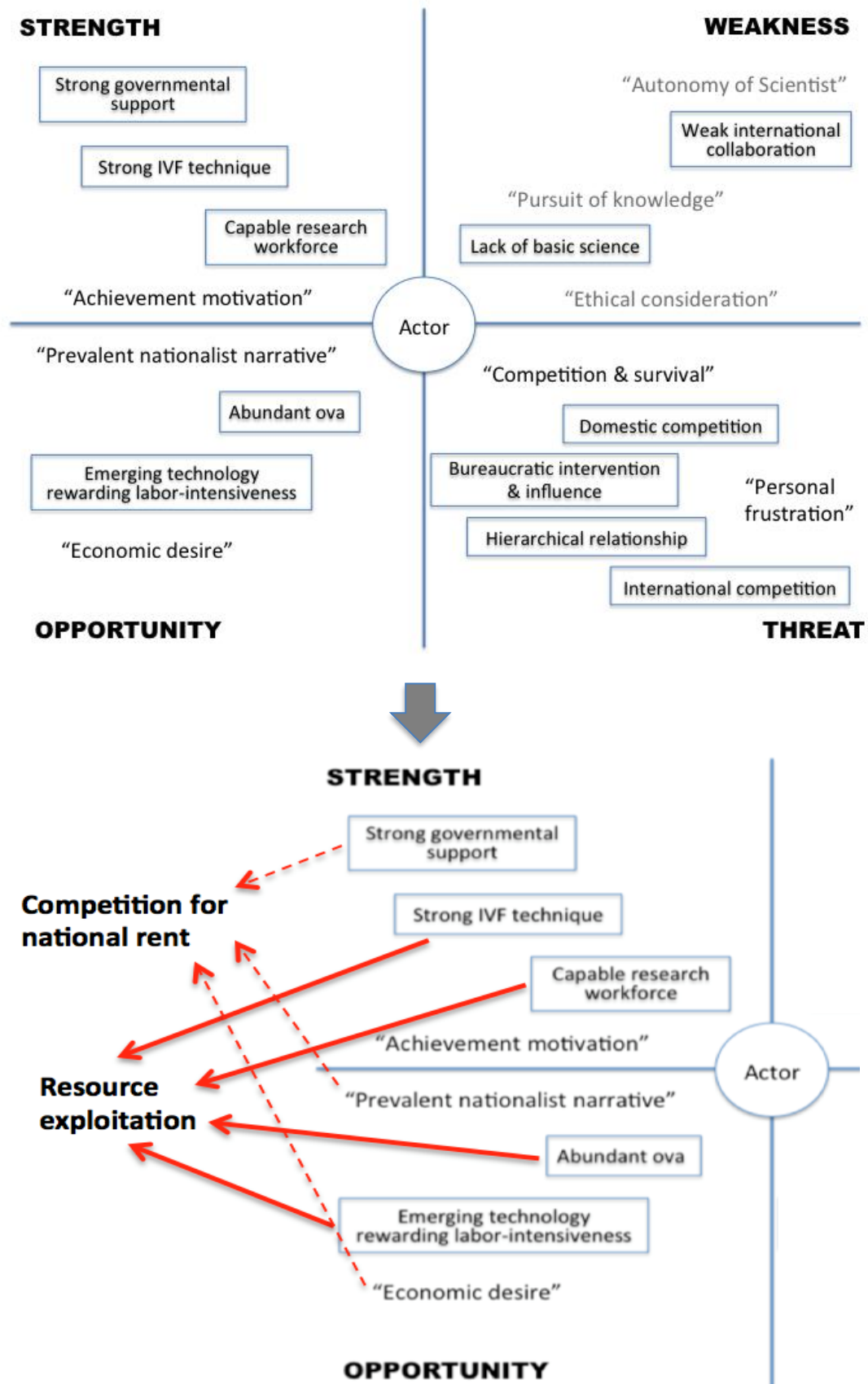


Figure 7.4. Summary: SWOT representation of actors' perception and strategic choice
 Notes: Text in box: objective circumstances, Text in quote marks: crucial discourse

8. Conclusion

A path toward scientific fiasco

What do the observations and representations in my thesis illuminate? Each chapter is a piece of discrete research, with a different abstraction level and method. Together, they are an attempt to trace the governmentality of the particular set of: the human body, ethics, the latest biomedical knowledge, and entrepreneurial projections, which are mediated through the topic of embryonic stem cell research. Reviewing policy and discourse by traversing the institutional boundaries and paying particular attention to a few actors and their actions might not represent the whole picture of scientific action in the field. Still, we can capture and problematize some crucial points.

Table 8.1. Salient discourses and effect in critical fields

Field	Governance / Discourse	Effect
Government	<ul style="list-style-type: none"> • Focus on quick industrialization • Promote star scientist 	<ul style="list-style-type: none"> • Output-orientated evaluation • Concentration of resources to a small number of scientists
Mass Media	<ul style="list-style-type: none"> • Focus on quick industrialization (vs. abstract criticism) • Promote star scientist 	<ul style="list-style-type: none"> • Public hype for immediate outcome • Uncritical promotion of successful scientist
Lay Public	<ul style="list-style-type: none"> • Dramatization of star scientist • Self Identification 	<ul style="list-style-type: none"> • Uncritical promotion of successful scientist • Absence of public debate and reasoning on scientific practice
Scientific community	<ul style="list-style-type: none"> • National glorification of scientific achievements • Cultural legitimization of current research practices 	<ul style="list-style-type: none"> • Avoidance of public debate and reasoning on scientific practice • Rent-seeking competition for scarce resources & recognition • Technique-oriented approach & little accumulation of scientific knowledge

As discussed in Chapter 3, the South Korean government's life scientific strategy was single-mindedly focused on quick, if not immediate, industrial translation of hESC research. Neither government nor the parliament was equipped with adequate expertise to evaluate if such rapid application was feasible. As noted in Chapter 7, the government

also needed a “star scientist” to legitimize new investment in the life scientific field. Promotion of the most promising scientist was not the only option to do so, but it was a handy way to draw public attention and support. The governmental approach could be understood as a strategic decision to evade the complexity and unexpected nature of biological and medical knowledge and the accumulation and interaction of those knowledges in basic science, and instead focus on expected, more visible, industrial application. Having experienced rather a short history of modern scientific studies, concentrating R&D resources on a small number of scientists who seemingly exhibited immediate “output”²¹ reflected such a strategy. It was also related to the bureaucratic practice of “policy for blame-avoidance” (see Table 3.2).

It is uncertain how the governmental approach and discourses affected mass media representation. Nevertheless, from the data analysis in Chapter 4, it is obvious that the majority-leading, conservative, newspaper representation of hESC research in South Korea shares key characteristics of representation with the governmental discourse. Its frame was focused on rapid industrialization and grandiose monetization from hESC achievements, mainly expected from the efforts of Woo-Suk Hwang. Such a predominant narrative provided a social background of uncritical support of Hwang and inflated public hype for an immediate outcome – industrial application. The counter-frame from more liberal media was weak. Liberal media like *Hankyoreh* in South Korea reflected far more diverse social concerns as well as ethical considerations. But they had much less impact on the lay public than the government and conservative media, which willingly accepted the latter’s economy-oriented framing of stem cell research.

As exhibited in Chapter 6, the South Korean public not only accepted the prevalent economic discourse of science but also showed a certain degree of self-identification of their daily lives with Hwang’s rise and fall. From the semantic network analysis of their core discourse, ethical concern was absent in the stem cell debate. Although Bauer (2002) notes that “dramatization of science” is a common platform in the public representation of science, the feature of ethical deliberation totally overshadowed by such dramatization is striking when compared to the analytical result of the UK

²¹ In discussing the innovation policy in South Korea, the OECD report (2014: 84-86), *Industry and Technology Policies in Korea*, notes that Korea is overly dependent on quantitative measures in the evaluation of state-funded research, and excessively “output-oriented” instead of considering longer-term “outcomes” that might have broader technological impacts. Although the OECD report is based on the operation of government research institutes, I find similar problems in government-funded university research in the South Korean stem cell field.

public's response to the same life science (Chapter 5). In the UK, I conclude, the concern with human rights, including women's bodies, was a consistent and connotative topic that represented the key value of Western civilization. And the consequence was a more cautious and deliberative approach to new science and technology that might spark ethical concerns.

All of the observed scientists, including Hwang, who took part in scientific misconduct in South Korea sought a "rent" by engaging in a very political and closed alliance to secure scarce state funds, and exhibited some skill in the "media play" without solid academic works. As explained in Chapter 6, the governmental evaluative system and policy of resource distribution encouraged this type of strategy. The effect was the avoidance of public debate and reasoning on scientific practice because the parochial network of scientific alliance also functioned as an institutional shield to protect their scientific actions from any further public enquiry. A more profound and deteriorating effect, I judge, is the continuation of a technique-oriented approach without proper accumulation of scientific knowledge.

The discussed path of South Korea that eventually led to a scientific fiasco like Hwang debacle was, however, not entirely preordained. There were a few actors in the South Korean government like Eun-Jeong Park who served as the chief of the National Bioethics Committee in early 2000s, and the initiated bioethical bill was intended to tightly regulate hESC research based on the German legislative approach. However, her role remained only "advisory", and it was ultimately up to governmental officials and parliament members to issue and endorse the bill (see Chapter 3). It is debatable whether a different administrative choice of stem cell regulation could have been made by the government. At least, it is obvious that the "possibility of doing otherwise" was significantly constricted after Hwang's announcement of scientific success in 2004. As Park testifies, it was not only the administrative operation and power struggle that hampered unbiased bioethical regulation; the "general atmosphere" of the public, expressed through media, also exerted pressure to belittle bioethical deliberation.

From a comparative angle, the success of the UK signifies the importance of high performing, authoritative natural scientists in the field who could ensure their advice was heard in the parliament. A lack of scientific authority and expertise both in parliament and the scientific field in South Korea may be pointed to as the cause of rather haphazard and bureaucratic legislation. As scientific expertise to evaluate and check peer's activity was weak, the popular media representation easily swayed public perceptions.

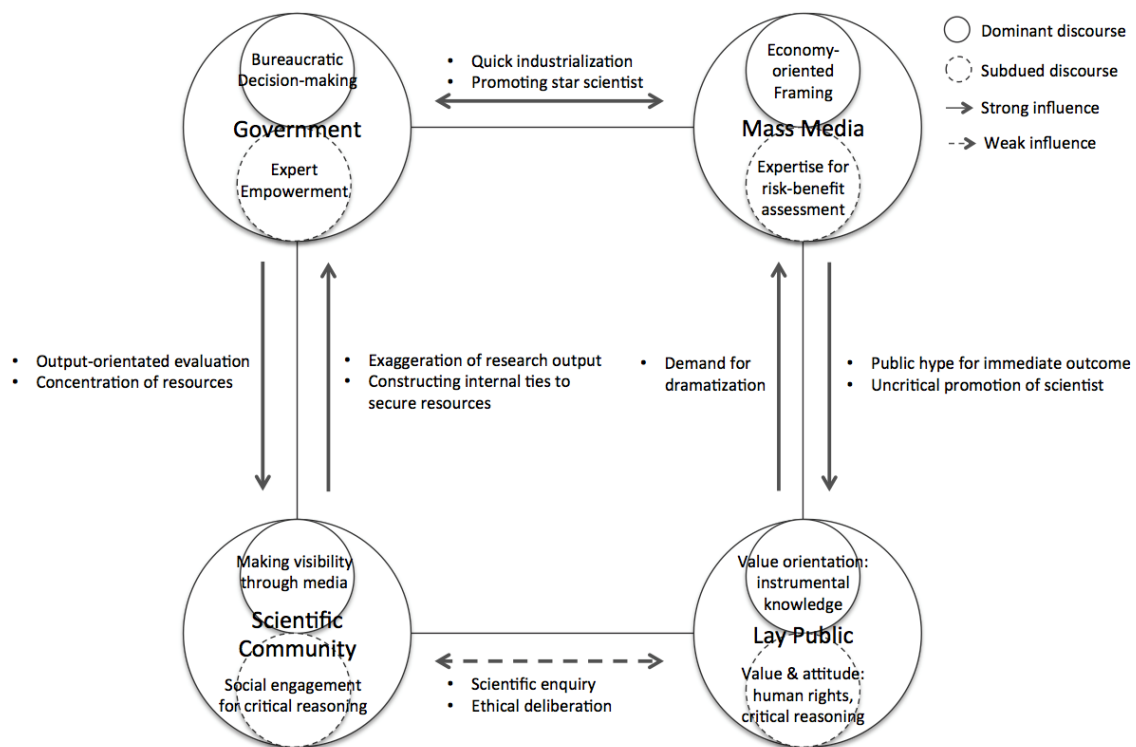


Fig. 8.1. Interaction & internal dynamics of critical fields

As depicted in Figure 8.1, the mutual influence among critical fields, government, mass media, scientific community and lay public, embodies internal dynamics between dominant and subdued discourses and actors in each field. Expert empowerment in the government, expertise for risk-benefit assessment in mass media, social engagement for critical reasoning from the scientific community, and consideration of human rights and an attitude of critical reasoning among the lay public (dashed circles) were most notably missing. Such an absence resulted in vulnerability with regard to checking bureaucratic decision-making by government, economy-oriented framing of predominant conservative newspapers, media play of a few scientists under question and the public's blind acceptance of instrumentalised scientific knowledge for economic achievement (circles). In addition, scientific enquiry and ethical deliberation created by the interaction between the scientific community and the lay public were missing.

From a policy perspective, the observed scientific failure hints at directions for achieving better interaction among actors. Most of all, growing and empowering expertise that has an independence from bureaucracy is important to establish a regulative system that also guarantees sustainable research. This applies both to scientists and policy

advisory bodies. One way to do so is to widen the public sphere of scientific deliberation, to make it more visible, and to organise the scientific discussion based on consultation with those experts. In South Korea, the room for public participation in scientific legislation is much smaller than in the UK and such participation has never been regularly exercised.²²

To emphasize, the strengthening of expert discourse can be an effective way to mitigate mass media representation of science as drama. Simplistic depiction of scientific research as the means to economic development or international recognition could be checked by a more diverse deliberation and verification process. If political stance affects media representation of science, as we observed in Chapter 4, and scientific “conservatism” as expressed in South Korea has yielded tragic consequences, we might also question the effectiveness of a counterpart media, *Hankyoreh*, that has tried to represent a more progressive version of scientific discourses. A media representation that is not caught in the current political polarity between economy and bioethics is needed.

The problems of the laboratory and academy in South Korean stem cell science seem to be more difficult to address. One hopeful sign we observed is that the government’s funding policy could encourage a change in scientists’ behaviour. However, Korea’s typical research approach, oriented towards labour-intensiveness as well as resource mobilisation, is not something that governing bodies can quickly transform with direct intervention. Creativity and ensuing innovation is the key to becoming less dependent on a strategy of labour and resource mobilisation. This alternative path will require significant and thorough educational reform, beyond the level of ethical oversight. Therefore, the core objective should be to increase the autonomy and excellence of students and junior researchers; governing bodies will find various measures to achieve this.

To effect a transformation, scientific leadership should be able to empower subdued actors, discourses, institutional process and value by actively mediating interactions among the mentioned fields in Figure 8.1. They include: expert empowerment, media expertise for risk-benefit assessment, social engagement for critical reasoning from the scientific community, and educating the public to pay more attention to human rights

²² To add, governmental advisory reports are seldom published with the names of consulting experts but only the name of department with which they are affiliated. This reduces the visibility and responsibility of public consultancy.

and critical reasoning. These are aimed to promote critical actors and discourses. Such leadership will traverse boundaries of government or the scientific community.

Leadership orientation: reformulating the knowledge- power relationship

Looking at the trajectory of stem cell research from 2000-2013 in South Korea, the results discussed so far provoke an immediate question: ‘Should a nation and its people inadequately prepared for the ethical governance of life scientific research, perform such research?’ I suspect that regardless of the issue of appropriateness, stakeholders will pursue the research. It is therefore reasonable to question what effect such continued actions under the aforementioned social constraints will yield. One thing is obvious: its results will extend beyond failures in scientific research and innovation. As already experienced through the Hwang debacle, other effects may include the abuse of human rights and social conflicts quite apart from conflicts in the laboratory.

By focusing on the dynamic interactions of resources, signifiers and actions in society, we can reflect on possible ways to change the interaction, governance and discourse. Historical analyses demonstrate that differences in societal context create different trajectories, despite common political and economic challenges, spurred by different responses in their superstructures (Hunt, 1984; Brenner, 1976; Moore, 1966). Max Weber thoroughly discusses how a complex system and interaction of political, social and economic variables eventually brought very different consequences (Collins, 1980). Weber himself, with his famous “switchmen” metaphor in *Social Psychology of World Religions*, clarifies how this could be achieved:

Not ideas, but material and ideal interests, directly govern men [and women’s] conduct. Yet very frequently the “world images” that have been created by “ideas” have, like switchmen, determined the tracks along which action has been pushed by the dynamics of interest. “From what” and “for what” one wished to be redeemed and, let us not forget, “could be” redeemed, depended upon one’s image of the world (Weber, 1946: 280)

On an institutional level, first of all, it is worthwhile to reassess the project of scientific cooperation and leadership. As Etzkowitz and Leydesdorff (2000: 113) indicate,

similar to a networked understanding of collaboration, the sources of innovation and the network of relations among scientific actors in the “Triple-Helix” spheres of government, industry and academy ‘generate a reflexive subdynamic of intentions, strategies and projects...apparent at the organizational, local, regional, national and multinational level...and are continuously reconstructed yet differently at different levels’. Therefore, the internal transformation within each of these spheres becomes more important than simple collaboration among them.

As we have observed, the failure of cooperation between scientists in South Korea, the key to success in scientific action, lies beyond the surface institutional interactions among government, industry and the academy (or scientific community). As I argued in the previous section, people’s perceptions and discourses regarding science and knowledge predefine the boundary of possible actions. Therefore, deliberation for scientific leadership goes beyond emphasizing the participation of lay people in formal scientific decision-making, but includes the vision and value of actors’ interactions and their attitudes toward broader knowledge-creating activity – I name this kind of leadership “knowledge leadership”. To rearrange the cumulative arguments in Table 8.1 and Figure 8.1, Figure 8.2 emphasizes prescriptive points for knowledge leadership to overcome the challenges that government, industry and academy each faces in South Korea. Under the economic pressure and technological challenges of global competition, not only the ability of governance but the quality of public discourse (desire, motivation, mindset, perception, and relations) becomes an important object to manage and improve.

What then does it mean that a leadership should extend beyond the existing institutional boundaries to stimulate positive interaction? Calvert (2010: 204) notes that the interacting social networks “should shift the focus from collaborative interdisciplinarity to *individual* interdisciplinarity” in order to realize Durkheimian “organic solidarity” (Law, 1973; emphasis by myself) by integrators rather than by specialists. In short, a new knowledge leadership should establish a social environment, as well as academic programs and conventions, which promote the individual’s ability and mindset for interdisciplinarity and creativity.

To motivate interdisciplinarity and creativity, critical reflection is needed on the sociological reproduction of the individual and the relationship of knowledge to power. The current dynamics of knowledge-power and typical individual conduct in South Korea that is oriented towards exploiting governmental funds and human resources undermine the potential for creativity and innovation, worsening the vicious circle of labour-

exploitation. As knowledge is narrowly understood as the means for power that is framed by nationalism and individual success, alternative values or different incentives are hard to find. Those who hold power, in turn, hardly appreciate the knowledge system beyond its being a narrow means for achieving wealth and more power (Thompson, 2010; Kim, 2008), reflecting both medieval and modern Korean cultural history in which the educational system was regarded as having “value for status” rather than “value for knowledge in its own right” (Lee, 2005; Choi, 2002). The objective of knowledge largely gains the significance of a “positional good” to seek rent by gaining social status (Hirsch, 1977) rather than an “intrinsic good” to explore new knowledge or discovery. The existing culture thus significantly constrains the potential and social function of knowledge. As discussed in Chapter 7, the evaluative process operates as a major intermediary to entrench this attitude.

The present impasse signals the need to change the role of evaluation in the academy. Imposition of a strong research evaluation system (Whitley, 2007) and the constructed bibliometric evaluation system (Gläser and Laudel, 2007) are global phenomena, but the state-centric research and educational system of South Korea homogenizes operations and value orientations regarding knowledge-related activities. If the state-guided “select and focus” strategy works successfully, scientific experiments can quickly translate into lucrative application. However, the OECD report (2014) on South Korea’s innovation policy points out that state-run research and innovation is finding it harder to achieve its goal, given the growing complexity of science and technology. In a similar vein, some state-run evaluative schemes like World Class University or the Brain Korea 21 project make scholars focus solely on increasing their publications rather than nurturing the intrinsic capabilities of students and junior researchers (Jang and Kim, 2013; Shin and Jang, 2013).

More qualitative assessment, consulting and resource distribution, based on diverse criteria of performance rather than the excessively quantitative and formal evaluation of universities and research labs (OECD, 2014), is required for invigorating creativity and the leadership of experts. If students and researchers are allowed autonomy to pursue education and research as intrinsic goods, i.e. study motivated by scientific curiosity rather than expected status, the social function of knowledge can be transformed to serve for broader social causes. The social causes will naturally include the proliferation of democratic leadership in the society, inducing more diverse values and entrenching common ethical principles (see Figure. 8.2) for more effective social

cooperation. Foucault discussed the implicitly desired formation of the subject based on the management of sexuality and pleasure in *History of Sexuality Vol. 3*; I think a similar approach can apply to the generation of “pleasure” that is the motivation of practicing knowledge. In Hwang’s case, we have witnessed how the exercise of disciplinary techniques without the leadership to induce genuine motivation in pursuing knowledge could ruin sustainable science, with vivid illustrations of exploitation and betrayal among researchers.

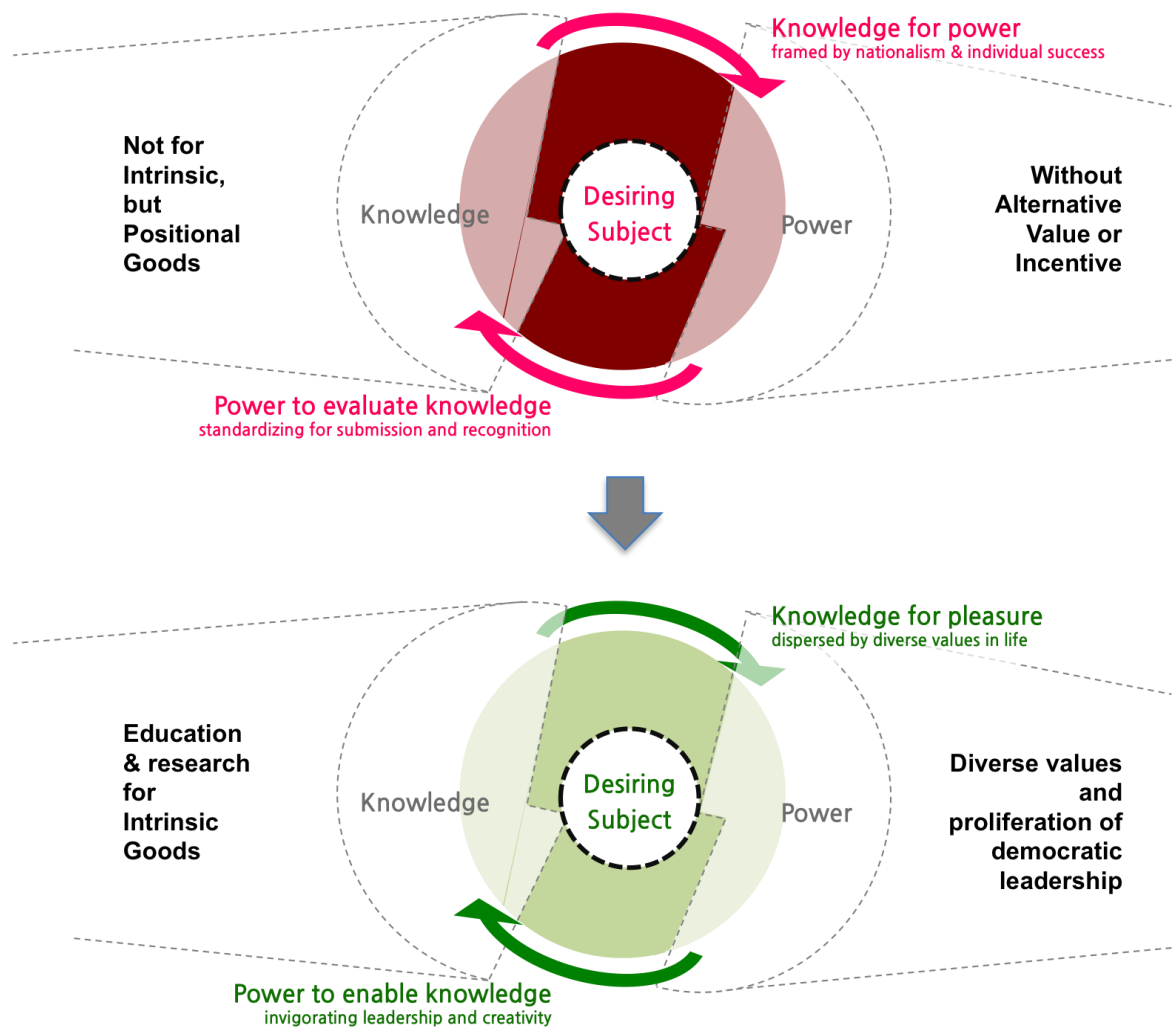


Figure 8.2. The current status and future projection of the knowledge-power relation

Therefore, it will require a transformative and challenging leadership to restructure the knowledge sphere and citizenry itself, which has to withstand cultural bias, reactionary responses, the possible short-term decrease of outputs, and more. Such a task is more fundamental and broader than technical knowledge management (O’Dell and

Hubert, 2011) or research team-based scientific leadership (Hemlin, Allwood, Martin, and Mumford eds., 2013). The studied characteristics and principles are useful, but, paraphrasing Denti and Hemlin (2013: 69), a “psychological empowerment mediating between transformational leadership and followership creativity” will become active only when the overall national knowledge-producing environment and individual desire overlap with the leadership-followership projection.

Consequently, strategies to reformulate and govern scientific practices require better politics and administrative functioning as well as good scientists. Good government, in turn, can only be based on sound media representation and public perception. In order to enhance the visibility and representativeness of identified causes and effects, the nation needs vigorous social reflection supported by more effective methodology. By looking for hidden variables and interactions, especially for semantic and social network interactions, the dynamics of society could be studied and reflected anew by integrating concepts of science and technology studies, social psychology, semiology, and more. That is what I have tried to achieve throughout this thesis.

Limitations and future research

My thesis has been, admittedly, an ambitious one, attempting to integrate theories of sociology, social psychology, and semiotics to develop a methodology to visualize and assess the dynamics of signifiers in the public sphere of science, and interpret their discursive meanings in contemporary society. Also, a series of empirical works implicitly attempted to bridge the gap between social studies of science and innovation studies in terms of research orientation and methodology.

The work has a number of limitations. As mentioned in the Introduction, the comparison between South Korea and the UK was not fully systematic from the beginning: the focus of interest lay in South Korea and some characteristics of the UK, e.g. the power of expertise and the importance of human rights in public perception, were highlighted to indicate their importance for sustainable science. Also, the business operation of stem cell research has been understudied. Sunder-Rajan’s (2006) ethnographic narrative describes the entrepreneurial-scientific actions in the Indian pharmaceutical field reflecting contemporary neoliberal discourses. There could be advantages for this type of research approach and interpretation, but I could not review

entrepreneurial actions in South Korea in detail except for a few problematic actions that drew mass media attention.

The question of robustness of methodology in relation to adopted theories could be also raised. Some limitations derive from the grounded theory approach itself that flexibly accumulates a number of data corpora and cases at different levels. The original intention of the grounded theory approach is to naturally derive a new theory out of empirical research, with flexibly constructed formal procedures, without being bounded by pre-existing theories. In the Methodology chapter, I argued that a certain degree of presupposition and deduction is inevitable even with such approach. In retrospect, my initial interest was to translate the Actor-Network theory into social-psychological and semiotic concepts and experiment with newly developed algorithmic approaches to semantic network analysis. What this exploratory approach revealed was that the observation of people's salient attitude or *habitus* regarding knowledge-related works was as important as mediating institutional actions. The Foucauldian concepts of governmentality, discourse and biopolitics supplied new insights to the observations, but the kind of theory I can develop from this particular coupling of theories and methodology requires much further effort.

My proposed incorporation of social-psychological and communicative concepts into quantitative and qualitative research needs refinement and standardization. Above all, the methodological endeavor to detect diverse levels of cultural identity using semiotic analysis will be faced with multiple challenges, as it seeks to analyse data in different situations. To standardize these methods requires the accumulation of empirical research, and there are consistent principles and concepts that the researcher should keep in mind. Underpinning these efforts should be a will to go beyond social categories defined by existing social science or popular perception, instead representing communicative process and semiotic interaction from a different angle. This approach can be used to resolve policy problems as well as to find new clues in social scientific research when there is an impasse over the interpretation of social phenomena. With this thesis as a stepping stone, I hope that a new form of research will develop to embrace newly available data sets, and to effectively interpret their underrepresented meanings.

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