WHAT ARE STEM CELLS?

STRATEGIES OF DEFINITION AT THE INTERSECTION OF POLITICS AND SCIENCE

by

JOHN LYNCH

(Under the Direction of Celeste M. Condit)

ABSTRACT

Since the isolation of embryonic stem cells from humans, the words "stem cell" have become the focus of intense debate. The concern is with the nature of stem cells: are they the medical miracle that will cure diseases like Alzheimer's disease, type-I diabetes and Parkinson's disease, or are they the murder of an innocent developing form of life? Attempts to answer these questions raise issues of definition – namely, what *are* stem cells? This dissertation examines the strategies of definition used in the political and scientific debates from December 1998 to April 2002, a period that covers the major political and scientific milestones in the early debate over embryonic stem cells. Definition is understood as the creation of a quasi-stable point from which individuals launch arguments. Those quasi-stable points are created through the organization of a series of "fragments." Three strategies play a role in the development of the political and scientific definitions of stem cell and embryonic stem cell. First, rhetors appeal to future applications as a justification for research: in this way, stem cells become defined by their purpose, the potential applications that they can be used to realize. Scientists offer a list of three potential applications, which political rhetors reduce to one – direct medical application. This shift in application changes how stem cells are defined. Second, both scientific and political

rhetors make use of the process of dissociation, where a unitary concept is divided into two differently-valued pairs, in defining embryonic stem cells. Scientific rhetors used dissociation to establish embryonic stem cells as an ideal model for understanding the earliest stages of development in mammals. Political rhetors used dissociation to undermine attempts by opponents of this research to define embryonic stem cells as the murder of a fetus or embryo. Third, both political and scientific rhetoric deploys an argument from hierarchy and its attendant ambiguities to argue about different types of stem cells, especially embryonic and adult stem cells, and their capacity to attain the applications each group desires.

INDEX WORDS: stem cells, science, politics, rhetoric, fragments, dissociation, hierarchy, application, translation

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DEDICATION

This dissertation is dedicated to Brynn Margaret Atwood and Stephen George Boerger who celebrated their first full year in this world two days before this dissertation was defended. May the world you inherit from us be as interesting as we hope it will become.

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Chapter 1.

Definition and the Stem Cell Debate

In August 2000, PBS's *Newshour* aired a debate on embryonic stem cells. The representatives of both sides – Richard Doerflinger, from the National Conference of Catholic Bishops, and Daniel Perry, chairman of the Patient's Coalition for Urgent Research – took little time highlighting what they saw as the core issues in stem cell research. According to Doerflinger,

> For the first time in federal history, U.S. History, the federal government will actually be taking a class of human beings, a form of developing human life which is what even the NIH calls these embryos, and destroying that life for the benefit of others.

The creation of embryonic stem cells destroys human life, an action even more troubling for Doerflinger because scientists could obtain stem cells from adults without the loss of life. For Perry, in contrast, the issue is creating effective therapies for cancer and Parkinson's disease. Adult stem cells do not work:

> Even after all of these years, we have not been able to make adult stem cells replace potentially, any cell in the body. That's the great promise of embryonic stem cells. … How can we tell a young woman, diabetic at age 20, we're going to wait five years and just study adult stem cells and we may say, well that didn't work, now we're going to try something else – when in the meantime, she may

> have faced the loss of sight, amputation, kidney failure? I think it would be immoral and unconscionable to tell patients wait until first we try this avenue that so far has not proven effective.

For Doerflinger, Perry, and the organizations they represent, stem cell research places the rights of fetuses against the rights of patients. These two positions have been replayed in almost all public debates about stem cells. Some rhetors reiterate the concerns of Doerflinger: for example, Davis (2002) notes that stem cell research touches on the same issues as abortion and cloning, and Zoloth (2002) insinuates that bioethicists and scientists have been seduced by the power of biological research. Yet, the opposition emphatically repeats the concerns raised by Daniel Perry. According to scientist Irving Weissman (2000), embryonic stem cells offer amazing opportunities to cure disease and learn more about human life and development. The late Christopher Reeve and actor Michael J. Fox have advocated for research on embryonic stem cells in order to cure spinal cord injuries and Parkinson's disease. In 2003, Senator Arlen Specter urged President Bush to expand the number of embryonic stem cell lines for the sake of creating safe and effective therapies from them in the future (Wade, 2003). In the election of 2004, the issue of stem cell research played a role in the presidential debates between George W. Bush and John Kerry. The election also saw states like California and New Jersey start stem cell research initiatives to support work not currently funded by the federal government (Kasindorf, 2004; Mansnerus, 2005). This dissertation examines the scientific and political definitions of stem cells from 1998 to 2002. This chapter provides the theoretical rationale, methodology, and an overview of the remaining chapters.

Definition and Translation

Rhetors in the stem cell debate address two questions. First, are embryonic stem cells like fetuses? If they are, embryonic stem cell research violates the 1995 Dickey Amendment that forbids the destruction of human embryos in scientific research. The research would then be illegal, as well as being viewed as immoral by some individuals. Second, do embryonic and adult stem cells have the same "potency" – can they both do the same things? If they have the same potential, then adult stem cells have the same therapeutic potential as embryonic stem cells. Otherwise, embryonic stem cells represent the better option for future therapies.

Furthermore, these two questions raise issues of definition – namely, what are stem cells? Are embryonic stem cells fetuses, and do they therefore present a moral conundrum? Are adult stem cells "pluripotent" and capable of producing the same therapies and medications that researchers claim embryonic stem cells will produce? Both sides try to define what stem cells – especially embryonic stem cells – are, and they try to do so in terms of future applications and moral issues. These questions also raise issues of translation. Stem cells are products of science. The arguments about their potency (are embryonic stem cells pluripotent and how do they compare to adult stem cells?) are raised in the scientific literature. Scientists try to define what stem cells are and what they do for their own purposes. Those definitions have migrated from the context of science and been put to work in the realm of politics and policy.

Stem cell research highlights the role of definition in scientific and public debates. As Zarefsky, Miller-Tutzauer, and Tutzauer (1984) note, "to choose a definition is to plead a cause. ... to name an object or idea is to influence attitudes about it" (p. 113). The study of definition in rhetoric has its roots in the work of Richard Weaver and in Chaim Perelman and Lucie Olbrechts-Tyteca's *The New Rhetoric* (Zarefsky, 1998). According to Weaver, definitions are a

form of argument – an argument grounded in timeless or eternal essences (Weaver, 1952). Perelman and Olbrechts-Tyteca identified dissociation as a key strategy of definition, a strategy that prototypically divided a concept into its "appearance" and its "reality" (Perelman & Olbrechts-Tyteca, 1969). When rhetoricians have examined the process of definition since then, many, like Edward Schiappa, have attacked these understandings of definition, especially the process of dissociation, as the product of naïve realism and a "picture theory" of language (B. R. McGee, 1999; Schiappa, 1985, 1993, 1996, 2003; Titsworth, 1999; Walton, 2001). In response to realist understandings of definition as a complete demarcation of a word and its meanings from all other words, Doyle (1997) has argued that definitions are impossible: one cannot create complete boundaries around words and clearly secure their meaning. While not responding directly to Weaver, Doyle's argument responds to his "picture theory" of language: contra Weaver and others who hold this theory of language, definitions cannot be established permanently. Yet Doyle overstates the case: while definition as the creation of the perfect picture of a word and its essence is impossible, the pragmatic use of definitions as a temporarily stable point from which to base an argument still occurs. Definition exists apart from realist philosophies of the type attacked by Doyle, Schiappa and others; people still define things and argue *by*, *from* and *about* definition.[1]

People use definitions all the time. These definitions play a central role in many debates in science and in politics. Definitions are not the identification of an "essence" or independent "reality," but they do provide a quasi-stable point from which individuals can make sense of the world and argue for various courses of action. Definitions play an important role in shaping

[1] Weaver (1952) provides the concept of *argument from definition*. Schiappa (1993) discusses how many arguments concerning definition are *arguments about definition*, instead of arguments *from* them, and Zarefsky (1998) introduced the concept of *argument by definition* where the definition of a word, concept or fragment is simply asserted during the course of argument.

people's psycho-social consensus about the world, what counts as "real" for a given group of people (Goodwin, 1991).[2] The various definitions of "stem cell" in the scientific and public discourse will shape what people believe stem cells "really" to be. These definitions will influence how lay people react to stem cells and whether the government will ultimately support or ban stem cell research. The definitions also shape what issues the scientists who study stem cells consider to be important. Definitions help shape research agendas and determine where scientists will spend their time and energy.

Stem cell research also highlights the importance of translation. Concepts and concerns move between the scientific realm and the political realm. Sociologists and social psychologists have developed a number of broad models to describe the movement, alternately described as "translation" or "popularization," of ideas and technology from the laboratory to the public (Latour, 1987; Latour & Woolgar, 1986; Moscovici, 1984; Wagner & Kronberger, 2001). These models of translation are limited for two reasons. First, as Bucci (1998) notes, they isolate the processes of translation from the process of constructing and conceptualizing scientific ideas. Scientists translate concepts from the popular culture when they begin the process of defining scientific concepts and objects, and this element of translation is missing from the existing models. Second, these models, especially Latour's model (1987), have been criticized as mechanistic or "brute force" models where the scientist with the greatest number of facts and most expensive "toys" or experimental apparatus wins (Gross, 1990). The role of the rhetorical – the element of the broader cultural sphere involved with the figuration of discourse – is downplayed in these accounts of the translation of scientific concepts.

[2] The "real" and "reality" are not the same: "the real" is a psychosocial consensus about the world, and "reality" is an ontological construct stipulating the complete independence of the world from our perception.

Science has its social and rhetorical elements, and the public has its scientific elements. This stem cell debate especially highlights the translation of definitions from the pages of the scientific journals and the laboratory to the halls of Congress and the pages of newspapers. The process of definition and the translation of those definitions make stem cells an interesting nexus for examining the process of definition, how those definitions circulate, and how those definitions are translated from one discursive arena to another. Three strategies play key roles in the definition of stem cells: appeals to application, dissociation, and what I will call the argument from hierarchy.

Surprisingly, the metaphor of "stemness" does not play a role in the definition of "stem cells." The name "stem cell" has potential to be used as a metaphor: like the stem of a plant that produces offshoots or branches, the "stem cell" produces cellular offshoots. Yet, this metaphor is not utilized in the scientific discourse, and it is used only three times in the political discourse. Only two scientific articles examined talked about "stemness," and in both cases, the articles were concerned about the molecular structure of "stemness," what made a stem cell capable of becoming different types of cells (Alison et al., 2000; Smith, 2001). The scientific use of "stemness" does not activate the resources of the arboreal metaphor. In politics, the only use of the metaphor of stemness comes from Michael West of Advanced Cell Technology: "Human ES cells are unique in that they stand near the base of the developmental tree" (*Hearing on stem cell research*, 1998). No other rhetor in the political field deploys this metaphor. Metaphors have many uses. They can perform epistemic roles, shaping the ways individuals makes sense of the world, but the range of functions can move from the epistemic, to the heuristic, down to the merely decorative (Condit et al., 2002). The use of the metaphor of "stems" acts as a heuristic signpost, providing an initial orientation to the subject of stem cells. The initial understanding of

stem cells is expanded through the use of the other textual fragments in the field of definition, while the metaphor itself is left inactivated.

When definitions translate from scientific to political discourse, the rhetor's *purpose* shapes the definitions used and translated from one arena to another. These purposes are the possible future uses, or *applications*, toward which a given course of research aims. When a rhetor has a certain future application in mind, those concepts, fragments or words that increase the suitability of an object like stem cells for fulfilling that purpose will become the most prominent. For example, "self-renewal" plays a key role in scientific rhetoric concerning stem cells, since scientists need to continually produce sufficient numbers of cells for experiments. Yet, when the debate moves to the halls of Congress, "self-renewal" receives far less attention from rhetors than the concept of "differentiation," which is key to the medical applications that plays a key role in advocacy for stem cell research in the political realm.

Purpose, the fifth element of Burke's pentad of motives, drives the debate about embryonic stem cells and the definitions deployed there (Burke, 1969). Yet purpose should not be equated with the mystic philosophies that Burke studies in that section of the *Grammar of Motives*, and we should not use an agent-purpose ratio to treat purpose as intentionality or the will of an independent subjectivity. Purpose can be understood independent of mysticism and agency, and in the case of the stem cell debate, the purposes driving the choice of definitions derive from elements of the greater scenes (science or politics) wherein a rhetor operates. The ideals of science, the ideologies of political parties and social movements, and the economics of biotechnology each play a role in shaping the purposes of stem cells research.

The debates during this early stage of the stem cell controversy became deadlocked on the possible medical applications of stem cells, the moral status of embryonic stem cell research

(i.e. is embryonic stem cell research the murder of a developing human?), and the relative value of embryonic and adult stem cells for furthering science and producing cures for diseases. The strategies of appeal to application, dissociation and argument from hierarchy were used to by both sides to create a definitions of "stem cell" and "embryonic stem cell" to shift the ground of the debate toward banning or supporting research involving embryonic stem cells. The debate did not reach a resolution. While arguments about the equivalent potency of adult stem cells were dealt a blow by scientific findings in early 2002, the political argument remained deadlocked with George W. Bush's policy on embryonic stem cell research. Bush's speech announcing the decision to fund research on embryonic stem cell lines derived before August 9, 2001, reflects the tensions within the ongoing political debate. His speech used the definitions from both sides – embryonic stem cells were defined as murder and as the potential savers of countless lives. The speech defined any middle ground out of existence and rendered the policy it announced incoherent. Yet this incapacity to successfully reorganize the definitional resources and strategies connected to "stem cell" reflects the tension within the political and scientific debates, a tension that continues today.

Definitions as Fragments

The deadlocked debate about stem cells and the policy that embodies it develop because how stem cells were defined and how those definitions were translated. The processes of definition and translation can be understood as parts of a whole if one views definition as the movement and organization of *fragments* (M. C. McGee, 1990). McGee's theory of fragmentation is a fruitful way to approach definition and translation because fragmentation describes theoretically how definitions develop and because fragmentation describes *how*

scientists and nonscientists read texts. Definition becomes the aggregation of fragments, and translation can be understood as the movement of fragments across discursive fields.

First, fragmentation describes theoretically how texts and definitions develop. According to McGee, texts can be understood as a structure of fragments: any finished discourse "is in fact a dense reconstruction of all the bits of other discourses from which it is made" (1990, p. 70). Authors pull together fragments and place those fragments in relation to one another when they create a text. These elements can, in turn, be borrowed for use in other discourses. Some elements that can be borrowed are the definitions a finished discourse creates. Furthermore, these definitions can be treated as a structure of fragments since they tie together a number of different concepts and words. This definition – this structure of fragments – can be borrowed by other rhetors. Those other rhetors may borrow the whole definition or merely parts of it. They can borrow the definition explicitly or by means of citation. The concept of fragments describes how scientific definition works: scientists take concepts, ideas, and methods from previous work and put them together to argue for the claims they forward. This process also provides a rhetorical critic the means of isolating the definition of a concept accepted by the scientific community as a whole. Because texts consist of fragments, the critic can follow individual fragments as they are used in a variety of texts. Those fragments used with the most regularity in a field of research and discourse represent the commonly accepted definition of a word or concept.

Second, fragmentation also describes how scientists actually read texts. According to Davida Charney (1993), scientists fragment scientific texts by reading them in a non-linear fashion. Scientists jump from section to section of scientific articles – for example, they read a portion of the introduction then move to the section on results briefly, before moving back to the section on methodology. Journalistic popularization and translation of scientific texts also

fragment them by taking the elements that might interest a lay public and presenting them out of the context established in research articles (see Curtis, 1994; Fahnestock, 1993; Myers, 1990). McGee's concept of fragments therefore provides a means of understanding the formation of scientific texts and of tracking a scientific discipline's commonly accepted definitions, as well as describing how scientific and lay audiences read scientific texts.

Isolating and Identifying the Field of Stem Cell Discourse

Basing one's approach to definition in McGee's idea of fragments requires being able to identify the field of discourse and isolating the elements of the definition within that field. When trying to do so in the scientific realm, especially areas such as stem cell research that have aroused a high degree of interest, the sheer profusion of documents can be daunting. A search for articles written in 2003 containing the words "stem cell" in the abstract or title on MEDLINE produced over 3600 documents containing the term (January 1, 2004). One must find a way to enter this large body of documents and identify the core texts, the texts that must be cited in order for the group of scientists working within that area to claim a new text is part of that field. One can do this through the use of scientific review articles. According to Gross, Harmon, and Reidy (2002), scientific review articles develop arguments with two components:

> an introduction designed to secure the attention of some research front, and an evaluation of the recent texts within that front. This second component informs readers of the state of the current research on a specialized topic and heightens the importance of some knowledge claims over others. It forms a second-order stratum of judgement, supplementing that of peer review. (p. 199)

Peer review determines which arguments are worthy of publication. The scientific review makes claims about those published arguments that are worthy of continued attention. Furthermore, it highlights the strengths and weaknesses of the extant research within a given field. A review article lets its readers know what the author or authors feel is the current state of the field and the directions it should take. In this sense, the review article is deliberative (Czubaroff, 1989) – it tells readers where the field stands and what conceptual material and issues it should engage in the future. While any one review might contain a number of idiosyncratic biases in the articles it claims constitute the most important work in the field, agreement across a number of reviews indicates that a group of researchers has come to agreement about what work, what concepts and what directions for future research matter.

Scientific review articles become the first level or layer of the core texts in a specific scientific discipline. The remaining elements can be identified through a snowball method. Articles mentioned in the first layer – in more than one scientific review article – will become part of the "second layer," and articles mentioned in two or more of the research articles will make up a "third layer" of the sample. This method found a core of 50 review and research articles that scientists cited presenting work at the nexus of the debate about embryonic and adult stem cells. An initial examination of the texts identified through this snowball method showed that they all attributed similar qualities to stem cells (pluri/multipotency, self-renewal, plasticity, etc.) and identified the same "types" of stem cells (hematopoietic, adult, embryonic, etc.). These key scientific fragments are marked (*) at the point of their first appearance, and brief definitions are found in the glossary (Appendix A).

All of the review articles focused primarily on articles published between 1998 and early April 2002. The publications and experiments from this time are central to the conceptualization

and definition of stem cells because of two events. The first is the isolation of embryonic stem cells from humans (Shamblott et al., 1998; Thomson et al., 1998). The second event is one of the last challenges to the definition of stem cells – namely, the challenge to the concept of adult stem cell plasticity (the ability of adult stem cells to become many different types of specialized cells) – that occurred with the simultaneous publication of Terada et. al. (2002) and Ying et. al. (2002). While the majority of scientific work discussed in the review articles occurred during the period from 1998 to 2002, the review articles also note several important early milestones, especially the isolation of stem cells in mice (Evans & Kaufman, 1981; Martin, 1981) and primates (Thomson et al., 1995), that define the field of stem cell research and stem cells themselves. 50 different articles were found that scientists frequently referred to when identifying the important moments in stem cell research and in identifying the properties of stem cells. This core research has been identified by the scientists themselves as the most important discourse for defining and conceptualizing stem cells, and this awareness on the part of scientists makes it possible for critics to study the definitions created by a field of researchers. This analysis can be synchronic – studying the relations between extant terms and how scientists link them together – and diachronic – studying how the terms were developed and translated into the field of research.

Political discourse was gathered from three different areas. First, Congressional discourse about stem cells was gathered through a search of Lexis-Nexus's Congressional Universe database for all prepared testimony and hearing transcripts that contained the keywords "stem cell" and appeared between November, 1998, and April, 2002. Transcripts and testimony for 24 hearings was gathered. Second, a keyword search of the NIH website (www.nih.gov) discovered the report *Stem Cells: Scientific Progress and Future Research Directions*, which was published

in 2001. Third, George W. Bush's speech announcing his policy on embryonic stem cell research was acquired from the White House's website (www.whitehouse.gov).

Overview of Chapters

In many arguments, defining is half the battle. Those who successfully define an object, idea, or group make the process of persuading their audience easier, and make the task of their opposition more difficult. The process of definition in science and politics is connected, and the creation and movement of definitions between these two rhetorical fields can be understood as the movement and organization of fragments. Chapter 2 outlines the process by which fragments move into and through science and back into public discourse. The process of definition and translation in science has two steps and can result in the distortion and amplification of fragments.

Application – the "why" for stem cell research – plays a key role in both scientific and political rhetoric, but the emphases on different potential applications shifts when the debate moves between the scientific and political realm. The shift in application changes the elements used to define "stem cell." In science, three applications appear: stem cells can help increase understandings of basic biology, stem cells can be used for screening new pharmaceuticals, and stem cells can be used to cure diseases for which no cure currently exists, like Parkinson's disease and diabetes. In political discourse, all three of the applications appear, but medical applications – the use of stem cells for curing disease – take the fore because they generate the most appeal for lay audiences. Yet, these applications are only *potential* applications, and it is their potentiality – the uncertainty about whether or not present research will yield future application – that plays a major role in political definition by application. Proponents of this

research must shape the definition by application so that stem cells, especially embryonic stem cells, represent the quickest path to the largest number of potential applications, while opponents of embryonic stem cell research emphasize the uncertainty inherent in deliberative discourse about future applications. Chapter 3 examines the different applications used in science and in politics to justify stem cell research.

A key strategy of definition is dissociation. Dissociation reorganizes the concepts and definitions used to make sense of the world in order to deal with potential contradictions and to create room for new ideas, new research and new objects (Perelman & Olbrechts-Tyteca, 1969). Dissociation reorganizes the sense of what is "real" versus what is only "apparent" or "false," and its operations in two distinct moments of the debate about embryonic stem cells are examined in Chapter 4. First, dissociation provides scientists, who were first studying stem cells twenty years ago before medical applications were possible, the means of distinguishing ES cells from the other types of cells applied to research on early development. Second, dissociation provides political proponents of embryonic stem cell research the means of reorganizing the fragment "embryo" to create the fragments "spare embryo" and "pre-embryo." These new fragments are used to counter the extensions of personhood and moral value to embryos that could undermine political support for research into embryonic stem cells.

Finally, the argument from hierarchy is used to create a ranking of stem cell types based on different "potencies," or the capacity of stem cells to produce different types of cells, and the uses of the argument from hierarchy in science and in politics is examined in Chapter 5. The hierarchy places embryonic stem cells at a higher level than adult stem cells: embryonic stem cells have pluripotency, compared to the multipotency of adult stem cells. Yet, the argument from hierarchy contains inherent ambiguities that can be deployed to trouble the rankings of the

two categories of stem cells. In science, "pluripotency" is the preferred capacity, in part because a greater capacity to differentiate is used to make arguments about the medical utility of embryonic stem cells, but also because pluripotency more closely approximates the totipotency of fertilized eggs. If one of the scientific purposes for pursuing embryonic stem cell research is to better understand the early development of mammalian, specifically human, life, then scientists would want a research object that approximates the earliest stages of development. In politics, though, the focus is entirely on medical application. Pluripotency becomes a key element in this debate because, as in science, greater power is equated with greater application. Yet, some opponents try to turn the pluripotency of embryonic stem cells against them by arguing that the potency of embryonic stem cells is too great for medicine to control or contain. Finally, both proponents *and* opponents employ the ambiguities of the argument from hierarchy to argue that either that research on both adult and embryonic stem cells should continue in tandem (a view of some proponents), or that the multipotency of adult stem cells is enough like pluripotency to make adult stem cells a more than adequate replacement for embryonic stem cells.

Chapter 2.

The Development of Scientific Definitions: Fragmentation and Translation in Stem Cell Discourse

Because of how scientists read scientific texts and how those texts are translated into the public sphere, one can read scientific definitions as a "text" consisting of a series of fragments (M. C. McGee, 1990). In addition to existing within a scientific definition, these fragments have also had a previous life, either in public discourse as everyday terms or in other scientific literature. Scientific definitions do not appear *ex nihilo*. They do not spring full-grown from the scientist's head. Instead, they congeal from pre-existing scientific and public vocabularies. The development of scientific definitions involves a series of translations: fragments are gradually tied to the experimental context of the specific science with which they become associated, and their association with this context will change them. Also, when these fragments return to political discourse, additional translations occur. Yet, the movement of fragments would not be possible without the existence of ambiguity in our systems of symbols. Fragments have some degree of inherent meaning – they are *fragments* and not ciphers merely reflecting the world around them – but that meaning only comes to full realization through the association and connections created between multiple fragments. This necessarily produces ambiguity. This ambiguity is not an inescapable failure of language: instead, ambiguity plays a productive role in discourse, including scientific discourse. After examining ambiguity and its productive

possibilities, this chapter will examine how fragments move from public discourse to scientific discourse and the amplifications and alterations that process causes.

Ambiguity and Productivity

Perelman and Olbrechts-Tyteca (1969) note that the use of an idea in an argument influences the level of ambiguity associated with it: clarifying one element of an idea automatically obscures the other elements. Kenneth Burke (1969) argues that this ambiguity is an inevitable part of any system of symbols:

> We take it for granted that insofar as men cannot themselves create the universe, there must remain something essentially enigmatic about the problem of motives, and that this underlying enigma will manifest itself in inevitable ambiguities and inconsistencies. (p. xviii)

Ambiguity is an essential part of the discourse and symbols we use to explain the world. If ambiguity exists in all human discourse, it will be especially apparent in scientific discourse:

> Scientific research is typically directed at the elucidation of entities and processes about which no clear understanding exists, and to proceed, scientists must find ways of talking about what they do not know – about that which they as yet have only glimpses, guesses, speculations. To make sense of their day-to-day efforts, they need to invent words, expressions, forms of speech that can indicate or point to phenomena for which they have no literal descriptors. (Keller, 2002, p. 118)

Ambiguity arises in science because it deals with objects and concepts for which names do not already exist. This ambiguity is not something that only appears at the cutting edge of science and as something that should be eliminated as soon as possible; rather, ambiguity, Keller argues,

is a productive force in science. In fact, Keller argues that explanation in biology "depends on productive use of the cognitive tensions generated by multiple meanings, by ambiguity" (p. 117). The concept and term "gene" represents one term that historically and currently has had numerous meanings all working for and against each other (Keller, 1995; 2000).

Ambiguity in concepts and terminology does several things for scientists. First, it can impel scientists to uncover clear and literal descriptions of phenomena that had previously been described in vague terms. Second, imprecision and ambiguity can fill in the explanatory gap left when scientists lack the ability or methods to answer certain questions about an object under examination. This happened with the concept of "gene action" used by geneticists from 1930 through the 1950s. At the time, no concrete definition of a gene existed. The concept "gene action" filled this gap until geneticists could establish that the gene consisted of DNA. It did so by implying that the gene was an agent – it performed an "action" – while also leaving the nature of that action and the nature of the agent undefined: "In this way, the very uncertainty in the basic unit of heredity becomes a resource" (Keller, 2002, p. 133-134). Genes could be seen as stable units of transmission – atoms, not agents – and also be seen as actively involved in the process of embryonic development – agents, not atoms. The two properties reinforced one another and provided a robust concept capable of provisionally answering questions that could not be better addressed until scientists established the chemical composition of the gene (Keller, 2002).

Third, ambiguity allows a concept to act as a liminal object that blurs the boundaries between categories. For example, some biologists at the close of the nineteenth and beginning of the twentieth century were interested in "synthetic biology." Studies in synthetic biology examined the production of "artificial" lifeforms (mineral and chemical compounds that

exhibited “lifelike” properties) and the artificial production of life (the creation in the laboratory of an organism; cloning). These studies and the moniker under which they were introduced – “synthetic biology” – blurred the distinction between the living and nonliving, as well as the two different questions these studies addressed.

Fourth, ambiguity in a concept provides a resource for explanation as well as a means of concealing issues that cannot be currently answered. According to Keller (2002), the concept of the “genetic program” contained this form of useful and productive ambiguity:

> It helped to secure a framework for the hypotheses that early generations of molecular biologists needed to guide their day-to-day research. Indeed the genetic program can be said to have consolidated the entire family of tropes that guided and gave meaning to virtually all of the discoveries that put molecular biology on the map – the finding not only of regulatory circuits, but also of messenger RNA, the genetic code, translation mechanisms, and even the central dogma of that new discipline. (p. 147)

“Genetic program” and its ambiguities provided a framework that allowed scientists to make sense of the discoveries they were making and to create hypotheses for future experiments.

Finally, ambiguity is necessary for scientists to speak across differing experimental programs and contexts:

> The use of language too closely tied to particular experimental practices would, by its very specificity, render communication across different experimental contexts effectively impossible. Some flexibility in terminology is necessary for the construction of bridges between these different contexts; in turn, such bridges work to guide biologists in their exploration of phenomena that are, by definition,

> still poorly understood, ill-defined, and open-ended. In other words, the construction of scientific meaning depends on the very possibility of words taking on different meanings in different contexts. (Keller, 2000, p. 140-141)

Ambiguity is necessary for communication. Language cannot be tied to the particular in an absolute fashion if it is allow us to draw connections between different events – to see the similarity between events that seem *prima facie* dissimilar – which is a goal not only of everyday language use, but of scientific explanation as well.

Translation of Fragments into Science

Ambiguity is inherent in language. This ambiguity is productive for science in several senses. It also makes the movement of fragments from one context to another possible. Although fragments contain an essential ambiguity, the path they follow through discourse can be traced. The critic can identify the process by which fragments enter a field like science. First, this section will describe the process whereby concepts and words enter scientific practice, and then it will discuss two of the implications of this process. This process has two steps – the move from public discourse practices to scientific discourse practices, and the move from scientific discourse practices to technical definitions. At each step, the definitions can be translated back into the public (see Figure 1, p. 31). While this move to technical definition holds for some fragments, it is neither the case that all fragments move toward a technical definition nor the case that all scientific terms gain a technical definition. “Gene” is one scientific term that has not followed this pathway. Instead of having one definitive technical definition, the term has multiple meanings and multiple technical definitions (Keller, 2000). Furthermore, even the technical definitions have contained a fundamental ambiguity that allow for multiple

interpretations (Keller, 2002). Although the process outlined above does not culminate in technical definitions all the time, it is a useful means of modeling and understanding definition for two reasons. First, many terms imported into the scientific realm move through the first step of the process described above, even if the importation does not necessarily lead to a technical definition. Second, though the incidence of technical definitions throughout all the sciences has not been measured, technical, laboratory-based definitions are a goal of almost all scientific disciplines, even if they sometimes fall short of this ideal.

Before terms are translated into science, they exist as part of the discourse practices of the public. In that area, they are often taken and used in numerous contexts, tied to different fragments to create a variety of texts. In the first step away from public discourse practices, scientists translate terms available in the broader culture into the realm of scientific discourse. For example, the term "plasticity"* was taken from discussions of arts like sculpture and incorporated into scientific discourse in 1868 initially to describe the ability of animals to adapt to their environment (Oxford English Dictionary). The potency terms* "totipotent" and "pluripotent," derived from the use of "potent" to describe power and sexuality (especially male sexuality), were translated into science during the first quarter of the twentieth century. "Multipotent" was translated in the 1990s to describe the lesser potential of some types of human stem cells, especially adult stem cells. These concepts can be in use over a long period of time and can be used to describe a variety of phenomena without having their meaning tied to specific technical demands. For example, "plasticity" means the adaptability of an organism to its environment and also the ability of adult stem cells to become different types of cells.

The second step involves a move toward technical definition. Technical definition ties a concept or term to the practices of a specific scientific discipline. These practices consist of

protocols of observation and protocols of calculation (Holton, 1986; White, 2001). Protocols of observation determine what counts as scientific observation and how those observations are to be made, and protocols of calculation determining how empirical observations should be analyzed. The combination of these two elements, along with protocols of evaluation and criticism (White, 2001), shape the creation of technical definitions. In most sciences, these protocols intersect within the laboratory. The laboratory becomes the site where definitions of concepts become tied to technical considerations and standards. The goal in making definitions technical then is to create experimental handles (Keller, 2000, 2002). Handles are products of the specific laboratory context and the practices of observation and manipulation there. Within that context, the experimental handle has a distinct and unambiguous meaning (Keller, 2000, p. 140). Furthermore, experimental handles can act as the *cause* for some experimental *effect*: "they [handles] can be manipulated in such a way as to induce definite and reproducible effects" (Keller, 2000 p. 141). In this way, the definition of a term or concept can be tied to a specific experimental handle, and if that handle produces its effect, this indicates that the term tied to that handle can be applied to a given object or entity.

One example of the use of experimental handles in definition is the linkage of certain genetic and chemical markers to stem cells. The transcription factor Oct-4 is a prime marker of embryonic stem cells. In order to claim any specific group of cells consists of embryonic stem cells, they must be shown to express Oct-4 (Nichols et al., 1998). This marker cannot stand alone – as Keller (2000) notes, the meaning of experimental handles depends on their relationship to other markers and other handles. To claim that cells expressing Oct-4 are "stem cells," other markers such as SSEA-3 and –4 and TRA-1-60 must also be seen in the stem cells (Amit et al., 2000; Smith, 2001; Thomson et al., 1998; Thomson & Odorico, 2000). Even when a series of

technical, experimental handles has been proposed and put to use, the definition is not set in stone. Skillful argument and the production of new experimental handles can force researchers to alter a technical definition. For example, several studies argue that while the markers described above are necessary for defining and identifying embryonic stem cells, they are not sufficient for the identification of embryonic stem cells or adult stem cells (Gage, 2000; Smith, 2001; van der Kooy & Weiss, 2000). It has been argued that morphology – the appearance of stem cells under the microscope – plays an important role in embryonic stem cell identification (Gage, 2000; van der Kooy & Weiss, 2000). This example shows that the scientific process of definition and debate is not ended by the creation of technical, laboratory-based definitions. As with the use of Oct-4 to define what counts as an embryonic stem cell, later experimental work can shift the value of the experimental handle. It is also possible to alter or devalue experimental handles rhetorically by, for example, arguing that a better set of concepts and terms describe a phenomena or object and therefore shall displace the previous term or terms and their experimental handles.

Technical definition has on its face similarities with operationalization in social science. Technical definition ties a word to a specific experimental result. Operationalization ties the use of a concept or word to the production of certain results in a statistical test or survey. The differences between the two appear as a result of the different epistemological cultures of the physical and social sciences. The physical sciences give greater presumption to their experimental findings – if one produces an experimental result for which one has an associated handle and concept, then the concept (for example, “stem cell”) tied to the handle is believed to exist “really.” In the social sciences, even if one operationalizes a concept, In the social sciences,

even if one operationalizes a concept, the validity of the operationalization – whether it adequately measures the concept – is still open to debate.

Technical definition is the culmination of the translation of fragments into science. Tying fragments to the laboratory though alters them. Specifically, the importance of some fragments becomes amplified.

Amplification: The Consequence of Technical Definition

One consequence of technical definition is that concepts tied to the laboratory and its technical limitations become amplified. Because technical definition is based on laboratory and experimental techniques available within a scientific discipline, the technical requirements and technical limitations of the laboratory can emphasize – and possibly distort – the concepts and experimental handles used in defining words. One example of this is the use of "self-renewal"* to describe stem cells. According to Verfaillie (2002), self-renewal is "the ability to generate at least one daughter cell with characteristics similar to the initiating cell." A number of reviews of the scientific literature emphasize the importance of self-renewal as a defining characteristic of stem cells (Burdon, Smith, & Savatier, 2002; Daniels, Dart, Tuft, & Khaw, 2001; Smith, 2001; Thomson & Odorico, 2000; Verfaillie, 2002; Watt & Hogan, 2000; Weissman, 2000b; Weissman, Anderson, & Gage, 2001). Certain types of stem cells would seem to require a strong capacity for self-renewal: hematopoietic stem cells that replenish the body's blood supply clearly need the ability to self-renew, to produce new stem cells that will in turn replenish the blood supply. Yet, the importance and degree of self-renewal appear to have been overstated in many cases. This occurs in part because scientists working in the laboratory need cells that will renew their numbers quickly in order to carry out experiments. Several scientists associate self-renewal

with the ability to produce new cells *quickly and constantly* (Burdon et al., 2002; Smith, 2001; Watt & Hogan, 2000). Yet, this capacity for quick and constant renewal does not seem to be a naturally occurring phenomenon. Verfaillie argues that many studies do not show that hematopoietic stem cells* have a strong capacity for self-renewal in the body. Watt and Hogan remark, "Although a stem cell has high self-renewal capacity, it may divide relatively infrequently." Gage (2000) claims that most stem cells exist in a quiescent state within the body and that it is not possible to determine whether or not they self-renew (see also Goodell, Brose, Paradis, Conner, & Mulligan, 1996). Stem cells in the adult body do not seem to have a capacity for quick and constant self-renewal, including the supposedly hard-working hematopoietic stem cells. Rather, they are quiescent most of the time, until their services are needed.

Researchers also claim that embryonic stem cells are self-renewing, but the situation with embryonic stem cells* is even more intriguing. Self-renewal is supposed to be a key capacity of embryonic stem cells (Burdon et al., 2002; Smith, 2001; Thomson & Odorico, 2000). Smith (2001) makes it one of the definitive characteristics that must be present in order for a cell to be called an embryonic stem cell. Yet, Thomson and Odorico (2000) argue that self-renewal is not a property of the cells of the inner cell mass (ICM) from which stem cells are derived:

> Although the cells of the ICM contribute to all adult tissues, *these embryonic cells proliferate and replace themselves in the intact embryo for only a limited period of time before they become committed to specific lineages*. Thus, in the unmanipulated embryo, cells of the ICM function as precursor cells, but not as stem cells. However, *if ICM cells are removed from their normal embryonic environment and cultured under appropriate conditions, they can proliferate and replace themselves indefinitely*, and yet maintain the potential to form advanced

> derivatives of all three embryonic germ layers, thus satisfying the criteria for stem cells. (p. 53; emphases mine)

Embryonic stem cells come from the inner cell mass of embryos. When the embryo is left intact and unharmed, the cells of the inner cell mass eventually *stop* renewing themselves. They become the differentiated precursor cells that eventually become incorporated into all the organs of an individual. *The cells that become embryonic stem cells never have the property of self-renewal as long as they exist in the embryo*. Self-renewal only becomes possible – and only becomes *necessary* – when scientists place the cells in petri dishes. One of the properties of stem cells becomes vitally important only because experimental manipulation makes infinite self-renewal tied to the ability for quick self-renewal necessary. While some populations of adult stem cells have an (often quiescent) capacity for self-renewal, and embryonic stem cells within the intact embryo have this capacity for a short time, self-renewal becomes an essential property of "stem cells" – that is, it becomes one of the defining properties of stem cells – because of the technical demands of the laboratory.

Translating Fragments Back into Public Discourse

Fragments move from the public into scientific discourse. They undergo a series of translations that tie them to the experimental context of the specific scientific discipline where they are used. Then, some fragments return to public discourse, where they interact with other fragments that were translated into scientific discourse as well as with fragments that remained within public discourse. During the move back to public discourse, these fragments undergo translation again. There are two powerful and prevalent modes of translating scientific fragments back into the public: appeals to wonder and appeals to application. According to Fahnestock

(1993), either a scientific discovery is attached to categories that hold a recognized value for the lay public or scientific discoveries are treated as a means to future benefits. Appeals to wonder are often associated with two specific narrative forms. One of these is the "detective story," where the scientist hunts down the clues that will lead her or him to the microbe that causes illness or the new species never before discovered in the depths of the Amazon (Curtis, 1994). The second form is the "narrative of nature," where attention is deflected away from the scientist and scientific activity and onto the object of study (Myers, 1990). Both narrative forms emphasize the object of science over the conceptual and methodological components of science.

While some elements of the appeal to wonder appear in discourse concerning stem cells, the more powerful and more useful translation is the appeal to application. The appeal to application ties science to human purposes and human activity: it focuses on what motives and desires can be fulfilled by new scientific discoveries. This is why discussion of science in public discourse shifts attention to deliberative issues such as "Is this good news or bad news? What should we do about it?" (Fahnestock, 1993, p. 32). The translation of stem cell research through the appeal to application can be seen in the different frequencies with which key fragments appear in scientific and political rhetoric about stem cells. Both scientific and political rhetoric about stem cells use the fragments "self-renewal" and "differentiation."* "Differentiation" refers to the capacity for a stem cell to become a number of different cell types: for example, stem cells could become the neurons that make up the brain. As noted earlier, "self-renewal" is a key fragment in scientific rhetoric about stem cells, but the fragment's importance, as measured by the frequency of its appearance, diminishes in the move to political rhetoric. In scientific discourse, rhetors use the fragment "self-renewal" 31 times. In political discourse, the fragment is used only eleven times. In contrast, "differentiation" appears 40 times in scientific discourse

and 35 times in political discourse. The shift in the relative frequency of appearance reflects an increased emphasis on the potential applications for stem cells, and increased use of appeals to application (Fahnestock, 1993) in the political rhetoric around stem cells. As application, instead of study and experimentation, becomes more important, the discourse will shift emphasis to fragments that most clearly contribute to application. In fact, rhetors in the political realm, including politicians *and* scientists, will explicitly define stem cells – providing an argument *from* definition instead of the standard argument by definition (Zarefsky, 1998) – solely in terms of differentiation. For example, Douglas Melton said, "Stem cells have the potential to develop into any tissue or organ in the body and yet cannot develop into a full human being" (1999). Senator Arlen Specter (R-PA) offers a similar definition of embryonic stem cells: "Embryonic stem cells have the ability to transform into any type of cell in the human body" (*Hearing on scientific impact of cloning ban*, 2002). The basis for appeals to medical application is a stem cell's ability to differentiate into a variety of tissues. Because of this, differentiation becomes vital to political definitions which try to motivate politicians to vote certain ways that will further the realization of stem cell therapy.

Conclusion

Scientific definition can be understood as the creation of constellations of fragments, and it can be studied by identifying the core texts of a scientific field and the fragments used there. Technical scientific definitions develop through a two-step process where fragments first move into scientific discourse and are then tied to experimental handles. This process can amplify and reshape the fragments and experimental handles used, making those that highlight the technical demands and limitations of the laboratory more important.

Some of these fragments move back into the public sphere. In the debate on stem cells, the fragments that make this move are filtered through appeals to application – specifically the application of direct medical cures for diseases like Alzheimer's, diabetes and Parkinson's disease. The fragments that have an immediate tie to application become paramount in public discussion. For example, differentiation – the ability of stem cells to become different cells such as neurons that could cure Parkinson's – becomes one of the key scientific fragments in public discourse.

One of the key elements in the translation of concepts is appeal to application. Not only does application play a key role in political definition of stem cells, it also plays an important role in scientific definition of stem cells. Changes in the emphasis on the different types of applications shapes the differences between the definitions created in the scientific field and in the political field.

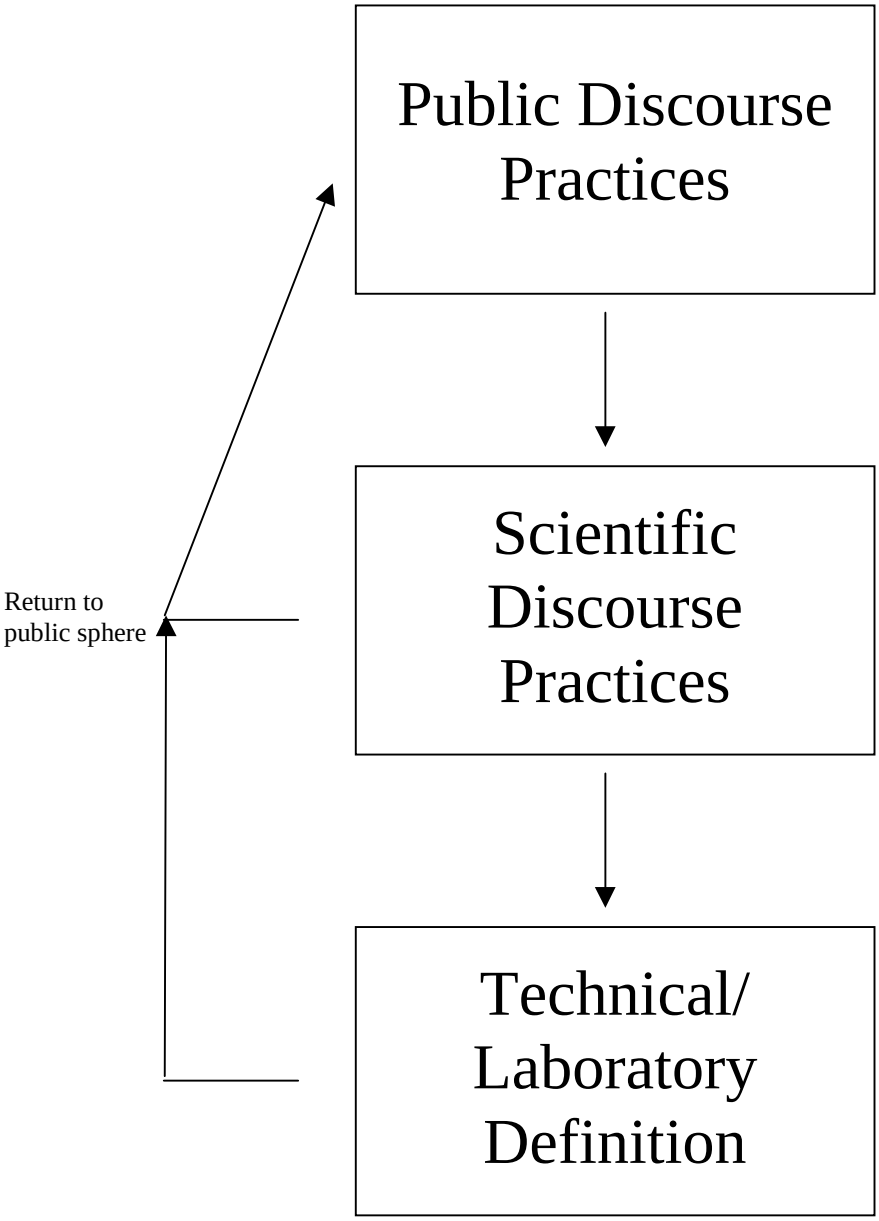

Figure 1: The movement of concepts/terms from the public sphere into science and the laboratory.

Chapter 3.

The "Promise" of Stem Cell Research:

Appeals to Application in Scientific and Political Rhetoric

Why do scientists study stem cells – adult or embryonic – and why should politicians care to fund this research in the first place? Scientists and politicians care about stem cell research because it broadly fulfills the purpose of making future actions – future applications – possible. As Latour noted in *Science in Action* (1987), the majority of science is funded by the military and by the healthcare sector for the purpose of creating new ways of maiming people and new ways of healing them, respectively. Fahnestock (1993) notes that the public is, in part, interested in applying science toward improving people's lives. Appeals to application define stem cells by the potential functions and purposes they can fulfill, but the range and type of appeals differs between the scientific and political arenas. The discourse of science uses three broad appeals, while the political discourse primarily focuses on one of those three appeals. Yet, in the political and scientific debate about this research, these applications are potential and not actual. They are part of a future that might not come to be. Application represents an element of deliberative rhetoric; application becomes an important element in arguments about what research should be pursued by scientists and which research the federal government should fund. Application uses the language of advantage, timeliness and possibility. This language amplifies the application, the purpose through which stem cells are defined, and it does so in order to increase the difficulty of arguing against stem cell research. The greater the advantages and the

quicker they appear, the greater the value of stem cells for all people. Yet, because these applications exist only in the future – because they currently exist *only* as possibilities – proponents must balance this language with ambiguity. Often, they try to avoid questions about the timeliness with which applications might appear and create multiple caveats when forced to answer questions about future applications. The language of possibility and promise is not the bailiwick of proponents of research alone. Opponents can use the uncertainty of potential applications, as well as the language of expediency and advantage to their own ends. This section will examine the explicit appeals used in science and in politics. It will first highlight the appeals that appear in science. Then, it will examine the political appeals to application, their differences from the scientific appeals and how opponents of embryonic stem cell research try to undermine the appeal to application.

Scientific Appeals to Application

In scientific rhetoric about stem cells, there are three broad applications explicitly discussed: (1) using stem cells to gain an understanding of the earliest events in mammalian, especially human, development, (2) using stem cells to create "screens," or specialized cell samples, to use in testing new drugs, and (3) using stem cells to create replacements for tissues destroyed by many diseases and degenerative conditions. With the exception of scientific articles published before the isolation of human embryonic stem cells (Evans & Kaufman, 1981; Gardner & Beddington, 1988; Martin, 1981; Thomson et al., 1995) and review articles specifically dealing with clinical applications of stem cells (Weissman, 2000b), articles that explicitly address potential applications of stem cell research raise all three possibilities. For example, Thomson et al. (1998) note in the abstract to their article announcing the isolation of human

embryonic stem cells, “These cell lines should be useful in human developmental biology, drug discovery and transplantation medicine” (1998, p. 1145). In his review of embryonic stem cell research, Smith (2001) develops a similar list of applications:

> The dual capacities of mouse ES cells for unlimited expansion and for multilineage differentiation have subsequently provoked interest in establishing similar embryo-derived cell lines of human origin. The motivations for this are essentially fourfold:
>
> a. human embryology – to recapitulate in vitro otherwise inaccessible aspects of early differentiation of the human embryo;
> b. functional genomics – to investigate and manipulate specific gene functions in diploid human cells;
> c. pharmaceutical development – to provide large numbers of phenotypically defined human cell types for compound screening and toxicological testing;
> d. regenerative medicine – to create a renewable supply of cells for clinical use in cell replacement, tissue repair and delivery of gene therapy. (p. 449-450)

Stem cell research is viewed as providing for a number of potential applications in research, drug discovery and transplantation medicine. Most often, these appeals to application in scientific literature are associated with embryonic stem cells, but occasionally scientists also explicitly mention application of adult stem cells as well. For example, Jackson, Mi and Goodell (1999) claim, “If stem cells from adult tissues are generally found to have a broad potential to differentiate, it may not be necessary to use embryonic stem cells in some medical and experimental settings” (p. 14485).

These claims of application represent the interests and issues of the scientific field – the purposes of scientific activity. The first is the drive of science to gather knowledge. While the pursuit of knowledge is never disinterested, the ideology and rhetoric of science foreground the search for new information and new models for explaining phenomena, and as the scientists above note, stem cell research – especially embryonic stem cell research – provides a means of understanding the earliest stages of human embryonic development and the effect of certain genes on that development and the function of specific human tissues. The second and third purposes represent the connections between science and the healthcare industry, divided into a pharmaceutical and a medical/clinical component. Stem cell research might find a role – and a potential source of further funding – from medical research organizations and hospitals or from the pharmaceutical industry.

The purpose of stem cell research also plays an important role in political rhetoric about stem cells. Yet, in the political realm, the importance of the three applications changes. Although scientists testifying before Congress often try to import the scientific appeals to application into politics, discussion of application amplifies the importance of medical applications – variously called “transplantation medicine,” “cell transplantation,” “cell therapy” or “regenerative medicine” – in relation to the other two applications from science. In fact, the value of creating pharmaceutical screens all but disappears from political rhetoric, and when all three potential applications are mentioned, the combined appeal of all three is slanted to reemphasize the preeminence of medical, not research or pharmaceutical, applications.

Appeals to Medical Application in Political Discourse

Like scientific discourse, political appeals to medical applications focus on embryonic stem cells, but the political discussions of stem cell research focus on the possible application of stem cells to medicine more than potential research and pharmaceutical applications. In Congressional discourse, all three applications are mentioned together in 14 individual testimonies; individually, medical applications appear alone in 68 testimonies (with eight of those mentions being attempts at refuting the medical application of embryonic stem cells), application to basic research appears alone in ten testimonies, and pharmaceutical applications appear alone in only one testimony. This shift reflects the rhetorical transformations of science discussed by Fahnestock (1993): appeals to application represent a primary rhetorical tool for making science salient to non-scientific publics. The drive for basic knowledge – unless it can be packaged as part of an appeal to wonder, an appeal that appears most often in stories about the discovery of new species or space exploration – does not have a broad appeal to the public, and the degree of detail inherent in many basic biological questions will make it difficult to translate the appeal of basic research into a form larger audiences can understand. The creation of cell cultures to screens drugs does not appeal to a large non-science audience because pharmaceutical companies, and not people, are the primary beneficiaries of this application. Medical applications directly appeal to mass audiences because all individuals can benefit, in theory, from new medical discoveries. Any individual might succumb to diseases and conditions like Alzheimer's disease, Parkinson's disease, diabetes, heart attack or stroke; therefore, any individual could potentially benefit from stem cell therapies for these conditions. Also, even if a person does not suffer from one of these conditions, they are likely to know at least one person who suffers or dies from one of them, so that medical applications for stem cells will impact their lives through

curing friends, family or other acquaintances. Speakers in the political realm recognize the personal connection individuals can have to the medical applications of stem cell research. They can use the potential benefits to the lay public as a means of appealing to them. The medical applications of stem cell research become a prime means of convincing the public to support this scientific endeavor.

Some scientists who speak in political fora try to deploy all three scientific appeals to application, but even then, the medical applications take priority. Sometimes, this priority manifests itself in the order in which the appeals are presented. For example, during the first congressional hearing on stem cell research, Dr. James Thomson said,

> Human ES cell lines are important because they could provide large, purified populations of human cells such as heart muscle cells, pancreatic cells or neurons for transplantation therapies. … Human ES cells are also important because they will offer insights into the developmental events that cannot be studied directly in the intact human embryo, but which have important consequences in clinical areas, including birth defects, infertility, and pregnancy loss. Screening tests that use specific ES cell derivatives will allow the identification of new drugs, the identification of genes that could be used for tissue regeneration therapies, and the identification of toxic compounds. (1998)

Although the wording of this section is almost identical to the list of applications from Thomson et al.'s article (1998) announcing the isolation of embryonic stem cells, the order in which they appear has changed. The structure of the testimony creates a temporal priority for medical application over the other two applications (see also *Hearing on the scientific and ethical impact of embryonic stem cell research*, 2000).

Additionally, Congressional testimony amplifies the importance of medical applications based on the quantity of testimony devoted to that application. For example, during the first hearing on stem cell research, NIH Director Harold Varmus presents all three applications in the same order as they appear in scientific rhetoric – first, basic research; second, pharmaceutical applications; and third, medical applications – but he devotes only one paragraph each to the first two applications and four to medical applications, providing extended examples about curing type I diabetes and repairing damaged heart tissue (*Hearing on stem cell research*, 1998). He repeats this pattern almost two months later during the second round of hearings in front of the Senate Appropriations subcommittee on Labor, HHS and Education (*Hearing on stem cell research: HHS legal ruling*, 1999).

The NIH report on stem cell research, *Stem Cells: Scientific Progress and Future Research Directions* (2001), combines both of these strategies. The preface, after mentioning that stem cells come from embryos and adults, notes,

> How and whether stem cells derived from any of these sources can be manipulated to replace cells in diseased tissues, used to screen drugs and toxins, or studied to better understand normal development depends on knowing more about their basic properties. (2001, p. i)

This creation of priority also appears in the executive summary, and the body of the report emphasizes the importance of medical applications by devoting five of the eleven chapters to how stem cells could cure autoimmune disorders, type I diabetes, repair damage to the brain and spinal cord, repair the heart after heart attacks and the safety issues related to these medical applications, respectively.

Finally, rhetors transform the three appeals, especially the appeal to basic research, to emphasize medical applications. When discussing the value of stem cells for basic research, NIH Director Harold Varmus says,

> The goal is to identify the genetic and environmental signals that direct the specialization of a stem cell to develop into specific cell types. Studying normal cell and tissue development will provide an understanding of abnormal growth and development which, in turn, could lead to the discovery of new ways to prevent and treat birth defects and even cancer. (*Hearing on stem cell research: HHS legal ruling*, 1999)

According to Varmus, basic research provides the grounds for future applications, such as preventing birth defects and cancer. Senator Tom Harkin (D-IA) also makes basic research the ground for future applications, especially cures for cancer (*Hearing on stem cell research*, 1998; *Hearing on the scientific and ethical impact of embryonic stem cell research*, 2000).

Even when rhetors repeat the language of application from science, as Thomson did, medical applications are foregrounded. In addition to this amplification, two things occur with political appeals to medical applications. First, appeals to medical applications define embryonic stem cell research as the best and most advantageous route to medical therapies for currently incurable diseases. Second, rhetors who appeal to medical applications must respond to concerns about the timeliness of embryonic stem cell research and create a timeline for when medical applications will become widely available, thus defining embryonic stem cells as the *quickest* route to therapies. This timeline contains a great deal of ambiguity, and detailed questioning about this timeline leads to the creation of multiple caveats that displace responsibility for

meeting the timeline from scientists to the bureaucracy of the NIH or opponents of stem cell research, especially those within the federal government.

Creating Advantage: Amplifying the Scope and Quality of Research

Since Aristotle (1941), scholars of rhetoric have recognized that deliberation deals with advantage and timeliness, or expediency. In order to maximize the appeal to future medical applications, rhetors must present an ideal situation where stem cell research will result in greatest advantage – the greatest number of cures – in the quickest period of time. Rhetors make broad claims for medical applications, yet also try to avoid clarifying those claims when questioned further about them. This results from a tension between the act of claiming as large a relative advantage as possible and the probable and uncertain nature of any course of action, including scientific research. Rhetors cannot guarantee that the research on which they ask Congress to spend millions of dollars will lead to the applications they claim, and the larger the claim of application, the greater the disappointment and anger will be if those applications do not come to light. Yet, maximizing the advantage of embryonic stem cell research is an important part of defining stem cells through application. Because embryonic stem cells are controversial, the advantages that will come from continuing research on them must "outweigh" the objections to their use: the use of embryonic stem cells must be presented in a way that makes other objections seem ancillary to the benefits of using them. Maximizing the advantage of this research, along with emphasizing the research's timeliness, defines stem cells, especially embryonic stem cells, as a path to medical application too valuable to be ignored. To maximize the sense of advantage, rhetors do two things. They provide a list of diseases, many of which cannot be cured today, and argue that stem cell research will cure them, and they assert in superlative language the powers of stem cells.

The appeal of medical applications gains part of its power because of the breadth of diseases that embryonic stem cell research might help cure. As Christopher Reeve notes, "These cells have the potential to cure diseases and conditions ranging from Parkinson's and multiple sclerosis to diabetes and heart disease, Alzheimer's, Lou Gehrig's diseases, even spinal-cord injuries like my own" (*Hearing on embryonic stem cell research*, 2000). Many rhetors provide lists of diseases like Reeve's. The total list of diseases mentioned covers a wide spectrum of conditions: from Down syndrome to Parkinson's and Alzheimer's disease to incontinence. Some rhetors only discuss one disease during their testimony, and when that occurs, it is always Parkinson's disease or juvenile (Type I) diabetes. On average, rhetors list about four diseases. Senator Arlen Specter provides the longest list with nine different conditions and diseases that embryonic stem cells could cure (*Hearing on scientific impact of cloning ban*, 2002). The most frequently mentioned diseases include Type I diabetes, Parkinson's disease, Alzheimer's disease, heart disease, spinal cord injury, cancer, ALS, and strokes. All of these diseases, except for cancer, are degenerative diseases that destroy cells and for which no cure is currently available. (For a complete list of diseases and the frequency of their appearance, see Table 1, p. 64).

The diseases most commonly mentioned by proponents of ES cell research have no cures at this time. Embryonic stem cells become defined as *the* path to cures for these diseases. The breadth of the list creates the appearance of maximal advantage for stem cell research. The list helps define ES cells as a medical panacea. The more diseases mentioned, the greater the advantages that can come from supporting ES cell research. Increasing the defined advantage makes it more difficult for individuals to argue *against* ES cell research. This definition of ES cells as medical panacea is further emphasized in later political testimony, like Harold Varmus's description of embryonic stem cells as the key to a scientific and medical revolution:

> The development of cell lines that may produce almost every tissue of the human body is an unprecedented scientific breakthrough. It is not too unrealistic to say that this research has the potential to revolutionize the practice of medicine and improve the quality and length of life. (*Hearing on stem cell research*, 1998)

Stem cells could revolutionize medicine: the scope of medical application then is large, and the relative advantage of funding and supporting research in this area is, therefore, obvious. Similar language of revolution appears in statements such as Dr. Lawrence Goldstein's from later hearings:

> The specific issue today concerns human stem cells, which have extraordinary potential to revolutionize the treatment and cure of devastating human diseases. Already, in the short time since the generation of these cells was announced, we can conceive of many important applications in the treatment of heart disease, diabetes, Parkinson's disease, Alzheimer disease, spinal cord injury; in fact, the list of possible therapeutic uses is almost endless. (1999)

Stem cell research, according to Goldstein, has an extraordinary and revolutionary potential. After providing a list of the most commonly mentioned diseases stem cells could cure, he proclaims the list of therapies "almost endless." This view defines stem cells as a means to a maximized medical utility – a cure for almost everything. A similarly broad claim appears in Allen Spiegel's prepared testimony: "Virtually every realm of medicine might be touched by this innovation" (2000).[3] On the basis of this view, stem cells produce a great advantage for medicine. The motive of pushing stem cell research for medical application results in definitions

[3] Almost identical wording appears in the prepared testimony of Fischbach and Spiegel: "Virtually every realm of medicine and human health might benefit from this innovation" (Hearing on the scientific and ethical impact of embryonic stem cell research, 2000a).

that maximize the advantages that come from using these cells, making it harder to argue against funding for stem cell research.

Even when rhetors do not move beyond a specific list of diseases to claim that stem cells will revolutionize medicine, their claims define stem cells as the only viable option to cure many diseases, especially diseases involving the degeneration or death of certain types of cells. For example, when asked about cures for degenerative diseases like Parkinson's and Alzheimer's, Dr. Vogelstein claims,

> The only hope on the horizon is through transplantation of these stem cells. And the other important point to mention, which is again, in our report, the details, but these are not rare diseases. We're talking about diseases which affect millions of people in the United States alone. (*Hearing on the implications of cloning legislation on stem cell-based therapies*, 2001)

Although Vogelstein does not use the language of revolution to define stem cell research, he still describes it as the means to impact the lives of millions of people in the United States who suffer diseases that cannot currently be cured.

These claims catch the attention of Senators and Representatives, who try to clarify the scope of application. For example, after hearing Dr. Harold Varmus's testimony about the almost limitless potential of stem cells, Sen. Specter asks him a series of questions about the scope of application:

> SPECTER: "Dr. Varmus, we'll begin the first round of questioning with you. There has been considerable discussion already about curing disease, dealing with life-threatening ailments – Parkinson's, heart disease, cancer, Alzheimer's. Are

there any limitations as to the range of this kind of a technique on curing diseases? Would it apply to everything?"

VARMUS: Well, Senator, it's a little difficult to answer the question because it's very difficult to know what science would be possible or producing. And as you've heard from…"

SPECTER: "But the basic point is you find a way of replicating cells which are diseased. So would there be any apparent limitation on the scope of these technologies to cure any kind of a disease?"

VARMUS: "There would be on certain kinds of diseases. For example, infections would not immediately be amenable to therapies with these cells. (*Hearing on stem cell research*, 1998)

Specter's question reflects the testimony provided in the hearing that emphasizes the scope of stem cell application – namely that they could cure everything.[4] Varmus immediately backs away from this claim of infinite scope, but his first response tries to avoid the question of the scope of application entirely. Yet, Specter asks the question again, and Varmus indicates that the scope of application is quite wide, with the possible exception of curing infectious diseases. Although proponents of stem cell research, especially embryonic stem cell research, have defined those cells as a panacea through broad claims for medical application, they try to avoid clarifying the exact scope of application. Proponents have made expansive claims about the relative advantages of stem cell research, but the realization of those advantages is probable and not absolutely certain. Rhetors, therefore, try to avoid clarification or provide caveats to

[4] In addition to Varmus's broad claim of stem cell application, Dr. Thomas Okarma of Geron Corp. makes similar claims about the potential of embryonic stem cells to "usher in a new era of therapeutic opportunities" (1998).

inoculate themselves against potential criticism if they fail to provide as many medical applications as they promised.

Establishing Timeliness: Creating Timelines For Medical Application

In addition to claiming a great advantage for supporting and funding stem cell research, rhetors also emphasize the expediency, or timeliness, of this research avenue. Rhetors state that research on embryonic stem cells, or stem cells in general, will lead to advantages – cures – in a short period of time, typically five to ten years. *Stem cells are defined as the quickest means to producing cures for a number of diseases.* This definition depends on an ideal presentation of scientific progress: it assumes a best case scenario of experimentation, but that best case scenario becomes qualified as the debate about stem cell research progresses. Two timelines – five to ten years and ten to twenty years – are established in the first hearing on stem cell research in 1998. The timeframes established in this hearing shape discussion of medical applications in the rest of the Congressional testimony from this period for two reasons. First, Arlen Specter (R-PA), who along with Tom Harkin (D-IA), chairs many of the hearings about stem cell research, repeatedly asks scientists and NIH officials about the timeframe required for medical application and refers back to the first hearing many times. Second, opponents use the shortest version of the timeline – five years until medical applications are developed – to attack embryonic stem cell research because it has not yet produced medical applications and therapies.

During the 1998 hearing, scientists claim that embryonic stem cell research will lead to cures "soon," but in their initial claims no explicit time is given. One of the boldest claims for almost immediate benefits comes from Dr. Thomas Okarma: "In conclusion, the therapeutic applications of this technology are real and near term" (1998). His description of the state of research on animal models, outline of defining properties of embryonic stem cells and the scope

of potential medical applications, leads Okarma to assure the Senators listening to him that the applications are real – assuring that the advantage of this research exists – and that they can be achieved soon. Okarma establishes that embryonic stem cell research is an expedient means of curing many diseases. Dr. James Thomson also provides a timeframe for developing medical applications, but he does not claim that cures will come quickly. Near the beginning of his testimony, he notes,

> Although the long-term potential for human therapies resulting from human ES cell line research is enormous, these therapies will take years to develop. Significant advances in developmental biology and transplantation medicine are required, but I believe that therapies resulting from human ES cell research will become available within my lifetime. How soon such therapies will be developed will depend on whether there is public support of research in this area. (1998)

In comparison to Okarma, Thomson provides a nuanced view of the challenges and timeframe within which medical therapies based on stem cells will develop. The possibility of medical applications of embryonic stem cell research is long term and requires significant scientific and medical advances that require public support and funding before they can be realized, but Thomson also believes they will be developed in his lifetime.

In both examples, no exact number of years is provided. After the initial testimony, Sens. Specter and Harkin begin to question the scientists and NIH director Harold Varmus about the timeline for producing cures. Specter, especially, asks them to provide a timeframe for cures for one specific disease, usually Parkinson's disease. The question forces scientists to focus on one disease instead of being able to make claims about the numerous diseases that stem cell research could cure in a near, but ambiguous, future. In response to this exigence, scientists provide a

range of years within which cures might appear, but they also begin to provide a series of caveats and qualifications for their answers that displace responsibility for not meeting the deadlines they establish onto the federal bureaucracy and the quirks of the process of funding research.

> Specter begins his questions about the timeframe for medical application with Varmus:
>
> SPECTER: "One of the questions which those of us on this side of the panel always ask with respect to a time line and cures, how much appropriations [*sic*] will set you in motion to find the answer? But illustratively, is it possible to give a generalization, if this research were unleashed, how long it would take to find a cure, say, to Parkinson's or Alzheimer's?
>
> VARMUS: "Well remember, Senator, that I referred to the fact that certain kinds of stem cells are already in use in clinical practice; for example, blood stem cells. And there are experimental models, especially in mice, that indicate that certain other tissues, like the heart, may be repaired by the use of cells that have been converted from committed stem cells to heart muscle cells using an appropriate recipe. Given these precedents, it seems to me that within the course of the next decade or two, with an appropriate cadre of investigators that many many diseases would be at least treated, if not entirely cured, by the kind of cell therapies we're talking about." (*Hearing on stem cell research*, 1998)

In response to Specter's question about how long it would take to cure Alzheimer's or Parkinson's disease, Varmus provides evidence – mouse models, the use of blood stem cells in therapy – to support his claim that cures will exist in 10 to 20 years. In addition to the ten year span he provides for treatments to appear, Varmus also qualifies what sort of progress will be made. Varmus claims that *treatments* to ameliorate the *effects* of Parkinson's disease or

Alzheimer's disease will exist; complete cures of these diseases *might* exist but Varmus will not vouch for that possibility.

Specter next turns to Dr. John Gearhart, who first isolated embryonic germ cells and asks the same question. Gearhart is reticent about providing a timeline:

> SPECTER: "Dr. Gearhart, what kind of time line do you see, on the kind of research that you have done, to provide practical answers to problems like Parkinson's or Alzheimer's or cancer?
>
> GEARHART: "Actually, I think Parkinson's will be one of the first targets and one that we will see in the short period. Those neurons…"
>
> SPECTER: "How long is a 'short period'?"
>
> GEARHART: "Well, now let me back off." (Laughter)
>
> SPECTER: "No, no. Come on."
>
> GEARHART: "I actually think… I won't… I actually think within several years to be honest with you, because these neurons that I have demonstrated here, we don't know… to be honest, since this is new data, we don't know what neurons they represent, what type; whether they are cholinergic, dopaminergic, etc." (*Hearing on stem cell research*, 1998)

Gearhart's answer narrows the timeframe further than Varmus does in part because he focuses solely on Parkinson's rather than Parkinson's and Alzheimer's. After being asked, Gearhart first indicates that cures for Parkinson's disease will appear shortly. When Specter follows up, Gearhart's first reaction is to back away from providing a timeframe for medical applications. After further prodding, he indicates that cures will appear in several years because of work being done on neurons, embryonic stem cells and embryonic germ cells, but he also provides the

caveat that the neurons produced by embryonic stem and germ cells require further study. Specter then asks the same question of Drs. Thomson and West:

> SPECTER: "I want to get a brief answer from Dr. Thomas [*sic*] and Dr. West on timeline for practical application before the red light [showing his time for questions is finished] goes on."
>
> THOMSON: "There are practical applications even today; not in therapeutics right away, but – for example, for making heart muscle cells, there are very simple techniques to do this in mouse embryonic stem cells, and they will probably transfer fairly quickly to human embryonic stem cells."
>
> SPECTER: "Applicable today?"
>
> THOMSON: "Applicable today because you can use them for drug screens, looking for new drugs."
>
> SPECTER: "Illustratively with Parkinson's, how long?"
>
> THOMSON: "Parkinson's? I am guessing five to ten years more. It will be one of the first…"
>
> SPECTER: "Dr. West, what timeline do you see?"
>
> WEST: "I would estimate for the discovery of drugs using the cells, simply to discover drugs in the laboratory, three to five years; for the first cell therapies, somewhere between seven to 15 to 20 years; Parkinson's potentially beginning within seven to 12 years." (*Hearing on stem cell research,* 1998)

As with Varmus and Gearhart, Thomson first moves away from providing a specific answer to the question about medical applications; in this case, he indicates that the creation of drug screens – pharmaceutical applications – might be immediately possible. This creates an exigence

for funding stem cell research, but given the focus on medical applications that Specter has already evinced in his line of questioning, the possibility of pharmaceutical applications becomes less than compelling for him and the rest of the committee. Then, Thomson and West provide answers that cover the entire range of times already mentioned in the hearing. Thomson says cures for Parkinson's disease might appear in 5 to 10 years, and West initially gives a range of seven to 20 years, before settling on a period of seven to 12 years within which cures might appear. With each speaker – Varmus, Gearhart, Thomson and West – there is a hesitation to provide a direct answer. While they have created the sense that embryonic stem cell research is an expedient means to creating cures, they do not wish to provide more exact answers. Deliberative rhetoric and the appeal to expediency focus on the probable; no guarantee exists that these promises will be fulfilled. Furthermore, as scientists continue to study stem cells, new discoveries could alter the timelines provided in political fora. Scientists could discover properties that make certain types of stem cells less viable as a means to medical applications, and some studies conducted in late 2002 have led scientists to question the potency of adult stem cells (Holden & Vogel, 2002; Ramalho-Santos, Yoon, Matsuzaki, Mulligan, & Melton, 2002; Terada et al., 2002; Ying et al., 2002).

Finally, Sen. Harkin asks the scientists what is required to attain a cure within the timeframes they have established:

> HARKIN: "Let me focus a bit. Now, you talked about this timeline that the chairman just laid down in terms of Parkinson's. And what I basically heard was that anywhere from three to five to 12 years, somewhere in there, we might be finding something. Is that assuming the federal ban continues and this research is not allowed to go forward, or federally funded, and only – well, let's back up.

> Now you can do it in the private field. NIH cannot fund it, generally speaking, around the country with all of the basic researchers in this country. What I heard all of you say it that that would be vitally important, to have NIH be able to do that. If this federal ban is deemed to cover research on stem cells, does your timeline hold?"
>
> THOMSON: "This time I have of seven to 12 years for Parkinson's assumed that the NIH would be allowed to fund research in differentiating these cells into cells for Parkinson's. If that is not allowed…"
>
> HARKIN: "So your answers were based on…"
>
> THOMSON: "Yes."
>
> HARKIN: "on… I shouldn't say lifting the ban, because, see, I don't think the ban applied. So I've got to be careful about what I say here. So your timeline is based upon an interpretation or reading of this that the ban does not apply to stem cell research."
>
> THOMSON: "Right." (*Hearing on stem cell research*, 1998)

Because of Harkin's question, scientists can now qualify the timeline they provided: if medical applications are to manifest, the government, specifically the NIH, must fund this research. A condition has been set on realizing the potential of stem cells to produce medical therapies quickly, a potential that has been made a central component of the definition of stem cells.

This testimony from scientists and the questioning that follows sets the pattern for subsequent discussion of a timeline for stem cell research. Scientists try to provide a general claim that stem cell research will produce cures in a relatively short period of time. Politicians push for more specific answers, and scientists try to dodge the question or provide caveats. Most

often these caveats focus on external impediments to research, especially the lack of federal funding. Like maximizing the advantages – the cures – resulting from stem cell research, creating this timeline maximizes the timeliness of stem cell research, as well as providing caveats if that timeliness is not realized. The argument defines stem cells and stem cell research as *the* path to cures for many diseases, *and these cells will lead to cures more quickly than other research avenues*. The only impediments are external. The provision of caveats to a usually short timeline of several years increases the argumentative burden for opponents to stem cell research: because stem cells are defined as the quickest means to curing many different conditions, opposition becomes a stumbling block to medical progress instead of a legitimate policy position.

The attack on continued opposition to stem cell research appears in testimony by Michael J. Fox, the actor who suffers from Parkinson's disease:

> For two years you have had a parade of witnesses – scientists, ethicists, theologians of every school, and some celebrities – discussing every nuance of stem cell research. You've given time to all sides of the issue, including the few but very vocal opponents. But the consistent and inescapable conclusion is that this research offers the potential to eliminate diseases – literally save millions of lives. So, while I applaud your thoroughness, I can't help but say "enough already!" It's time to act on what we've learned. (*Hearing on the scientific and ethical impact of embryonic stem cell research*, 2000)

While praising the senators for their thorough investigation of the issues surrounding embryonic stem cell research, Fox claims the advantage of medical applications is an "inescapable conclusion," and that time has been lost listening to the litany of objections from a supposedly

small number of opponents. Fox uses the timeline established in 1998 to argue that time has been lost, and the loss of time equates to a loss of lives. This loss of time and loss of lives derives from the timeframe within which medical application should appear, and these losses become the main appeal in Fox's testimony.[5]

In addition to the concerns raised about legal hurdles, funding and opposition to embryonic stem cells, rhetors – especially scientists – sometimes refer to the research needed before medical applications can be realized. Scientists usually refer to past research as a reason to feel *confident* in the timeline they have established – as both Varmus and Thomson did in their 1998 testimony. Yet, the progress of science itself eventually becomes an ambivalent resource for rhetors advocating embryonic stem cell research.

Most of the early advocacy for stem cells that refers to medical applications uses a best case scenario of experimentation: in other words, all experiments necessary to produce medical therapies will produce ideal results and will occur in rapid succession. This becomes explicit in the September 2000 question-and-answer session between Sen. Specter and Dr. Darwin Prockop:

> SPECTER: What do you anticipate in two to three years with respect to stem cells and Parkinson's?
>
> PROCKOP: Well, I can give you the best case scenario. If our experiments now being conducted come out right, in terms of efficacy and toxicity, we think we may be able to begin the very first clinical trials in patients with Parkinsonism in two or three years. That's a best case scenario.
>
> SPECTER: Why not sooner, Dr. Prockop?

[5] A similar concern that focuses on funding is raised by Thomson after Bush's decision on embryonic stem cell research: "However, the existing ES cell lines will not fulfill their promise unless NIH begins to aggressively fund this area of research. As of Monday, October 29, 2001, the NIH Embryonic Stem Cell registry, necessary to initiate funding, has not yet been posted." Medical applications, according to Thomson, understood as the "promise" of ES

PROCKOP: Senator Specter, we have to be safe about this. We have to be sure we're not going to do more damage than we're going to help the patient, and…

SPECTER: Well, you're going to have to qualify with the Food and Drug Administration, understandably so – important precautions, but my question goes to do you have a projection as to how long it will take to cure Parkinson's?

PROCKOP: Senator Specter…

SPECTER: It's a hard question…

PROCKOP: I'm an optimist, all right? One has to be an optimist to do research. I think it's somewhere on the order of four or five years to cure many patients. I'm saying in two or three years, the first few patients – carefully controlled studies and very carefully controlled environments. I'm hoping it goes fast after that. (*Hearing on the scientific and ethical impact of embryonic stem cell research*, 2000)

Specter pushes Prockop to provide a prediction on where research on a stem-cell based cure for Parkinson's disease will be in three years, and he treats FDA guidelines and approval for trials as an obvious part of medical research that does not impact his question. Specter again pushes Prockop to provide an answer. When Prockop does, he notes that he is an "optimist" before rearticulating the five-year timeline that first appeared in 1998. The timeframe of five years – originally five to ten years when Thomson first provided it – depends on ideal results in experiments. The progress of science – the journey from the earliest experiments to full-blown medical applications – has been placed on a fast track in Prockop's testimony and previous testimony about the likelihood of medical application.

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cells is impeded by the NIH's bureaucracy and failure to post a registry of embryonic stem cells that meet the criteria of Bush's decision.

Later testimony by scientists though does not paint as rosy a picture. In December 2001, Dr. West pulls back from answering Sen. Harkin's question about the timeframe for medical application:

> You're asking a question that scientists always hesitate to answer. You know, it's so hard to predict the future of science and how fast things will develop because they aren't always in our control. (*Hearing on the implications of cloning legislation on stem cell-based therapies*, 2001)

Unlike in his 1998 testimony, West does not provide a timeframe based on the best case scenario of science. Instead prediction becomes difficult, if not impossible, because so much is outside the scientist's control. The Hasting Center's Thomas Murray's concern about the progress of stem cell research is more explicit:

> One observation I would like to make is that, it's very difficulty to predict the course of science. It's impossible to predict with any confidence exactly where the science will go, even if it will ever lead to useful therapies. But, of course, we'll never know unless we try. (*Hearing on scientific impact of cloning ban*, 2002)

With Murray's comments, the possibility of medical therapies from stem cell research itself becomes uncertain. Yet, in spite of this uncertainty about the progress of science, Murray claims that research must still continue – we will never know unless we try.

Appeals to medical application from advocates of stem cell and embryonic stem cell research, especially scientists, focus on the relative advantage of this research – the number of diseases that it might cure – and the timeliness of this course of action – how soon medical applications can be developed. Often this results in the production of a timeframe for the

appearance of these applications. Politicians push rhetors to provide an explicit timeframe, and they often get a sliding scale of 5 to ten to twenty years that is also loaded with caveats about funding and opposition to research that displace blame for not meeting the timeline on others. The timelines provided also depend on a best case scenario for application, but this best case scenario disappears from later rhetoric by embryonic stem cell advocates. The doubt they evince in their testimony also reflects the strategies of opponents of embryonic stem cell research.

Opposition Use of the Appeal to Medical Applications

Appealing to the possible medical applications of stem cells justifies eliminating legal barriers to stem cell research as well as providing funding for it. Yet, the appeal to application, based on the rhetorical creation of the relative advantage and expediency of stem cell research can be refuted as well. Refutation or diminution of the appeal to medical application sometimes involves attacking specific claims of relative advantage or timeliness, but they usually play on uncertainty about the future and the "potential" of stem cell research. This play on the inherent uncertainty of the "potential," or "promise," of stem cell research occurs either when rhetors wish to undermine application appeals used for embryonic stem cell research or when rhetors try portraying President George W. Bush's decision about embryonic stem cell research as the best possible decision that could be made.

Opposing Embryonic Stem Cell Research

Opponents of embryonic stem cell research refute claims about the potential medical applications of embryonic stem cells in one of two ways: they specifically attack claims of relative advantage and expediency or create a broad attack on this research avenue that plays on

the words “potential” and “promise,” emphasizing the uncertainty and possibility of failure implied there. Fr. Fitzgerald provides the general outline of the refutation of relative advantage:

> It may well be the case that for many patients the treatments for their illnesses may come more quickly from research avenues other than human embryonic stem cell research, and that these alternative treatments may even be better than any treatment derived from human embryonic stem cell research. (*Hearing on stem cell research*, 2001)

Fitzgerald tries to attack the relative advantage that has been claimed for embryonic stem cell research, but his rather weak claim that other treatments might be better lacks any evidence and does not provide a concrete alternative. The alternatives to embryonic stem cells and their advantage were more clearly described earlier that summer during a hearing by a subcommittee of the House Committee on Government Reform. The prepared testimony of John and Lucinda Borden claims,

> It is clear that the advances possible with adult, placenta and umbilical stem cells are in their infancy. On the other hand, recent articles suggest embryo stem cell research is deadly not just for the donor embryo, but also the recipient patient. (*Hearing on opportunities and advancements in stem cell research*, 2001)

The Borden’s testimony highlights alternatives to embryonic stem cells, and while conceding that the potential of these cells is not yet fully understood, they also claim that embryonic stem cells represent a danger to patients. The claims here attack the relative advantage of embryonic stem cells by redefining the cells as dangerous, and then providing an alternative that, by implication, does not result in the same dangers.[6] The testimony of 16-year-old Eric Salley, who

[6] It is not clear what dangers the Borden’s refer to. This might be based on reports that clinical trials performed in the early and mid-nineties with fetal tissue resulted in harm to patients, or it might be based on scientific claims

underwent a transfusion of hematopoietic stem cells from umbilical cord blood to treat leukemia, also attacks the relative advantage of embryonic stem cells: "I am living proof that there are promising and useful alternatives to embryonic stem cell research and that embryos do not need to be killed to achieve medical breakthroughs" (*Hearing on opportunities and advancements in stem cell research*, 2001). Salley uses his treatment and its success in curing him to undermine claims that stem cells provide the best means to curing many diseases; he attempts to undermine the relative advantage of embryonic stem cells by showing that other types of stem cells, specifically umbilical cord stem cells, can also lead to cures of diseases.

The existence of therapies derived from stem cells from non-embryonic sources is used to attack the expediency of embryonic stem cell research. For example, Senator Judd Gregg (R-NH) compares embryonic stem cell therapies to therapies based on adult stem cells,

> These therapies, unlike the unproven and untested potential application of embryonic stem cell therapies, which are at minimum five and potentially 10 years away from clinical application, are actually being used today, and are being used very successfully, and we should not forget that. (*Hearing on stem cell research*, 2001)

According to Gregg, embryonic stem cells compare unfavorably to adult stem cells, especially on the issue of expediency. Using the same timeline established by James Thomson in 1998, Gregg claims that medical applications from embryonic stem cells will be at least five years away, while therapies based on adult stem cells already exist.[7]

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about differentiation and certain experimental protocols. For an examination of claims based on the latter basis of experimental protocols concerning differentiation see Chapter 5.

[7] Like the claims of the Bordens, Salley and Gregg's respective claims about adult stem cell therapies are based on misunderstandings or distortions of claims about embryonic stem cells and their potential applications, which are examined in Chapter 5.

A global refutation of embryonic stem cell applications also appears in Gregg's statement. In addition to attacks on the advantage or expediency of embryonic stem cell research, opponents also emphasize negative connotations of "potential" and "promise," usually by contrasting them to the "actual" benefits of other therapeutic approaches. Gregg's testimony, for example, contrasts the "unproved and untested potential application" of embryonic stem cell therapies with adult stem cell therapies. Other rhetors make similar claims. Dr. Usala says, "While many respected scientists are understandably enthused about their possibility, human embryonic stem cells may not provide a viable path [to therapies]" (*Hearing on the scientific and ethical impact of embryonic stem cell research*, 2000). Dr. Christopher Hook asks, "Are we willing to set the precedent that the promise, not proof, of future medical treatments for third party patients is sufficient to justify the destruction of living human beings?" (*Hearing on opportunities and advancements in stem cell research*, 2001). In both cases, the rhetors contrast potential with actual applications and thus redefine embryonic stem cell research in relation to application. In these definitions, embryonic stem cells no longer represent the ideal path to application. Usala deploys a spatial metaphor to do this: embryonic stem cells might appear like a "path" leading to a cure, but that possibility might not be viable. The "possible" path of embryonic stem cells might be a dead-end. Hook contrasts "promise" with "proof" – since embryonic stem cells have not actually produced medical applications, pursuing research on embryonic stem cells is not justifiable, especially since it requires the destruction of embryos.

Supporting Bush's August 2001 Decision on Embryonic Stem Cells

In addition to using it to oppose embryonic stem cell research, rhetors also attack the "promise" of embryonic stem cells to make President Bush's decision restricting the funding of embryonic stem cell research appear as an ideal position in the debate. Playing on the uncertainty

of embryonic stem cell's potential undermines the urgency behind supporting the research: if the research will not lead to advantages in an expedient fashion – if a great deal of research and caution is needed – a policy that moves at a slower pace appears as the most judicious course of action. This rhetorical strategy primarily appears in a September 5, 2001, hearing of the Senate Committee on Health, Education, Labor and Pensions that examines the impact of Bush's decision on medical research. In his prepared testimony for this hearing, HHS Secretary Tommy Thompson minimizes the expediency attached to embryonic stem cells. After noting "we have every right to feel hopeful about what scientists may be able to accomplish," Thompson warns,

> We have much to learn about these cells – much basic research that needs to be conducted. Clinical applications, which could emerge only after considerable basic research, are years away. What is important now is that we begin the process of gaining a thorough and scientifically based understanding of the promise and potential of embryonic stem cell research. (*Hearing on stem cell research*, 2001)

While recognizing the advantages embryonic stem cells offer to scientists hoping to cure degenerative diseases like Parkinson's disease and diabetes, Thompson argues that "considerable" amounts of time and effort must be devoted to basic research before medical applications will be possible. Thompson minimizes the expediency of embryonic stem cell research; in contrast to the claims that medical applications will be available in a few years, Thompson implies that much work will need to be done. The degree of work required minimizes the urgency of this research, making a more restricted, less urgent approach to funding and studying embryonic stem cells appear, as Thompson describes it, "wise." Despite minimizing the expediency of this research, Thompson goes on to provide a timeframe of five to eight years

before medical applications appear, the same timeframe used by proponents of embryonic stem cell research. During his opening statement to the committee, Sen. Bill Frist (R-TN) makes a similar claim:

> We must recognize that the field of embryonic stem cell research is young. It is early. It is pioneering. It is not yet tested. The benefits of this research, although we all attach huge hope to this particular field, have not yet been realized, and they are just possibilities. (*Hearing on stem cell research*, 2001)

Frist's comments deploy the fragments used to highlight the potential applications of embryonic stem cells to produce different effects that those proponents try to produce. He uses fragments describing the promise of stem cell research, but here the language of promise now highlights the uncertainty surrounding embryonic stem cell research's potential. He praises the promise of embryonic stem cell research, but he also emphasizes the uncertainty surrounding it. His comments undermine the expediency proponents of an unrestricted approach to embryonic stem cell research have created. Though the work is "pioneering," it is also "young" and "untested." Though there is hope, that hope is based on unrealized possibilities.

In addition to these claims refuting or undermining the promise of stem cell research, advocates of Bush's decision also describe proponents of embryonic stem cell research as overselling the promise of this research. In his testimony, Thompson notes,

> Some people want to make the grand leap from the onset to federally funded research to the cures for Parkinson's, Alzheimer's and other diseases. If only it was that easy. It is easy to make such a leap in the emotion of this debate, but it is also inaccurate and unfair to do so. The cures for these diseases are not just around the corner. (*Hearing on stem cell research*, 2001)

Thompson even repeats the warning that cures are "not just around the corner" during the question and answer session following his statement. Frist also argues that during these hearings speakers must be careful "not to oversell the promise of this research to the American people" (*Hearing on stem cell research*, 2001). According to these speakers, the promise of embryonic stem cell research has been exaggerated. Those who make claims about the possibility of embryonic stem cell research to lead to cures for many diseases have played on the emotions of people. For these rhetors, the "promise" of stem cells, the definition in terms of application, is redefined as an ethically unacceptable deception: medical applications will not come soon.

Conclusion

Rhetors in science and in politics both turn at some point to deliberative rhetoric. They debate the *purposes* of the research being conducted, the end towards which the research aims. These purposes are potential applications, and these purposes drive deliberative rhetoric about scientific research. In discussions of stem cells, three applications appear: stem cells further basic research, can help in creating, and developing pharmaceuticals and can form the basis for new medical therapies. In political discussion, appeals to medical application take priority over the other two. Rhetors in the political sphere develop claims about the relative advantages and timeliness of embryonic stem cell research in attaining the goal of medical applications. Yet, because deliberative rhetoric deals with future events – future applications and benefits – those events can never be guaranteed with any degree of certitude. Because of this uncertainty, proponents of ES cell research and its future applications must inoculate themselves against criticism if the potential of embryonic stem cells does not manifest itself. Opponents of this research can play on the uncertainty of the future – whether embryonic stem cell research will

produce medical therapies – when trying to refute claims of advantage and expediency of ES cell research.

The strategy of refutation alone, while powerful, is not sufficient to overcome the appeal to medical applications in political rhetoric. Proponents of embryonic stem cell research have clearly articulated a need for this research – it might cure diseases that effect millions and for which no cures currently exist. Opponents cannot rest with only attacking the supposedly "overhyped" promise. Blanket attacks on research and policy because their benefits are only "potential" cannot work as a long term strategy since it forecloses *all* future courses of action, which are "potential," and deliberation about them. Deliberation deals with the future, the probable and the uncertain. It deals with the fulfillment of promise and potential. No absolute guarantee can exist that a promise will be fulfilled. A decision about which research to support – which future to aim toward – will always be based on incomplete information. Arguing against research because the end result is not known cannot work as a long-term strategy. People will move forward on the basis of promise in this and other venues.

The refutation of the promise of stem cell research requires something else: it requires the addition of other lines of argument. These options involve creating alternative courses of action – ironically creating another "promise" to be fulfilled – or creating a new set of "ultimate" terms (Burke, 1951) that can rearrange the field of argument about stem cells. The latter argument deals with tying concerns about embryonic stem cell research to concerns about embryos. The former option – the other alternatives – involves proposing adult stem cells as the alternative means of reaching medical applications. The argument for adult stem cells requires the rhetor to compare the two types of cells and find adult stem cells to have equal or greater power or

"potency." The argument about alternatives incorporates the argument from hierarchy about potency into the political debate about stem cells.

Table 1
Diseases Mentioned in Political Appeals to Medical Applications
(listed by frequency of appearance, from greatest to least)

Type I diabetes	56
Parkinson's Disease	50
Alzheimer's Disease	35
Heart disease	27
Spinal cord injury	24
Cancer	18
ALS/Lou Gehrig's disease	13
Stroke	10
Arthritis	4
Multiple Sclerosis	4
Leukemia	3
Birth defects	2
Incontinence	2
Paralysis	2
Sickle cell anemia	2
Burns	1
Canavan's disease	1
Cirrhosis	1
Cystic fibrosis	1
Muscular dystrophy	1
Osteoporosis	1
General appeal to medical application	13 (with an additional 5 negative references to application)
*Average number of diseases mentioned in testimony**	4.4
*Maximum number of diseases mentioned in testimony**	9
*Minimum number of diseases mentioned in testimony**	1

*number of diseases based on 89 transcripts and prepared testimony that mentioned medical application in Congressional hearings from December, 1998, to April 2002.

Chapter 4.

Making Room for Stem Cells:

Dissociation in Scientific and Moral Arguments about Research on Embryonic Stem Cells

Scientific research results in new objects and new ideas that scientists and lay people must incorporate into their worldviews. Potential applications draw our attention, money and energy. Metaphors, comparisons and double hierarchies help us organize the new discoveries of science, but sometimes division is as important as identification and similarity. In order for people – scientists and nonscientists – to accept the new objects and ideas produced by science, old concepts must be divided and reorganized.

The practice of dissociation represents a paradigmatic means of creating the space – the rhetorical, political and scientific space – for a new object and the political and scientific activity that will surround it. Dissociation takes a unitary concept and breaks it into two components; those components are given positive and negative valences through the use of "philosophical pairs," pairs of opposed value terms. This breakage is necessary to create space for new ideas and objects and to deal with conflicts and contradictions that begin to accrue in one's worldview. Ultimately, multiple dissociations crystallize around new objects and ideas and shape what groups of people identify as "real" and as "appearance."

Two sets of dissociations play a vital role in defining "stem cell." First, researchers who twenty years ago were first working with embryonic stem cells needed to establish the value of embryonic stem cells as a model of development: they needed to clear the conceptual space of

other models in order to make room for embryonic stem cells as *the* model of development. At the time, medical applications were not feasible, and the prime value of stem cells was in making sense of how mammals grew from embryos to adults. Embryonic stem cells had to become the path to understanding the *reality* of mammalian development, while other models only offered the *appearance* of mammalian development, and a series of dissociations were used to define embryonic stem cells as the *real* model of development.

Second, proponents of embryonic stem cell research had to respond to moral arguments against human embryonic stem cell research that were based on the status of the embryo as a potential person. This status was established through a series of rhetorical strategies that produced the "public fetus," a symbol of the fetus as an autonomous person separate from its mother and the symbol of a range of interests and desires (Petchesky, 1990). Proponents used two different dissociations to create categories of embryos that did not have the status of the original unitary category of "embryo": they dissociated the "spare embryos" from in-vitro fertilization clinics from "essential" embryos that were developing into life, and they dissociated the 14-day-old blastocyst as a "non-person" from later stages of fetal development that were defined as individuals.

This chapter will examine previous work on dissociation. Then it will examine the three dissociations used in early scientific work to define embryonic stem cells as the real model of mammalian development. Then, it will examine the use of dissociations to counter arguments about the personhood of the early embryo.

Dissociation and Philosophical Pairs

Many rhetorical critics who study definition focus on the concept of definition by dissociation. Dissociation involves taking an original unitary concept and splitting it into two components one of which is viewed as the "actual" or "real" content of the original. The two new concepts exist in a hierarchical relationship – one is "better" or "more realistic," while the other is "bad", "less effective" or "ephemeral." Dissociation "is always prompted by the desire to remove an incompatibility arising out of the confrontation of one proposition with others, whether one is dealing with norms, facts, or truths" (Perelman & Olbrechts-Tyteca, 1969, p. 413). The use of dissociation is implicit and explicit, conscious and unconscious (Schiappa, 1985). It can involve attempts at definition and persuasion viewed as deliberate, such as Reagan's redefinition of "safety net" and "truly needy" (Zarefsky et al., 1984), as well as the "indirect" introduction of a dissociation that occurs when individuals argue whether an object belongs in a certain category (Perelman & Olbrechts-Tyteca, 1969, p. 445). Dissociation is a means of overcoming the contradictions that inevitably arise in one's worldview over time as well as a deliberate means of clearing the conceptual and practical space for a specific course of action.

Dissociation is possible because of value-laden "philosophical pairs." In these pairs, one of the terms is valued over the other for metaphysical, ethical or epistemological reasons (Perelman & Olbrechts-Tyteca, 1969; Schiappa, 1985; Zarefsky et al., 1984). Some typical philosophical pairs are accident/essence, means/end, good/bad, relative/absolute, particular/general and theory/practice (Perelman & Olbrechts-Tyteca, 1969, p. 420), but the prototypical philosophical pair is appearance/reality (Perelman & Olbrechts-Tyteca, 1969, p. 415; Schiappa, 1985; 1993). Often, the appearance/reality pair is deployed when an advocate

claims “that his or her definition represents the *real* or *true* instance of ‘X’, whereas his or her opponent is pointing to an illusory appearance” (Schiappa, 1985, p. 73). Reagan’s definition of the “truly needy” is an example of this. Reagan’s use of the word “truly” indicates a dissociation between those who have a *real* need versus those with *apparent* needs, and it is through this dissociation that Reagan can cut welfare programs while still claiming to help those who need help (Zarefsky et al., 1984). According to Schiappa (1985), the accident/essence pair is also a common feature of scientific discourse – scientists will argue that previous studies of an object have highlighted accidental features, while the current study identifies the essence of the object or phenomenon under study. Regardless of the philosophical pair being mobilized, dissociation works to establish what is “real.” A scientist might mobilize the accident/essence pair, but implicit in the use of that pair is the claim that what is associated with essence is the “real” object deserving of continued scientific attention.

Some scholars have critiqued dissociation as essentialist and linguistically naïve (B. R. McGee, 1999; Schiappa, 1985, 1993, 2003). Definition by dissociation has often been viewed as a permanent and unchanging answer to the question “What is X?” (B. R. McGee, 1999; Schiappa, 1993). According to Schiappa (1985; 1993; 2003) such definitions depend on essentialist language, which “obfuscates important social needs involved with defining” (Schiappa, 1993, p. 410). Schiappa also argues that the language of dissociation also requires a simplistic view of language as purely representative:

> the persuasiveness of the language of essentialism and dissociation is based upon acceptance of something like a picture theory of language. The definition which captures the “essence” of an object is one which accurately pictures reality. (Schiappa, 1985, p. 77)

Under this perspective, dissociation reproduces problematic ideas about language and reality that limit or excludes non-representative elements of language such as illocutionary and persuasive acts. Schiappa does not offer an alternative to dissociation that still allows for definition and conceptual division. In order to mitigate the essentialist nature of dissociation, Schiappa suggests that scholars should be reflexive in language use (1985, p. 80), and that they recognize "that definitions are human-made, not found; constructed, not discovered" (1993, p. 413). Obviously scholars should view definitions as human-made and aim for a high degree of reflexivity, but Schiappa's discussion of dissociation encounters two difficulties. First, if dissociation is so thoroughly infected with an essentialist or positivist view of language and one is opposed to such ways of thinking, then one cannot endorse the use of dissociation, no matter how reflexive the user is. Dissociation, under this view, always already reproduces essentialism, and using it under any condition is highly problematic. Second, Schiappa's argument against dissociation is troubled by the unrecognized irony that it is a dissociation based on the appearance/reality pair. Schiappa argues that while dissociation might *appear* to be a useful linguistic and conceptual device, it *really* operates from, and reproduces, essentialist thinking and a "picture theory" of language.

One can recognize the important contribution of Schiappa's work – that definition is a pragmatic matter often confused with essentialist understandings of the world – while also having a non-essentialist view of dissociation and the philosophical pair appearance/reality. Titsworth (1999) argues that critics studying definition, especially definition in public argument, should first examine how ideology grounds definition. McGee (1999) claims that individuals can overcome the perception of definitions as permanent and unchangeable by conceiving "definitions as contingent and fluid categories that are always subject to revision and

renegotiations." While both views, especially McGee's, are useful, they do not confront the problem embodied in the apparent essentialism of the prototypical philosophical pair appearance/reality that grounds many attempts at dissociative definition. Goodwin (1991) does so by distinguishing between "reality" and "the real":

> [Reality] refers to an onto-philosophic concept tied to the metaphysics of an objective, inherently knowable world order. … [The real], however, refers to a psycho-social concept tied to an epistemology that underscores the power of human perception, cognition, language, and society to shape our understanding of, and our reactions to, the world. (p. 149)

The "real" in the appearance/reality pair should be understood as a psychological and social category created through the lived experience of individuals. What counts as "the real" will change with different groups and will change within groups over time. This will lead to different uses of dissociation in the arguments of different communities, so while biologists and physicists both use dissociations, they will use them in regard to different issues and in slightly different ways.

Dissociation divides a unified concept into parts that are placed in a hierarchical relationship on the basis of a philosophical pair. The dissociation helps confront changes and possible contradictions in a group's understanding of the world, which is why the prototypical philosophical pair is appearance/reality. While some scholars have raised concerns that the appearance/reality pair reflects a naïve and positivist view of language and reality, these concerns can be sidestepped with a pragmatic approach that views the "reality" of the philosophical pair as a society's psycho-social consensus about how to use language and organize the world.

Dissociation in Science

Dissociation shapes the psychosocial consensus that makes up science, a realm of human activity viewed as the bastion of realism, as well as other activities like politics. Dissociations categorize the objects scientists examine: they help determine what properties are attributed to each category or object and what names will be used to describe the objects of science. Dissociations using the pairs aberrant/normal, secondary/original, and weak/strong were used by scientists to distinguish between embryonic carcinoma cells* and embryonic stem cells, and these provide a potential basis for dissociating embryonic stem and embryonic germ cells*.

Dissociating Embryonic Carcinoma and Embryonic Stem Cells

Dissociation occurs when individuals need to divide categories or concepts. Objects considered to be identical or members of the same category must be separated on the basis of a new set of distinctions, embodied in philosophical pairs. At one time, embryonic carcinoma (EC) cells and embryonic stem (ES) cells were both considered "stem" cells, until continuing research highlighted differences, which drove a need to reorganize the category of "stem" cells.

EC and ES cells have a number of similar characteristics. Both were originally described as stem cells because they both represented "a discrete population of undifferentiated cells" (Gardner & Beddington, 1988, p. 13). In addition to being undifferentiated, ES and EC cells look and behave in a similar fashion: "ES cells closely resemble EC cells in morphology, growth behavior, and marker expression" (Smith, 2001, p. 437; see also Thomson & Odorico, 2000). Both types of cells express the marker, Oct-4, which is considered necessary for the maintenance of a pluripotent and undifferentiated cell (Nichols et al., 1998). Finally, they, along with embryonic germ (EG) cells, share the same capacity to produce teratomas when implanted into mice (Evans & Kaufman, 1981; Martin, 1981; Smith, 2001).

Embryonic stem and embryonic carcinoma cells have a number of similarities. Yet, several differences exist that impact the value of embryonic carcinoma cells for research on mammalian development, drug development and the creation of cell-based medical therapies. By ordering these differences within the hierarchies provided by philosophical pairs, scientists can dissociate the category of "stem cell" so that the concept refers to embryonic stem cells while placing embryonic carcinoma cells in a new category of lesser value. These dissociations work through the philosophical pairs of aberrant/normal, secondary/original, and weak/strong.

Scientists use the aberrant/normal pair when examining the genome of embryonic carcinoma and embryonic stem cells. Most EC cells contain extra chromosomes, a condition called aneuploidy that is associated with a number of deleterious conditions. When embryonic stem cells were first isolated in 1981, Evans and Kaufman (1981) indicated that the embryonic stem cells had a normal karyotype – a normal complement of chromosomes – while embryonic carcinoma cells did not. Smith (2001) notes, "EC cells are almost always aneuploid… [while] ES cells maintain a diploid karyotype" (p. 437-438). Thompson et al. (1995) tell readers, "All pluripotent human EC cell lines derived to date are aneuploid, suggesting EC cell lines may not provide a completely accurate representation of normal differentiation" (p. 7844). All of these statements describe embryonic carcinoma cells as genetically and chromosomally aberrant, and embryonic stem cells as genetically and chromosomally normal. On the basis of genetic normalcy, the scientists begin dissociating the two types of pluripotent cells.

The dissociation of these two groups of cells is continued through the use of a secondary/original philosophical pair. Embryonic stem cells are described as coming from a more originary or primal source, the inner cell mass of blastocysts. Embryonic carcinoma cells come from carcinomas or teratocarcinomas, tumors that develop in fetal tissue at various stages

of development. Martin (1981), in her work announcing the isolation of embryonic stem cells from mice, makes explicit the reasons for her naming and categorization strategies: “Such cells were termed embryonic stem cells to denote their origin directly from embryos and to distinguish them from embryonal carcinoma cells derived from teratocarcinomas” (p. 7635; see also Thomson et al., 1998, p. 1145). Nichols (2001) also makes explicit reference to the origin of both embryonic stem and embryonic carcinoma cells in justifying her claims that embryonic stem cells represent “a very important step towards cell replacement therapy” (p. R505). In each of these cases, the origin of the cells provides the basis for dissociating the two groups of cells and placing embryonic carcinoma cells in the inferior position. Claims based on origin also help ground arguments about the medical utility of each type of cell: embryonic stem cells come from an earlier stage of development than embryonic carcinoma cells and therefore are more valuable as a means toward the end of application.

Finally, embryonic stem cells were dissociated from embryonic carcinoma cells through the philosophical pair weak/strong. Strength is discussed in terms of a cell’s ability to differentiate (i.e. become other types of cells) and contribute to the development of an embryo or tumor. Thomson et al. (1995) describe the differentiation potential of embryonic carcinoma cells as limited: “The range of differentiation obtained from human EC cell lines is more limited than that obtained from mouse ES cells and varies widely between cell lines” (p. 7844). Smith (2001) concurs: “Most EC cell lines show poor differentiation potential in vitro and in vivo and contribute poorly to chimeras and/or produce embryonic tumors” (p. 436). In addition to emphasizing the weakness of embryonic carcinoma cells, some researchers emphasize the strength of embryonic stem cells: “Similar to their mouse counterparts, human ES cell lines have both more advanced and more consistent developmental potential compared with human EC cell

lines" (Thomson & Odorico, 2000, p. 54). These remarks characterize embryonic carcinoma cells as weaker – as less able to differentiate, thus having lower levels of potency or power – than the stronger embryonic stem cells.

All three philosophical pairs – aberrant/normal, secondary/original, and weak/strong – work to dissociate embryonic stem cells and embryonic carcinoma cells. In tandem, all three enact the primordial philosophical pair, apparent/real. The three dissociations create the dissociation between those objects that are *apparently* stem cells (embryonic carcinoma cells) and those objects that are *really* stem cells (embryonic stem cells). This can be seen in Smith (2001) who, after noting the limited differentiation potential, abnormal karyotype and origin of EC cells, says, "Studies with EC cells did eventually pave the way for the establishment of 'true' embryo stem cell cultures" (p. 437). An appearance/reality dissociation is enacted here – the author has merely used true and false in place of reality and appearance in defining and categorizing the two groups of cells. The argument by definition occurring here is that embryonic carcinoma cells are not really stem cells; only embryonic stem cells with their normal karyotype, greater differentiation potential, and origin in the ICMs of blastocysts deserves that title. This dissociation also reinforces the fact that the appearance/reality pair deals with a psychosocial consensus about how words are used and objects categorized. In this case, the words "stem cell" will be used to refer to objects that have a specific origin, power and karyotype. Scientists chose these characteristics because they contribute to creating effective models of mammalian development and drug interactions.

Embryonic Stem Cells and Embryonic Germ Cells: A Potential Dissociation

In addition to embryonic carcinoma and embryonic stem cells, researchers have also isolated embryonic germ (EG) cells. These cells are derived from primordial germ cells, the cells

that ultimately produce sperm or eggs, that are obtained from 5 to 9-week old embryos (Shamblott et al., 1998). Embryonic germ cells have a number of similarities to, and differences from, embryonic stem cells, but unlike embryonic carcinoma cells, EG cells are not clearly dissociated from embryonic stem cells. While some researchers have made moves toward dissociation along the aberrant/normal and weak/strong philosophical pairs, the dissociation is not performed by all researchers, and some researchers express doubt as to whether there are differences between ES and EG cells.

As with embryonic carcinoma cells and embryonic stem cells, researchers note a number of similarities between embryonic germ and embryonic stem cells. Both types of cells express Oct-4 (Nichols et al., 1998), and they both have a normal karyotype (Shamblott et al., 1998). Both ES and EG cells have similar powers of differentiation (Nichols, 2001; Smith, 2001; M. Tada, Takahama, Abe, Nakatsuji, & Tada, 2001; Thomson & Odorico, 2000). Some researchers have argued that when viewed under a microscope, embryonic germ cells have the same shape as embryonic stem cells (Smith, 2001; T. Tada et al., 1998), though others have argued that this similarity only occurs in mice and that human EG cells do not look like human ES cells (Nichols, 2001; Thomson & Odorico, 2000).

While only some researchers argue that embryonic germ cells have a different appearance, or morphology, from embryonic stem cells, all researchers agree that embryonic germ cells differ from ES cells in their capacity to erase genetic imprints. Genetic imprinting occurs when one of the pair of identical chromosomes in a cell is “turned off” or prevented from producing RNA and thus from contributing to the functioning of a cell. This imprinting occurs during development of a fetus, but it does not exist in the germ cells that produce eggs and sperm. Those cells – primordial germ cells – lack an imprint, and embryonic germ cells, which

are derived from the primordial germ cells, also lack this imprint (M. Tada, Tada, Lefebvre, Barton, & Surani, 1997; M. Tada et al., 2001; T. Tada et al., 1998). For Tada et al. (2001), this change does not compromise the developmental potential of EG cells: they still have the same capacity for differentiation and contributing to development as ES cells. Yet, Smith (2001) argues that the lack of imprint "compromises the developmental potential of EG cells derived from later stage PGCs" (p. 440). The power of certain types of embryonic germ cells to contribute to development is suspect for some.

Because of the ambivalence about cell morphology and developmental potential, dissociation between embryonic germ cells and embryonic stem cells has not been completed. As Thompson and Odorico (2000) argue,

> It is not yet clear whether the apparent morphological and phenotypical differences between human ES and EG cells reflect basic biological differences resulting from their different origins, or merely reflect the different culture conditions used to isolate and propagate these two cell types. (p. 54)

Instead of a completed dissociation, the discussion of these two cell types leaves open the *possibility* for dissociation. The existing research establishes the grounds for a dissociation on the basis either of the pair aberrant/normal – embryonic germ cells remove imprints necessary for development, while embryonic stem cells do not – or of the pair weak/strong – the embryonic germ cell's lack of imprint limits its capacity for development and differentiation in comparison to the embryonic stem cell. Yet neither dissociation can be completed since the justification for either one, which would be developed through experimentation, did not exist at the time these individuals were writing.

"Baby Talk": The Status of the Embryo in Debates about Embryonic Stem Cell Research

A central component of the opposition to embryonic stem cell research has been that acquiring embryonic stem cells results in the destruction of embryos. These concerns develop from the cultural and technological practices that have produced the "public fetus" – the symbol of the fetus as an autonomous person separate from its mother and the symbol of a range of interests and desires (Petchesky, 1990). This image of fetal life has been a metonymy for all the stages of human development from conception to birth (Condit, 1990), and although it stands for all developing life, its symbolic power derives from the use of images of late-pregnancy fetuses that easily fit visual conventions for depicting people. Yet, this symbol and the discourse on abortion in which it figures so prominently represent only one strand of discourse on the fetus. Technological practices such as fetal surgery, fetal tissue research, in vitro fertilization and ultrasound imaging simultaneously embody current conceptions of the fetus as well as transforming those same understandings (Casper, 1998; Franklin, 1999; Hartouni, 1997; Spallone, 1989). These overlapping technological, cultural and legal practices have produced a range of meanings for the fetus, including person, patient, "nobody" and commodity (Williams, Alderson, & Farsides, 2001), and these overlapping and conflicting discourses make problematic the extension of familiar pro-life arguments into the field of embryonic stem cell research. Those who oppose embryonic stem cell research because of moral arguments about the fetus must *extend* arguments about the personhood of developing life from the fetus to the embryo, instead of merely *asserting* them. Opponents use an *incrementum* – a rhetorical figure that creates a series – to extend the definition of personhood so that it includes the embryo. Proponents of embryonic stem cell research must disrupt that extension: instead of the embryo being part of an earlier form of human person, a difference in *degree*, proponents must dissociate

early-stage embryos from later forms of developing human life, creating a difference in *kind*. Dissociation allows for the creation of different kinds, different categories. Proponents use two different groups of dissociations: the first create the category of "spare embryos," and the second creates a division between embryos and blastocysts or "pre-embryos."

After discussing the rhetoric surrounding the public fetus, this chapter will examine the strategies of definition applied to "embryo," a definition which in turn shapes the definition of embryonic stem cells as either a moral medical application or immoral murder of a developing form of life. Proponents of ES cell research dissociate "embryo" either into "necessary embryos" and "spare embryos" or into "embryos" and "14-day-old blastocysts/pre-embryos." These rhetorical figures appear in two overlapping stages of argument. The first involves the debate about whether or not embryonic stem cells are actually embryos and thus subject to the federal ban on public funding of research on embryos (the Dickey Amendment). After the Department of Health and Human Services provides a legal opinion stating that embryonic stem cells are not embryos, the debate shifts to the morality of destroying embryos in order to obtain embryonic stem cells: opponents try to establish the definition of the embryo as a fetus, which they in turn define as a person, and proponents either argue that spare embryos from IVF represent an acceptable source of stem cells or argue that embryos at the 14-day blastocyst stage do not represent persons.

"Fetus" and "Embryo"

In addition to being a biological entity, the fetus also has a "public" life outside of the womb (Petchesky, 1990). According to Monica Casper (1998), "fetuses are multiply meaningful and they are fertile signifiers" (p. 17). Numerous technical and cultural discourses intersect in the image of the fetus, each contributing different ideas and different sets of standards and concerns.

Three technological advances and the rhetoric surrounding them have significant influence on understandings of the fetus. The first, and arguably the most important, is in vitro fertilization (IVF). The discourse about IVF has engendered a paradoxical treatment of the fetus: according to Patricia Spallone (1989), "On the one hand, IVF practitioners assure everyone that they have due respect for embryos. On the other hand, these same IVF practitioners must handle and inevitably destroy or discard human embryos" (p. 21). According to Spallone, "respect" involves treating the fetus as a full person who should not be put at risk of destruction, yet the IVF procedure inevitably destroys embryos and produces more than will ever be needed. While this concern treats "respect" simplistically and does not consider ways in which technological intervention could be "respectful" while still resulting in the risk of destruction and being discarded,[8] it does recognize an issue often unaddressed in discussion of reproductive technology, an issue that also arises in the debate surrounding embryonic stem cells. The fact that IVF produces embryos in surplus of the needs of an infertile couple raises the issue of "spare" or "orphan embryos" (Franklin, 1999; Hartouni, 1997). The existence of these embryos, especially when the parents cannot or will not use them, raises a number of issues. Hartouni indicates the concerns these embryos raised in the case of an Australian couple who had died before making a decision about embryos from an IVF procedure:

> Whose property were they, what was their status, the nature of their relationship to each other and their "genetic sponsors," the extent of their claims? Should they be thawed and flushed, used for experimentation, or "put up for adoption?" (p. 28)

IVF raises questions about the storage of embryos, their use in research and the possibility of "embryo adoption." While Great Britain has a set of laws dealing with the use and disposition of

[8] Baylis (2001) argues that the National Bioethics Advisory Commission's report on embryonic stem cell research also uses the term "respect" in uncritical and problematic ways.

spare embryos (Franklin, 1999), the United States has no framework. In fact, a moratorium on federally funded research on IVF existed until 1993 (Fletcher, 2001).

Second, fetal surgery – the practice of temporarily removing a fetus from the womb, operating on it, and replacing it in the hopes that it will be carried to term and be healthy – has altered understandings of the fetus by constructing it as an individual patient (Casper, 1998; Williams et al., 2001). This practice has helped define the fetus as a patient with rights and legal interests distinct from its pregnant mother (Casper, 1998). This status as separate and unique patient has also been used to develop the argument in abortion debates that the interests of the fetus stand in opposition to the rights and interests of the mother (Casper, 1998; Hartouni, 1997; Oaks, 2000).[9]

Third, techniques of fetal imaging, from photographs to the ultrasound image, have also shaped contemporary understandings of the fetus. These images help create the autonomous, public fetus by, often literally, erasing the mother from pictures of the fetus (Casper, 1998; Duden, 1993; Petchesky, 1990; Stabile, 1994; Stormer, 2000). Stormer describes the standard image: it consists of

> a darkened or neutral background broken by the spherical border of the amniotic sac, occasionally with some placental mass attached or without any sac at all. The fetus rests serenely, alone, sometimes with its thumb in its mouth. As a photograph the image is often backlit to add a translucent, ethereal quality to the fetus. (p. 128)

[9] While not focusing on the effects of fetal surgery, many feminist scholars have addressed the discursive creation of mother-fetus antagonism. A sample of these works includes (Duden, 1993; Morgan, 1996; Morgan & Michaels, 1999; Rothman, 1989; Spallone, 1989; Stabile, 1994)

Stormer argues that the visual schemes of individualism frame this image to create a "prenatal space" wherein the fetus is the only actor, the only person: "The womb is purified by the erasure of the woman, as well as the doctor, family, community and so forth" (p. 129).

These three technologies and their surrounding discourses have been incorporated into political, legal and cultural debates about abortion and fetal rights. As Casper (1998) notes, "Contemporary abortion debates are thus framed around static biological definitions of personhood and life, embodied in the compelling image of the tiny homunculus" (p. 17). Medical technologies have provided powerful persuasive tools for pro-life forces in the debate concerning abortion. Various scholars have highlighted the dynamics of these images in the broader abortion debate (Condit, 1990; Duden, 1993; Franklin, 1999; Hartouni, 1997; Morgan & Michaels, 1999; Petchesky, 1990; Stabile, 1994; Stormer, 2000). The result has been the creation of the public fetus – a being that has rights independent of others, especially its mother. Casper is probably right when she says, "The autonomous fetus is a seemingly permanent fixture on the popular cultural scene and has become firmly lodged in the social imaginary" (p. 16).[10] Additionally, the logic of pro-life arguments creates a series of terms that slowly extends personhood to the autonomous public fetus. As Schiappa (2003) notes, despite their failure in *Roe v. Wade*, "anti-abortion advocates often defend the linkage *fetus = live human being = person*" (p. 97). This series, or *incrementum*, is used to extend the definition of person, as an individual protected by the Fourteenth Amendment of the Constitution, to fetal life.

The discussion in the public sphere and in the academic literature has focused on the *fetus* instead of the embryo. This occurs because the two terms are treated as identical, as the result of

[10] Oaks (2000) reaches a similar conclusion: "Representations of fetuses as persons and patients are unlikely to fade given legal attempts to recognize fetal rights, the development of medical treatments for fetuses, and the fact that many women experience and think of their babies-to-be as specific individuals" (p. 67).

a metonymic reduction[11] of all forms of developing life into the "unborn": "the wide variety of beings that constitute developing unborn human life-forms – the blastocyst, embryo, fetus, viable baby – were reduced to a single entity through the creation of a single vision of the 'unborn baby'" (Condit, 1990, p. 82). Visually, the unborn baby was depicted as a fetus in the third trimester of pregnancy. As Stormer (2000) notes, images of other stages of development would not have worked:

> We do not see images of blastocysts or piglike fetuses, nor do we see malformed fetuses held up as emblems of the individual. … We usually see a perfect baby-like fetus of several months. (p. 130)

The visual similarity between the late stage fetus and fully developed humans is central to the persuasive power of the public fetus. Yet, the metonymic focus on late-term fetuses opens up the possibility of destabilizing the category of "unborn" when dealing with forms of developing life that do not appear obviously human.

In fact, maintaining the metonymic reduction in the embryonic stem cell debate is problematic. While some elements of medical science treat the fetus and embryo as "person" or "patient," other elements treat both as "prime work objects" (Casper, 1998, p. 214). Also, as Williams et al. (2001) note, healthcare workers – ranging from midwives to obstetricians, genetic counselors to pediatricians – view developing human lives as "nobody" or a commodity as often as they view them as patients or persons. Medical developments have resulted in healthcare professionals having several contrasting views of the fetus. Similar contrasts exist in federal law and practice: while *Roe v. Wade* rejected the argument about the personhood of the fetus (Schiappa, 2003), the U.S. Center for Disease Control's National Center for Health Statistics

[11] According to Condit, "metonymy is the figure of speech in which a technical, precise or denotative name for some class of things is replaced by a different name that stresses a quality, attribute or connotative image" (p. 82). A

only collects information about "fetal death" for developing humans after 20 weeks of gestation (Control, 2004).[12] Also, since 1974 and the development of IVF, the government has debated the issue of fetal and embryonic tissue research. As part of the conservative trend since the 1980s, the federal government has progressively restricted research on developing humans, starting with a ban on federal funding of fetal research in 1984 and a ban on embryonic research in 1996 (Fletcher, 2001). The treatment of the developing humans as a work object in medical and scientific practice has created the perception of them as not people and, sometimes, as a commodity. Furthermore, the history of the bans on fetal and embryonic research – the fact that Congress felt it necessary to specifically ban *embryonic* as well as fetal research – shows that the terms fetus and embryo were not coterminous and referred to different types of developing humans.

While the "public fetus" has become a part of contemporary discussions of reproductive issues including abortion, embryo adoption, fetal surgery, fetal and embryonic tissue research, IVF, and ultrasound imaging, the intersection of various reproductive technologies and the discourses surrounding them has troubled the metonymic reduction that has made the fragment "fetus" a substitute for "embryo." The political rhetoric surrounding the issue of embryonic stem cell research is one area where this occurs. The definition of embryos – especially their status as persons – comes to the fore in this debate. Debates about this definitional status also raises issues concerning IVF, the spare embryos it produces and the possibility of embryo adoption. The remainder of this section examines the Congressional debate concerning the status of the embryo in relation to embryonic stem cell research. This debate has two overlapping stages. The first stage involves debate about the relationship between embryos and embryonic

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metonymic reduction takes multiple objects or groups and replaces their individual names with the same name.

stem cells: proponents for ES cell research define ES cells as "not an embryo," and opponents try to argue that embryonic stem cells when reintroduced to the uterus could produce a fetus, thus defining them as embryos. This debate occurs because the status of ES cells as embryos or not embryos determines whether the federal government, given the Dickey Amendment that bans all federal funding of embryo research, can fund ES cell research. The second stage occurs after a 1999 legal opinion from the Department of Health and Human Services stating that, for the purposes of the embryo research ban, embryonic stem cells are not embryos and after opponents of ES cell research fail to convince a majority of Senators and Representatives of the contrary. During this second stage, opponents try to explicitly extend the chain of definitions that produce *fetus=live human being = person* to include the embryo, using the rhetorical figure of incrementum. They do this in order to persuade members of Congress as well as other audiences watching the hearings to protect embryos from the process of deriving embryonic stem cells, which ends up destroying embryos. Proponents employ a series of dissociations in an attempt to disrupt the extension of personhood to the embryo and define certain types of embryos as "spare" or as "pre-embryos" and not capable of being individual humans.

Separating Stem Cells and Embryos

During the first stage of the debate about embryonic stem cells and embryos, proponents of ES cell research worked to define embryonic stem cells and embryos as qualitatively different entities. They had to dissociate embryonic stem cells and embryos in order to obtain federal funding for this research, funding that would be withheld if these stem cells were treated as identical to embryos themselves. Senator Tom Harkin clearly states the issue:

[12] The same situation holds in Great Britain where death certificates are not produced for miscarriages before 20 weeks of gestation (Williams et al., 2001).

> A key question that I hope will be addressed today is whether, under current law, scientists can use Dr. Thomson's stem cells for federally funded research. These stem cells do not have the capacity to become a human being, and it is my belief that they therefore do not fall under the ban on human embryo research. (*Hearing on stem cell research*, 1998)

In order for basic research on embryonic stem cells to go forward, the cells must not fall under the ban on human embryo research. Additionally, Harkin makes the assertion that underlies the definition of embryonic stem cells as "not an embryo" – embryonic stem cells cannot lead to the development of a human being.

All of the scientists who testified during this hearing also make this claim. Furthermore, these claims are repeated in the rest of this phase of the debate. Some simply assert that embryonic stem cells and embryos are not the same thing. For example, John Gearhart says, "It is important to note that while these cells have the capacity to form a variety of cell types, they cannot form embryos." Thomson makes the same claim with more detail:

> Human ES cell lines are not the equivalent of an intact human embryo. If a clump of ES cells was transferred to a woman's uterus, the ES cells would not implant and would not form a viable fetus.

Thomson asserts that ES cells are not like an embryo, and he provides the example that ES cells would not be able to form a fetus and ultimately result in a baby. These assertions use the philosophical pair part/whole: ES cells are only part of an embryo and not a whole embryo, because they can form many cell types but not develop into a full grown human. Thomson and Gearhart do not fully develop the argument based on the part/whole pair, but their status as the

scientists who originally isolated ES and EG provides them the rhetorical space to make the assertion without fully developing it.

Other scientists on the panel do provide some of the possible warrants and data for using the part/whole pair in dissociating ES cells from embryos. NIH director Harold Varmus claims that embryonic stem and germ cells are not like embryos since they cannot form the trophoblast cells that develop into the tissues needed for an embryo to implant in the uterine wall:

> Unlike the fertilized egg, or the early embryo, or the intact blastocyst, neither the disaggregated inner cell mass nor the pluripotent stem cells derived from it (nor the pluripotent stem cells derived from fetal germ cells) will produce a human being even if returned to a woman's uterus. These cells do not have the potential to form a human being, because they do not have the capacity to give rise to the cells of the placenta or other extraembryonic tissues necessary for implantation, nor can they support fetal development in the uterus.

Varmus separates ES and EG cells from the entire continuum of development – from fertilized egg to embryo to blastocyst – on the basis of ability to implant in the uterus and develop: ES and EG cells lack that ability. West bases his claim on science's collective experience with embryonic stem cells from animals:

> I would – the cultured cells, I would say, are not, in that would – if they're, for instance, grown in a laboratory dish or transplanted into a uterus, they will not form a human being. They have never been observed to form a complete animal, using the animal equivalent of these cells. (*Hearing on stem cell research*, 1998)

Previous work on animal stem cells, West argues, has shown that embryonic stem cells do not form a fully developed organism, whether that organism is an animal or a human being. In both

Varmus and West's individual testimonies, ES cells and embryos are dissociated through a part/whole pair: embryonic stem cells are not capable of forming a whole person; therefore they are not embryos, which *are* capable of producing the whole human.

Finally, Dr. Thomas Okarma's dissociation of embryos from embryonic stem cells employs both a part/whole pair and a synthetic/nature pair. He implies that scientific intervention creates the division between embryonic stem cells and embryos:

> My view is that these cells are clearly not organisms. They are highly derived by a laboratory process that took years to develop and in fact, as we've said, are not the cellular equivalent of [an] embryo. Were these cells to be implanted, they would not form a conceptus nor develop.

According to Okarma, ES cells are not embryos since they are synthetic, the end result of a laboratory process, and embryos are natural, the end result of sexual activity, and because these cells would not be able to develop into a person.

The use of dissociation based on the part/whole pair sets the pattern for the rest of the definitions of embryonic stem cells as not embryos. In a 1999 hearing, Dr. Douglas Melton asserts, "Stem cells have the potential to develop into any tissue or organ in the body and yet cannot develop into a full human being" (1999). While Melton's claim is as brief as Thomson or Gearhart's earlier remarks, Melton clearly deploys the part/whole pair in this dissociation. Varmus also uses this philosophical pair, but he also ties this dissociation to the language of potency:

> Human pluripotent stem cells, which are under discussion today, do not have total potency, and hence cannot form an entire organism under any known condition… the statutory prohibition on human embryo research does not apply to research

> utilizing human pluripotent stem cells because human pluripotent stem cells are not embryos. (*Hearing on stem cell research: HHS legal ruling*, 1999)

Varmus ties totipotency to the fertilized egg and the resulting embryo. Only totipotent cells can develop and "form an entire organism." Since ES cells are pluripotent, they lack the necessary capacity for development; they are part of an absent totipotent whole. Dr. Lawrence Goldstein's dissociation mimics that of Dr. West: he argues on the basis of research on mouse embryonic stem cells that human embryonic stem cells will not form an embryo (*Hearing on embryonic stem cell research*, 2000). By the time Dr. Richard Hynes states that embryonic stem cells are not embryos in September 2000, he does not need evidence (*Hearing on the scientific and ethical impact of embryonic stem cell research*, 2000). Legal rulings and NIH Guidelines for funding embryonic stem cell research have established the claim, and further evidence is not required.

Opponents of this research do not let these claims go unchallenged. Richard Doerflinger tries to define embryonic stem and germ cells as embryos over the course of two hearings. His attack focuses primarily on work reported by Dr. John Gearhart:

> The new question raised here is this: Are the primordial germ cells obtained from abortion victims being used to create human embryos, which are then destroyed or suppressed to provide tissue? There is some ambiguity in current reports of the new research, because the researchers speak of collecting "embryoid bodies" from these cultures and finding "derivatives of all three embryonic germ layers" in the culture. They add that some of these bodies form "complex structures closely resembling an embryo during early development" and that they "appear to recapitulate the normal developmental processes of early embryonic stages and

> promote the cell-cell interaction required for cell differentiation." (*Hearing on stem cell research*, 1998)

While quoting the research report announcing the isolation of embryonic germ cells (i.e. Shamblott et al., 1998), Doerflinger does two things. First, he uses *polyptoton*, the similarity and repetition of parts of words, to establish an identity between the embryonic germ cells and embryos. Doerflinger plays on the use of the term "embryoid" and its visual and grammatical similarity to "embryo" in order to imply that embryoid bodies are actually embryos. Second, he recasts the report in a dissociation: cells are simple, and embryos complex. Since Gearhart's cells form complex structures, it is questionable whether or not these samples are "only cells." Later in the hearing, Doerflinger remarks,

> So I think there's an open question with regard to Dr. Gearhart's experiment, whether, in the course of this experiment, he is actually creating some early embryos in the culture. I think the answer is no, but I don't know, and I don't know that anyone knows.

While he admits that he does not know for sure whether the cells that Gearhart has isolated form embryos, he also argues that no one else knows, thus implying that arguments that ES and EG cells are not embryos are untenable. In another hearing, Doerflinger uses the same evidence from Gearhart, but offers a modification of his original conclusion:

> A stem cell is not an organism, but the possibility must be explored that groups of stem cells may recongregate to form an entity that is, however briefly, a living organism. (*Hearing on stem cell research: HHS legal ruling*, 1999)

Here, Doerflinger concedes the point that stem cells are not organisms, and therefore not embryos. Yet, he argues that cells that were part of an embryo have the power to "recongregate"

and become an embryo again: the *telos* that comes from being part of an embryo is so great, that the end of human development could potentially reassert itself.

Two other opponents of this research repeat the claim that embryonic stem cells can become embryos. The prepared testimony for the Center for Bioethics and Human Dignity says, "Some evidence suggests that stem cells cultured in the laboratory may have a tendency to recongregate and form an aggregate of cells capable of beginning to develop as an embryo" (*Hearing on embryonic stem cell research,* 2000). The Center's testimony recapitulates strategies used by Doerflinger: the ability to recongregate and form complex structures implies the beginning of development as an embryo. Dr. David Prentice also argues that embryonic stem cells can form embryos:

> Embryonic stem cells can form not only tissues which become part of the human body, but also trophoblast... Reformation of this layer in cultures of embryonic stem cells could lead to reformation of complete human embryos in culture, able to survive if implanted into a womb. (*Hearing on the scientific and ethical impact of embryonic stem cell research*, 2000)

Prentice claims that ES cells are totipotent – they can form trophoblast cells. This argument contradicts the claims made by Harold Varmus that embryonic stem cells are only pluripotent, and it forms part of a whole with Prentice's other claims about embryonic stem cells being "too powerful" for use in medical applications (see Chapter 5).

These attempts to define embryonic stem cells as embryos or fetuses do not succeed for three reasons. First, opponents who claim ES cells are embryos lack any evidence for their claims. The literature on human embryonic stem cells extant during the period this argument was made did not provide any warrants or evidence for claims that stem cells could recongregate into

embryos, especially in the petri dish. Second, and in part because they lacked evidence, the majority of these claims were phrased in tentative language: "some evidence suggests" that stem cells might become embryos again, but it is still an "open question." Prentice uses concrete language to claim that embryonic stem cells can produce trophoblast, but that is not supported by the extant scientific literature. Third, none of the individuals making these claims have done any laboratory work with embryonic stem cells, including Prentice, the only scientist. The individuals trying to claim that ES cells are embryos cannot provide an adequate rhetorical counter to the proponents who offer their claims with a high degree of certitude and who are all scientists that either work with these cells in the laboratory or offer evidence to support their claims. Given this weak position – a position that was most likely obvious to these rhetors even from the beginning – opponents of embryonic stem cell research also deploy other claims about ES cells and embryos from which they are derived that use familiar rhetorical strategies from the debates about abortion.

Embryos, Spare Embryos and Personhood

After opponents of embryonic stem cell research failed to stop federal funding under existing bans of research on embryos, they deployed arguments about the personhood of the fetus that are familiar from debates about abortion. Yet, opponents repeatedly state that the issue of embryonic stem cells has nothing to do with abortion. Nigel Cameron from the Center for Bioethics and Public Policy argues,

> We are in danger of losing sight of the middle ground in the assessment of the early embryo, that is to say, this is not a rerun of *Roe*. This is not essentially a debate about the implications of our stands on the abortion issue. (*Hearing on patents and ethical issues raised by embryonic stem cell research*, 2001)

Senator Sam Brownback (R-KS) makes a similar remark: “Now, despite some similarities, this debate is not about abortion” (*Hearing on the implications of cloning legislation on stem cell-based therapies*, 2001). Both rhetors try to dissociate opposition to embryonic stem cell research from the abortion debate, while employing rhetorical strategies central to pro-life rhetoric. While opposition to abortion and ES cell research might appear to be the same, they really are not. Making this dissociation between opposition to ES cell research and abortion makes it easier for opponents to persuade individuals who might not hold a pro-life position yet still feel uncomfortable with research involving human embryos.

Opponents’ arguments about the status of the embryo must do two things: establish that embryos are people and that isolating ES cells kills embryos. Opponents of ES cell research must make the derivation have greater emotional impact and make it appear as the equivalent of killing a person. Proponents of embryonic stem cell research respond with two dissociations. First, they discuss “spare embryos,” embryos remaining after the process of IVF. Proponents of ES cell research portray spare embryos as having no chance at developing into a person, thus dissociating “spare embryos” from embryos that could actually develop. Also, proponents try to dissociate the earliest stages of human development, up to and including the 14-day-old blastocyst, from the category of human person.

This section will examine debates about the status and personhood of the embryo. First, it will examine arguments from opponents of ES cell research who extend the definition of person to include the embryo and simultaneously argue that deriving ES cells is the equivalent of murder. Second, it examines depictions of spare embryos by proponents of ES cell research who argue spare embryos are potential humans whose capacity for development will never be realized and will ultimately be destroyed and depictions by opponents who offer embryo adoption as an

example of how spare embryos can go on to live. Third, it will examine attempts by proponents to undermine the status of the embryo as a person.

Extending personhood to the embryo. Opponents of ES research must make the embryo a person and the derivation of ES cells its murder. They must convince people that, as Father Kevin Fitzgerald says, "Embryonic stem cells are not harvested after the embryo has died. The procedure for removing the embryonic stem cells from the embryo destroys the embryo" (*Hearing on stem cell research*, 2001). To convince people that embryonic stem cell research depends on the "death" of embryos, embryos must be perceived as living beings. Pro-life abortion rhetoric typically employs a metonymic reduction of all developing life to the "fetus," but the intersection of different scientific and cultural trends – with different conceptions of the fetus – in the debate about embryonic stem cells disrupts this reduction. The status of the embryo becomes an open question, and in order to define the embryo as a person, opponents of embryonic stem cell research must *extend* the definition of personhood from fully developed humans and the fetus down the chain of developmental forms to the embryo and the blastocyst. According to Fahnestock (1999), extension of definitions is a recurring strategy behind the use of rhetorical figures that form series – like *incrementum* and *gradatio*. Pro-life rhetoric has already created a series – epitomized by Schiappa (2003) as *fetus=live human being=person* – that only requires extension to other stages of developing human life, such as the embryo, blastocyst, and zygote. This series, combined with emotional descriptive language about the process of deriving stem cells, work to make ES cells the end result of a laboratory process that destroys or kills a human person.

Although the first strategy of opponents of embryonic stem cell research was to define embryonic stem cells as embryos, they also deployed arguments about the status of the embryo.

In the first hearing on embryonic stem cells, Richard Doerflinger treats the extension of personhood as both a legal opinion and scientific fact:

> [The Supreme Court] has even allowed states to declare that human life begins at conception, and that it deserves legal protection from that point onward – so long as this principle is not used to place an undue burden on a woman's "right" to choose abortion before viability… Moreover, a scientific consensus now recognizes the status of the early human embryo, and the continuity of human development from the one-celled stage onward, to a greater extent than was true even a few years ago. (1998)

Legally, states can declare that life begins at conception. Science also recognizes the "continuity" of life from conception onward. Given the series logic noted above, establishing that something is "human" also established that it is a person who is the bearer of certain rights and deserving of legal protection. Doerflinger makes this point clear shortly after these statements. After describing the process of deriving embryonic stem cells, he claims, "The effect is the same as if one were to 'isolate' the heart and lungs from an adult human – the being from whom the cells are taken is killed." Doerflinger's testimony establishes a continuum of human life and personhood. He then applies it to the process of deriving stem cells: if embryos are like people, deriving stem cells would be like isolating vital organs from an adult.

Most of the remaining testimony opposed to embryonic stem cells only presents parts of this argument, but what they lack in completeness is made up for in the use of repetitive and descriptive language. Mary Jane Owen from the National Catholic Office for Persons with Disabilities provides a variant of the incrementum that extends throughout her testimony. She begins by urging the Senators at the hearing to not support "destructive harvesting of embryos

for stem cell research" (*Hearing on embryonic stem cell research*, 2000). From there, she argues Americans find "human embryos and fetuses should not be harvested" and that "most of us consider the idea of harvesting fellow human beings… abhorrent." Finally, she asks the Senate "to call for a nationwide calming of the frenzied research efforts based upon destroying future citizens." Owen draws out the figure of incrementum through her entire testimony: she moves from concern about embryos, to "fetuses and embryos." Those fetuses are "fellow human beings," and finally "future citizens." This use of the series more than others ties the fate of the embryo to legal protections of persons and "citizens," and it is supported by the repetition of emotional language. She uses the figure of "harvesting" human life eleven times and "destruction" or "destructive" four times to describe the treatment of embryos or the unborn. The destruction of "future citizens" is frenzied and abhorrent. The repetition of harvesting and destruction helps tie together the series and her testimony as a whole that condemns the treatment of human life as an agricultural product that must be harvested and used for our own ends.

The repetition of images of "destruction" and "harvesting," alongside brief claims about the status of embryos or rhetorical questions about the purpose of using embryos in research is common. For example, Dr. Frank Young asks, "Should we destroy living human embryos in order to experiment with their cells for the potential benefit of the living?" (1999). He then repeats the term "disintegration" when referring to the derivation of embryonic stem cells. Acquiring ES cells depends on "killing embryos by disintegration." The testimony of the Center for Bioethics and Human Dignity repeatedly uses the terms "destruction" and "death" to describe the derivation of ES cells (*Hearing on embryonic stem cell research*, 2000). It also notes, "Human embryos are not mere biological tissues or clusters of cells; they are the tiniest of human

beings." It also tries to base the incrementum in science: "An international scientific consensus now recognizes that human embryos are biologically human beings beginning at fertilization and acknowledges the physical continuity of human growth and development." Dr. Micheline Mathews-Roth of Harvard Medical School repeatedly describes embryos as the "youngest members of our species" (*Hearing on the scientific and ethical impact of embryonic stem cell research*, 2000), and both Dr. Christopher Hook and Eric Salley, who testify before the House Committee on Government Reforms subcommittee on criminal justice, use the phrase "living human embryos" multiple times (*Hearing on opportunities and advancements in stem cell research*, 2001). The use of repetition not only creates presence and foregrounds the *means* of obtaining ES cells as a key issue in the debate (Perelman & Olbrechts-Tyteca, 1969), it also links together all of the elements of the incrementum that have been scattered throughout a testimony. As Fahnestock (1999) notes, "Repetition can bring concepts together by giving them the same name or attributing the same property or action to them" (p. 160). The repetition of words like "harvest" with different stages of human development – fetuses, embryos, children, adult, "citizens," etc. – makes the actions done to any of these beings equivalent: harvesting embryos, therefore, is the same as harvesting children or adults. These repetitions help tie all the stages of human development scattered throughout a testimony together and make them equivalent to each other.

Spare embryos and embryo adoption. While this argument for the personhood of the embryo is powerful, it competes with other definitions of the embryo. One of these is the definition of some embryos as "orphan" or "spare embryos." Rhetors compete over the definition of these spare embryos and whether they should be understood differently than other embryos. Proponents of ES cell research emphasize that these embryos remain frozen until they

are either destroyed or the time spent frozen damages their capacity to develop. The dissociation of "spare embryos" from "embryos" depends on the philosophical pair of superfluous/necessary. Opponents respond with three different strategies: they reiterate the moral status of the embryo, argue that the number of "spare embryos" created can be manipulated by scientists, and argue that spare embryos can be adopted.

Spare embryos are the result of IVF treatments: they are the unintended consequence of trying to produce a child by artificial means. During the first hearing on embryonic stem cell research, bioethicist Arthur Caplan summarizes the status of IVF and embryo overproduction: "This country now finds itself in a situation in which tens of thousands of orphan embryos sit in liquid nitrogen unwanted and highly unlikely to be used by anyone ever to try to make babies" (*Hearing on stem cell research*, 1998). Caplan's description emphasizes the fact that these embryos are superfluous. The couples who produced these embryos already have the child or children they wanted: these embryos are no longer required, no longer necessary, for assisted reproduction. Therefore, they are abandoned – they are unwanted, and it is unlikely that they will be used. Later, Caplan notes that some people argue that spare embryos because they are *embryos* still represent life:

> There are some who would still object that these frozen embryos are still potential persons. But that claim does not square with the facts. If no woman is willing to have the embryos placed inside her bodies, if clinics are reluctant to use embryos that have been stored for long periods of time because their potential to become babies is diminished or if couple do not want anyone else using their embryos then their potential for becoming persons is zero.

Because these embryos are superfluous, they cannot be potential persons. Either they will never be implanted in a woman's uterus, providing the context wherein development into an actual person could occur, or they will lose their capacity to develop as a result of long-term storage. Caplan concludes, "Spare embryos would seem to be a legitimate and morally defensible source of human embryonic stem cells." During the same hearing, James Thomson indicates the superfluous nature of these embryos:

> The embryos that were used were specifically made for clinical purposes, but they were beyond what the patients could use. The majority of these embryos had been frozen for a number of years, and they had to decide what to do with them. The option that they were considering was to discard them, so it was a choice between discarding the embryos and doing this research. (*Hearing on stem cell research*, 1998)

The embryos are in excess of the patient's need. Not only do embryos fail to become potential persons because they are not used or they lose the capacity to develop: these spare embryos were slated for destruction when researchers intervened.

Proponents argue that for a variety of reasons spare embryos will never be used to produce children, and after these embryos languish frozen in liquid nitrogen for a number of years, they are almost always discarded. The image of discarding an embryo becomes a metonymy for this dissociation of the category of embryo. Often, it is contrasted to appeals to medical application, creating the impression that the option is to either discard embryos and fail to help people with illnesses or donate the embryos for vital medical research. In the first hearing on this research that was held in 2000, Christopher Reeve asks, "Is it more ethical for a woman to donate unused embryos that will never become human beings, or to let them be tossed away as

so much garbage when they could help save thousands of lives?" (*Hearing on embryonic stem cell research*, 2000). During the same hearing, Dr. Lawrence Goldstein asks,

> Is it ethical to literally throw away the opportunity to allow all people to benefit from the demise of these embryos? How can we justify not pursuing every reasonable means of finding cures for our friends, our parents and our children, who will suffer and die if we do not find suitable therapies? (*Hearing on embryonic stem cell research*, 2000)

In September of 2000, Dr. Richard Hynes says,

> I submit that, if the issue is morality, using embryonic stem cells for life-saving research is greatly preferable to discarding them. Surely, we should take advantage of the enormous life-saving potential of thousands of embryos that are currently frozen and destined for destruction? (*Hearing on the scientific and ethical impact of embryonic stem cell research*, 2000)

Senator Orrin (R-UT) asks, "Why shouldn't these embryos slated for destruction be used for the good of mankind?" (*Hearing on opportunities and advancements in stem cell research*, 2001), and during a hearing on President Bush's policy on ES cell research, Rep. Jim Langevin (D-DE) claims, "To relegate these potentially life-saving cells to the trash heap after the arbitrary deadline of August 9th is simply wrong" (*Hearing on stem cell research*, 2001).

The image of dumping embryos into the trash stands for the entire argument for the use of spare embryos. Spare embryos are superfluous embryos: they are not needed or necessary for the people who originally produced them to have a child. Spare embryos will not become life because the long time spent in freezing has either damaged them, or there is no one who will provide them the womb and the nurture required for them to develop. Because of these facts, IVF

clinics dispose of most, if not all, of these embryos. In addition to this line of argument, proponents of embryonic stem cell research also use the routine discarding of spare embryos to attack opponents of ES research as holding an incoherent position. During an exchange about the moral status of IVF, Sen. Harkin notes,

> I mean, I can understand if you're opposed to in vitro fertilization, then I can see it [opposition to the use of spare embryos in research]. But if you're for it, then you've got to say OK, what do you do with these leftover? (*Hearing on the scientific and ethical impact of embryonic stem cell research*, 2000)

Often, this issue is raised as a question to opponents of ES research. For example, Sen. Christopher Dodd (D-CT) asks HHS Secretary Tommy Thompson, "If you're not opposed to their destruction, how could you be opposed to using them?" (*Hearing on stem cell research*, 2001). While he does not ask the question, Christopher Reeve in March 2002 recalls a previous hearing where Senator Sam Brownback was asked about IVF and spare embryos:

> Because Senator Brownback has introduced a Senate version of the House bill, I wish to comment on some of his public statements. He has characterized embryonic stem cell research as "immoral and unnecessary." But in testimony before the Harkin/Specter subcommittee on January 24, he stated that he supports in vitro fertilization clinics.
>
> When Senator Harkin asked if he was aware that the majority of excess fertilized embryos are routinely thrown into the garbage, his response was, "I think most of them are put up for adoption." That is simply not true. (*Hearing on scientific impact of cloning ban*, 2002)

Proponents ask this question in order to highlight what they see as a contradiction in the position of many opponents of embryonic stem cell research. If they support IVF, they support the creation of spare embryos that will be discarded: individuals arguing for the sanctity of unborn life also support the creation of life that is not valued in the ways they valorize in their testimony. The question becomes more pointed, and the appearance of contradiction greater, if the individual also does not raise objections to the destruction of spare embryos from IVF clinics while still opposing ES cell research.

Opponents of this research use one of three responses to the argument about spare embryos. First, opponents argue that the distinction between "necessary" and "spare" embryos is meaningless and imply that IVF clinics will alter their methods in order to produce embryos to meet research requirements. In 1998, Richard Doerflinger claimed,

> We found a number of statements from people who run the IVF clinics, who were willing to say that the distinction was meaningless. Basically, if you allow the research on spare embryos, then when they do the IVF work – the in vitro fertilization work – they'll just make more of them upfront, and make sure that they'll have spares left after the fact. (1998)

Dr. Usala makes a similar point in a 2001 hearing:

> What we know will happen is that, with in vitro fertilization, if we have these embryos – science is an all-consuming fire, and what will happen is maybe a few more embryos will be fertilized so that we could give the embryos to justifiably sound science for development and understanding. (*Hearing on the scientific and ethical impact of embryonic stem cell research,* 2000)

Both Doerflinger and Usala create a slippery slope. If embryonic stem cell research goes forward, the demand for embryos will increase, and the people who run IVF clinics are either weak or evil and will create more embryos to meet demand.

A second argument compares spare embryos and prisoners on death row. For example, Ron Heagy notes,

> The frozen embryos are potential human life right now. If you thaw them out and let them die, then they are dead, correct? And prisoners, like we're discussing, yes, they have a voice right now, but once they're executed, they're dead, so why can't we use their parts – it's the same thought process in my mind. (*Hearing on the scientific and ethical impact of embryonic stem cell research*, 2000)

Fr. Fitzgerald also uses this argument:

> some argue that frozen "spare" embryos, left over from in vitro fertilization treatments and not likely ever to be used to produce a pregnancy, might justifiably be destroyed in order to get embryonic stem cells… one can counter that no human life is "spare." Who among us has the right to decide that another human life is a "spare" life, especially when that human life does not have the chance to contest the decision? We do not consider it appropriate to take organs from dying patients or prisoners on "death row" before they have died in order to increase someone else's chances for healing or cure. Neither, then, should we consider any embryos "spare" so that we may destroy them for their stem cells. (*Hearing on stem cell research*, 2001)

This strategy essentially recapitulates the claims derived from the incrementum. The incrementum provides the opening for opponents to claim that embryos are people. These

comparisons work on that claim and allow for the comparison of actual people like prisoners and dying patients with potential people like embryos. Yet, this claim does not address the destruction of spare embryos in IVF clinics. Given that the Catholic Church opposes IVF, this failure is not as problematic for Fitzgerald: since the Church condemns IVF, reconciling the practice with a stand on the personhood of the embryos is not necessary. For others, such as Heagy, who claim that IVF is morally neutral, or even morally good, reiterating this position does not counter the spare embryo argument used by proponents. Yet, this constant repetition might be useful outside the context of a Congressional hearing, especially in journalistic coverage of this debate – coverage that might not cover all of the nuances of the arguments.

Finally, some opponents of ES research offer the practice of "embryo adoption" as counter to proponent's arguments about spare embryos. This alternative to discarding embryos or using them for research is discussed at length during the House Government Reform Committee's subcommittee on criminal justice. Couples acquire legal ownership or custody of spare embryos and attempt to have them thawed and implanted. Those who discuss embryo adoption use many of the same strategies that appear when speakers establish the personhood of the embryo. Repetition is used, but while some references to "destruction" of embryos still appear, emphasis on children appears. For example, Joann Davidson, director of Snowflakes Embryo Adoption Program, says, "Snowflakes like human embryos are frozen, unique and cannot be recreated" (*Hearing on opportunities and advancements in stem cell research*, 2001). She then repeats the phrase "frozen live humans" three times in her testimony. The testimony of John and Lucinda Borden and Marlene Strege – parents of children who developed from adopted spare embryos – both refer to the derivation of ES cells as "slaughter" and "genocide" (*Hearing on opportunities and advancements in stem cell research*, 2001). The unique element in

arguments about embryo adoption is the use of the children themselves. All of the participants in the hearing make reference to the infants who are present at the hearing, and their parents make specific reference to them in their testimony. For example, the prepared testimony of John and Lucinda Borden notes, "Mark and Luke are living rebuttal to the claim that embryos are not people" (*Hearing on opportunities and advancements in stem cell research*, 2001). When describing her daughter Hannah, Marlene Strege states, "No mere 'dot,' she contained within her the entire blueprint for human life, including all her human organs and tissues" (*Hearing on opportunities and advancements in stem cell research*, 2001). These claims derive from the incrementum: if the children present today are people, their point of origin – spare embryos – must be people.

Countering the personhood of the embryo. Some proponents of embryonic stem cell research, like Arlen Specter, respond to the argument for embryo adoption on pragmatic grounds that the number of embryos "saved" by adoption cannot match the number of embryos destroyed in the everyday practice of IVF clinics (*Hearing on stem cell research*, 2001). Yet, this response leaves unanswered concerns about the personhood of the embryo. While arguments about spare embryos and the practices of IVF respond in part to that argument, proponents of ES cell research use a set of strategies to dissociate the category of embryo, so that some, if not all embryos, do not have status as a person.

One strategy involves dissociating embryos into two categories – embryos that will develop and embryos that will not develop. Bioethicist Arthur Caplan notes,

> Most human embryos at the point of conception will not become human beings even under the best of all possible developmental circumstances… While it is true as a matter of historical fact that all human life has begun with conception it is not

> true that all conception is capable of becoming human life. (*Hearing on stem cell research*, 1998)

Louis Guenin explicitly refers to implantation when he makes a similar claim: "Nor is it obvious that a moral wrong occurs if embryos die without implanting in a uterus. The majority of embryos do die in such manner. We do not treat their passing as the death of a person" (*Hearing on the Cloning Prohibition Act of 2001*, 2001). Sen. Hatch makes a similar distinction: "Human life begins in the womb, not a petri dish or refrigerator" (*Hearing on opportunities and advancements in stem cell research*, 2001). As Caplan notes, human life begins at conception, but not all conceptions are human life. Many zygotes and early stage embryos like blastocysts do not implant into the uterus and never become life, and if an embryo is not placed in the uterus – if it remains, as Hatch says, "in the refrigerator" – then it will never have the opportunity to develop. These arguments attempt to break apart the continuum of personhood created by the use of a series. They attempt to create two distinct categories of embryos. The creation of these two categories – embryos that will become life and embryos that will not – allows rhetors to argue that research with human embryos – embryos in the second category – is permissible.

A second strategy emphasizes the visual differences between fully developed humans and embryos. Some of these arguments focus on the size of the embryo in order to emphasize its lack of similarity to human beings. Dr. Mary Hendrix claims, "This very early embryo (called the blastocyst) is so small that it can fit on the tip of a sewing needle" (*Hearing on embryonic stem cell research*, 2001). Former Senator Connie Mack describes the blastocyst as "something so small it cannot be seen by the naked eye" (*Hearing*, 2002). Often discussion of size is connected to discussion of the lack of other obviously human features. In a September 2000 hearing, Mary Tyler Moore, actress and chairwoman of the Juvenile Diabetes Foundation, states, "The embryos

that are being discussed, according to science, bear as much resemblance to a human being as a goldfish" (*Hearing on the scientific and ethical impact of embryonic stem cell research*, 2000). Later, in the hearing, Sen. Harkin asks her some questions about this comment:

> HARKIN: I couldn't help, Mary, when you were talking about resembling – I did this once before. I held up a piece of paper. Can you tell me what's on that piece of paper?
>
> MOORE: You've got to be joking. No.
>
> HARKIN: There's a teeny little pencil dot that I put there that you can't even see. That's the size of embryos we're talking about.
>
> MOORE: Right. That's the whole point.
>
> HARKIN: I think a lot of people get confused and think an embryo is something almost like a fetus or something like that, a fully developed fetus. We're talking about something less than the size of a pencil dot.
>
> MOORE: Yes.
>
> HARKIN: ... So somehow to equate this with a fully developed human being, I think is stretching.

Finally, Dr. Bert Vogelstein makes a similar claim about embryos: "They have none of the characteristics of human beings. It's essential to distinguish a human being from human cells" (*Hearing on stem cell research*, 2001). Arguments about the size and characteristics of the embryo emphasize the dissimilarity between embryos and full-grown humans and late-term fetuses. Embryos have no human organs or other "characteristics," and they are so small they cannot be seen with the naked eye. Emphasizing these differences is another way of dissociating the embryo from other developing and fully developed humans.

Fourth, proponents argue that recent scientific developments – especially SCNT, a process that allows any human cell to become the basis for a new life – have made previous conceptions of the embryo and the beginnings of human life moot. These arguments dissociate embryos from humans through the potential/actual philosophical pair, and it furthermore diminishes the importance of embryos by emphasizing that things like hair and skin are, because of cloning, also *potential* human beings. In the first hearing on embryonic stem cell research, Caplan claims,

> Some of the bright lines that we think we can go to, are not so bright when the DNA of any cell can be converted ultimately, potentially, into a human being by transfer and technology that allows for nuclear cell cloning, we can no longer say that we understand exactly when life beings, how to respect life, depending upon certain properties that might adhere in particular cells or tissues. (*Hearing on stem cell research*, 1998)

Dr. Ron Green from Dartmouth College's Ethics Institute notes, "In an era of cloning technology, every single cell in our body has the potential to be equated with these clusters of cells [i.e. embryos]" (*Hearing on the implications of cloning legislation on stem cell-based therapies*, 2001). Dr. Bert Vogelstein uses an extended example to make the same point:

> Let me illustrate those differences by comparing what we could do with cells taken from me. I could take skin cells from a little biopsy or cheek palp cells, or I could even take a hair. Now, is that hair a clone of me? It's not such a trivial question. Because each cell in the hair is genetically identical to me, to every other cell in my body.

> And, moreover, the cells in that hair have the potential to be me. It used to be, just a few years ago, thought that there was a strict line between the potential to form human life and human life. And that potential was only in embryos. But we now know that every living cell in an animal's body could at least potentially be used to create human life. (*Hearing on the implications of cloning legislation on stem cell-based therapies,* 2001)

All three men emphasize that cloning technologies, like SCNT, make it possible that any cell could become the beginnings of human life. Yet, they argue, those cells would not be treated as people. We do not allow hairs, to use Dr. Vogelstein's example, to have any of the rights or privileges we attach to people or citizens. By foregrounding the *potential* of *any* cell to become the beginnings of human life, this argument dissociates the category of "human life" into actual and potential human life, and it lowers the value of potential life and the unique status given to the embryo. A division is created between *potential* human life and *actual* human life. Embryos are placed on the side of *potential* life alongside skin and hair cells, and the category of *potential* human life has significantly less value because of the sundry cell types that occupy it.

The fifth strategy is also based in biology, but uses the findings of embryology to argue for a biologically based distinction between people and the potential life of blastocysts and other early embryonic forms. In response to calls for a bright line separating ethical and unethical research on embryos, proponents of embryonic stem cells suggest using the primitive streak, the proto-spinal cord that appears on the fifteenth day after conception, when the embryo implants in the uterine wall. Dr. West argues,

> The bright line [that] I would argue would be a wise one for us to draw is primitive streak. At about the time of implantation this pre-implantation embryo

> begins the first steps toward becoming a human being, or indeed, it may form two human beings, identical twins. Primitive streak, I think, is an effective line to draw and say that is the beginning of a human being and prior to primitive streak we should use some other terminology, a pre-implantation embryo or some other such terminology because this is not an individualized human being. (*Hearing on the implications of cloning legislation on stem cell-based therapies*, 2001)

West argues that the primitive streak provides a division between an embryo – which West identifies as a human being, as a person – and a pre-implantation embryo, which is a group of cells with human DNA and not a human person. Green also makes this point later in the same hearing, but he emphasizes that the division is natural, not manmade:

> And what our point is, is there's such a convenient line, a bright line, that we could draw which is drawn for us by nature itself, it's called primitive streak. So, once this cluster of cells attaches and finds a home in a woman's uterus to begin a pregnancy, nature begins by drawing a line on those cells, it's called primitive streak. It's the first, sort of spade in the ground, you know, a ceremonial spade to start the construction of the building. It's the first step towards the production, the beginnings of a human life, a human life, as opposed to what was cellular life. (*Hearing on the implications of cloning legislation on stem cell-based therapies*, 2001)

Green affirms, like West, that the development of the primitive streak can act as a division between human life and cellular life. Green's argument though tries to transform a social determination – When does human life begin? When do we begin extending rights and protection of those rights to developing human life? – into a biological fact. The personhood of the embryo,

Green claims, is decided by nature, which draws the dividing line between human life and human cells.

These five strategies work together to disrupt the series logic extending personhood to the embryo and to reshape the category of "human life" in two categories: embryos and then humans and late-term fetuses. Emphasizing the differences in size, the lack of identifiable features like fingers, a heartbeat, etc., and the fact that many embryos fail to develop works to separate the embryo and the fetus. These strategies create a difference/identity dissociation: embryos cannot be in the same category with other later forms of humanity because of these gross physical differences. Arguments about the primitive streak aim to cement that division by creating a philosophical pair of pre-implantation/post-implantation, where personhood becomes a characteristic of post-implantation embryos. Additionally, some proponents argue that scientific developments have rendered current understandings of the embryo, with their concern about its status as a person, obsolete, since all human cells could potentially be the basis for human life. This argument recasts the discussion of potential and actual human life: potential human life used to be unique and precious, but since that potential exists in skin cells as well as embryos, the value of that potential is less because of its ubiquity; what should now be valued are actual human lives, those who have been born or who are almost ready to be born (i.e. late-term fetuses). Taken together, these strategies create an appearance/reality dissociation: early-stage embryos "appear" to deserve the full value accorded to human life, but in reality, there is a clear difference between embryos and developed humans.

Conclusion

Dissociation helps reorganize and restructure our worldview. It can make room for new objects and ideas, and because of this capacity, one finds it used in both science and politics. Dissociation takes the fragments used in definition and breaks them into two new fragments with specific values attached to them. In science, dissociation breaks apart the category "stem cell" to produce embryonic carcinoma and embryonic stem cells, and produces the groundwork for separating embryonic germ and embryonic stem cells, if future experimental work makes such a break necessary. In politics, dissociation reorganizes the fragments used to describe developing human life in order to make embryonic stem cell research morally acceptable and counter arguments that try to extend personhood to embryonic stem cells or blastocysts. Fragments like "spare embryo" or "pre-embryo" are dissociated from the overall category of "embryos" to highlight that not all embryos are the same in potential for development or in the likelihood of their use.

In science and politics different sets of philosophical pairs play the key role of making room for stem cells. This occurs because of the purposes behind these dissociations. In science, the purpose is to make embryonic stem cells an ideal model for early stages of mammalian development. This requires a genetically normal group of cells derived from an early embryo that can produce as many types of the cells that exist in the fully developed body. In politics, the goal is to create an exception to the category of "embryo," an exception that does not have the same moral standing.

In science, pairs like aberrant/normal, secondary/original and weak/strong were deployed to reorganize the fragments describing "stem-like" cells and make ES cells the only model for development. ES cells were the real stem cells because they had the normal karyotype necessary for organisms to grow and develop properly. ES cells were the "real" stem cells because they

came from an early point in an embryo's development than EC cells; therefore, ES cells provided a more "real" model because it could represent more of the developmental process than EC cells. Finally, ES cells were 'real' stem cells because they were developmentally stronger because they could become more types of cells than EC cells. Because they could differentiate into more cell types, ES cells were able to model more of the developmental process making them a "real," more comprehensive model that could help scientists understand more about development than EC cells. Because ES cells were viewed as more normal, more original and more powerful than EC cells, the name "stem cell" was attributed solely to them. In politics, superfluous/necessary, difference/identity, and potential/actual play important roles in the various dissociations used to create an exception to the moral value applied to "embryo." "Spare embryos" are in excess of the needs of IVF; they are not necessary to assist reproduction. Because of advances in cloning technology, all types of cells – from skin to fertilized eggs – really have the "potential" for human life, but they are not "actually" humans, and the primitive streak in early embryo marks the difference between mere cells and humans.

Because dissociation is prototypically based on the philosophical pair of appearance/reality, some have argued that dissociation propagates naïve realism. Rather, dissociation is grounded in a psychosocial consensus of what counts as "real" for a group of language users. This study shows how that also holds for science as well as lay publics. No assumption of ontological realism is required by the critic in examining scientific uses of dissociation. Further, the scientists themselves realize that their language use is based on communal agreement and consensus. Many rhetors in the scientific sphere realize that the choice of terms to describe stem cells is based on agreement about what issues are important for scientists working in stem cell research. They have treated their concern as primarily one of the

"origin" of the cell under consideration, and tied to that issue of origin is concerns about potency and genetic normalcy. The persuasive power of this dissociation exists because the dissociation responds to the community of scientists and their concerns about having useful models for studying development, modeling drug interactions with the body, and developing cell-based medical therapies. On the basis of this consensus on issues, the dissociation operates.

The dissociations operating in politics share some similarity with dissociation in science, but they also have a number of unique qualities. Like scientific dissociations, political dissociations are driven by application. Moral arguments about the embryo threaten the possibility of embryonic stem cell research, which is valued because of its potential medical applications; therefore, proponents of embryonic stem cell research must dissociate the fragment "embryo" so the moral arguments associated with it do not impact this research. Yet, while science aims to associate its objects with the valorized term from the philosophical pair, political rhetoric about stem cells focuses on depreciated term of the philosophical pair. *The goal of political dissociation is to create fragments that lack the moral value associated with "embryo."* Most often, dissociation works to create valorized terms with which the rhetor associates her or his projects. The goal in political rhetoric about stem cells is to create a term that lacks the moral value and associated legal protections of "fetus" and "embryo" so that research on embryonic stem cells can continue.

Furthermore, this examination shows how appearance/reality is more than a prototypical philosophical pair. It is more than the first among equals. Rather, the goal of all philosophical pairs is to create one's sense of the "real," in contrast to "appearances." Philosophical pairs may work to implicitly or explicitly create an ordering of a community's shared experience along the continuum bounded by appearance and reality. With scientific rhetoric about stem cells,

aberrant/normal, secondary/original and weak/strong operating within the project of modeling mammalian development and pharmaceutical interactions made ES cells the 'real' stem cells while EC cells merely 'appeared' that way. With political rhetoric about stem cells, superfluous/necessary, potential/actual, and difference/identity work to create an understanding of embryos that will "really" develop and those that only "appear" to have the potential for development.

The status of the embryo – what it *means* as it is defined in public argument – plays a key role in debates about embryonic stem cell research, but that status, which has always been challenged by certain pro-choice positions, has also been put into question by scientific developments. Pro-life forces have tried to extend the status of person – and along with it a host of rights – to all forms of developing life from the zygote onward, and this move is reflected in the discourse from many opponents of embryonic stem cell research. Reproductive and cloning technologies like IVF and SCNT have effected how people think about the beginnings of life and created "spare embryos" whose status as person, as embryo and as life becomes key to ES cell debates. Proponents of ES cell research take advantage of certain elements of pro-choice argument and insights from studies of reproduction and cloning to attack the status of the embryo by either making all embryonic life mere "human cells" or creating a dividing line – the primitive streak – between human persons and human cells. The status of the embryo will not be determined by debates on ES cells. Many discourses focus on the embryo, and with the possible exception of abortion, no single issue will likely resolve the status of the embryo in the near future. Different discourses and different argumentative fields will carve out their own understandings of the status of the embryo and carve out its own unique exceptions to that status. For example, "spare embryos" have proven a powerful means of arguing for the acceptability of

embryonic stem cells – embryos already slated for destruction should be used for the benefit of others. This argument has helped sway pro-life individuals like Orrin Hatch to support ES cell research. “Spare embryos” appear to be an exception to the status of the embryo that will become an acceptable compromise, barring major shifts in other debates about abortion, cloning, IVF, etc. Such a compromise will play a role in this greater debate, but it will be one actor among many.

Dissociations help redefine the concepts used to make sense of a community’s shared world, their “reality.” Dissociation represents a common strategy of definition used by both scientists and lay publics. Such dissociations work by mobilizing existing evidence in order to organize words, concepts and objects along a hierarchy embodied by the philosophical pairs. Although rhetors in science and politics try to make conceptual room for embryonic stem cells, they are not the only cells that could help individuals attain the desired medical, pharmaceutical and research applications for which people have turned to embryonic stem cells. Adult stem cells also represent another possible means of creating those applications. Rhetors must rank and organize these objects in order to make claims that embryonic stem cells or adult stem cells represent a better path to application.

Chapter 5.

Power, potency and plasticity: Categorizing Adult and Embryonic Stem Cells through potency terms

One issue common to both the scientific and political debate about stem cell research is the issue of stem cell "potency"—the capacity of various stem cells to differentiate into the 210 tissues that constitute the human body. It is this power to differentiate that is supposed to allow stem cells to fulfill the three types of applications toward which scientists and politicians wish to apply them. Embryonic stem cells will supposedly fulfill these functions, but it is possible that adult stem cells can be used to screen new drugs or as the source for cell therapies. The debate over which cell type is "better" focuses on the degree of power or "potency" each group of cells supposedly has. Potency is described by a list of terms organized by degree of differentiation capacity. These range from totipotency, the capacity to produce all cell types, to pluripotency, then multipotency before the range is restricted to the ability to only produce more of the same type of fully differentiated cell. This ranking of potency terms is one part of a argument from hierarchy in science; the potency terms provide the basis for creating a rank or hierarchy of cell types. Cells fall into a variety of categories, ranging from the totipotent fertilized egg to the pluripotent embryonic stem and embryonic germ cells to the decreasing degrees of multipotency of adult stem cells (see Figure 2, p. 154). This hierarchy provides the basis for claims that embryonic stem cells will provide a better avenue to medical therapies than the "weaker" adult stem cells. Yet, even though this hierarchy describes ES cells as more potent than adult stem cells, ambiguities in the hierarchy—especially ambiguities between pluri- and multipotency—

allow opponents of embryonic stem cell research to argue that adult stem cells are at least as powerful as embryonic stem cells. The use of the term "plasticity" helps to reinforce this argument.

The hierarchy found in science can also be found in politics. The rhetorical formation and the claims based upon it move with minimal translation from one field to another: the move resembles more a "low fidelity transcription," where the fragments are used in approximately the same way but with less rigorous demarcation and placement within the hierarchy, than a "translation" of ideas. The hierarchy and its attendant ambiguities animate politics and science because the concept of potency impacts the capacity of different types of stem cells to fulfill the purposes for which rhetors in both science and politics wish to use them.

Potency is the basis for the hierarchy of cell types. Scientists must develop the rhetorical and scientific tools to distinguish the power of various types of cells for medical and scientific advancement. The hierarchy of potency terms and cell types provides a discursive basis for scientific claims about which types of stem cells will provide the most efficacious applications in the shortest amount of time. Within political discussion of stem cells, the hierarchy also appears but some claims made on the basis of it do not accurately represent the science of stem cell research. These differences reflect the nature of contemporary deliberation, where multiple issues are presented with little time for in-depth research and deliberation. The hierarchy and its ambiguities are used in one of four ways. First, some testimony deploys the hierarchy within a narrative of biological development and uses it to establish the importance of embryonic stem cells. Second, some testimony deploys the ambiguities attendant in the hierarchy to attack ES research and valorize adult stem cells. Third, some political rhetors respond to the use of ambiguity by attempting to reestablish the hierarchy through attacks on adult stem cells. Finally,

there are a series of ambivalent responses that recognize the ambiguity and uncertainty about the qualitative differences between adult and embryonic stem cells and use that ambiguity as justification for supporting both lines of research; given the nature of contemporary deliberation, these responses – responses that ultimately avoid making decisions – become an ideal response to the complex mix of science and ethics.

This section will examine the creation of the argument from hierarchy. It will show how the hierarchy and its ambiguities are used in science, where the value of "pluripotency," which is associated with embryonic stem cells, plays a predominant role because pluripotent cells will be able to fill all three applications of stem cells that scientists want. When the hierarchy is transcribed into political rhetoric, scientists speaking in the political realm try to maintain the scientific emphasis on pluripotency.

Hierarchy and Repetition

> According to Perelman and Olbrechts-Tyteca (1969),
>
> Hierarchies, like values, belong to the agreements which serve as premises to discourses. But hierarchies can also be the subject of argumentation; there can be discussion as to whether a hierarchy is well founded and where some one of its terms belongs. (p. 337)

Extended series of terms such as hierarchies provide a resource for argumentation, while simultaneously being the subject of debate themselves. Fahnestock (1999) notes that classical rhetorical texts identified a number of different types of series or hierarchy, including *articulus*, *incrementum* and *gradatio*, but the most common form – and the most common form in scientific argument – is the *incrementum*, which embodies a principle of ordering or gradation. This type

of hierarchy can be put to at least five different uses, notes Fahnestock. First, a series can be created in order to place a term or category. Second, an incomplete series can be created, and its incompleteness can be used either to argue that a search for the missing element must be mounted or to argue that certain elements or objects should be placed in the "blank" spots in the series. Third, arguers can create a *sorites*, "an overlapping series of premises and conclusions, to establish set relations or causal relations" (Fahnestock, 1999, p. 97). Fourth, arguers can use a series to dissolve antitheses and categorical differences. Finally, "an arguer can also use an established series as a model for forming another" (Fahnestock, 1999, p. 97).

This last use of series is discussed in *The New Rhetoric* (Perelman & Olbrechts-Tyteca, 1969). Arguments from hierarchy, called a double hierarchy by Perelman and Olbrechts-Tyteca, use an established or familiar hierarchy to form a second hierarchy and bring order to a new realm of objects. As Fahnestock (1999) notes, the first hierarchy is used to make the ordering of objects in the second hierarchy plausible. *The New Rhetoric* also notes, "The double hierarchy makes it possible to base a contested hierarchy on an accepted hierarchy" (1969, p. 324). Arguments from hierarchy provide a basis for making claims about order or rank amongst a group of objects or categories. These hierarchies can be strengthened through repetition of key elements in the first or second hierarchies. Some hierarchies focus on the amount or quantity of an attribute, and the use of a root word with modifying prefixes and suffixes will tie the elements of the hierarchy together, reinforcing the continuity of the items in the hierarchy while still allowing their separation.[13] Repetition creates presence, such as the presence of a property that unites a number of disparate elements: consistency in terminology implies consistency in the objects and categories discussed (Fahnestock, 1999; Perelman & Olbrechts-Tyteca, 1969). Repetitions also "provide visual chains across a text" (Fahnestock, 1999, p. 157). By repeating

words, or the roots of words, across a text, an arguer creates the sense of a unity bringing the (potentially) disparate objects discussed together. That unity is reinforced visually by the repetition of words and fragments across the text, "chaining" all of the elements together.[14]

Scientific Ranking of Stem Cell Types

Scientists studying stem cells try to organize and rank the types of cells they encounter. That ranking works through a hierarchy where the ranking of cell types is organized by its association with a hierarchy of potency terms. The hierarchy of potencies is made explicit, and it is then used to create the hierarchy of cell types. Because a hierarchy is used to divide the groups of cells, the difference between cell types is a difference of degree, not kind. Thus, the use of the argument from hierarchy *creates* a relationship between the types of cells that would not otherwise exist. These differences in degree provide the basis for arguments that pluripotent embryonic stem cells are better than adult stem cell for the purposes to which scientists wish to use stem cells, yet the ambiguities that inhere in the argument from hierarchy also provide the basis for scientific counterarguments to this claim.

The Potency Hierarchy

The potency hierarchy consists of two elements: a prefix denoting the extent of the potency (toti-, pluri-, and multi-, in decreasing order of strength) and the word "potency" itself, which is repeated at each level. As noted in Chapter 2, the term "potent" first appeared in the English language almost 500 years ago and used to refer to power. The use of the term expanded to cover the idea of the "power of development" and the "power" of male sexuality. Usually in

[13] Fahnestock identifies this specific form of repetition as *polyptoton*.
[14] Fahnestock also argues that the visual element of repetition exists also in the use of graphic elements in scientific argument, as well as in the use of words.

scientific usage, “potency” refers to the power of a cell to differentiate into many different types of cells. In a parallel move, Nichols (2001) defines potency as flexibility – cells have a capacity to twist and shape themselves into different cell types. Whatever its cultural or scientific form, the capacity or power which “potency” refers to is assumed to be a power to be valued and, if possible, used.

The highest level of the potency hierarchy is totipotency, which refers to a cell’s ability to become all the cells of the fetus, as well as the trophectoderm, the extra-embryonic cells that form the placenta (Gage, 2000; Nichols, 2001; Smith, 2001; Thomson et al., 1995). The next level, “pluripotency,” refers to cells with the ability to become all types of cells, except those of the placenta (Gage, 2000; Nichols, 2001; Smith, 2001). After “pluripotency,” scientists place “multipotency.” Multipotency is less clearly defined throughout the literature (Gage, 2000). Two sources do explicitly define the term as the ability to produce all the cells of a specific tissue type, such as the epithelium or the cells of the blood (Slack, 2000; van der Kooy & Weiss, 2000). After multipotency comes the use of specific potency terms like tripotent (Bjornson, Rietze, Reynolds, Magli, & Vescovi, 1999), bipotent (Mitaka, 2001; Theise et al., 2000), and unipotent (Slack, 2000), where the prefix indicates the exact number of differentiated progeny a cell can produce.

The creation of this hierarchy links the different cell types together, transforming what is potentially a difference in *kind* into a difference of *degree*. Some researchers have questioned whether the same molecular and genetic signals produce toti-, pluri- and multipotency (Gage, 2000; Smith, 2001; Verfaillie, 2002; Wulf, Jackson, & Goodell, 2001). According to these researchers, it is not clear whether or not the same mechanisms work in all cells to create “potency” and how this mechanism is weakened to produce less potent cells. Yet, most

researchers do not raise these questions. In fact, Gage, along with other researchers, describe potency discursively and through the use of charts and figures as a continuum of power (Daniels et al., 2001; Gage, 2000; Nichols, 2001; Watt, 2001; Watt & Hogan, 2000; Weissman, 2000a, 2000b; Weissman et al., 2001). Two reasons for this phenomenon exists. First, there is no experimental data that definitively challenges the potency hierarchy and the idea that the potency of various stem cells is based in different molecular and genetic mechanisms. Second, the use of repetition in the hierarchy lends rhetorical force to the belief that potency exists as a continuum. The various levels of the hierarchy are tied together through the use of "potency" in the naming of each level. The repetition of the word creates a discursive chain linking "totipotency" with "pluripotency" and "multipotency." With the hierarchy, all types of stem cells are defined in terms of the same quality, potency. This similarity increases the explanatory power of any set of scientific experiments: work on "pluripotent" ES cells can be used as the basis for universal claims about all types of cell types. Also, the difference in degree that the hierarchy creates makes it easier to argue that "multipotent" adult stem cells have the same qualities as pluripotent ES cells.

The Hierarchy of Cell Types

Potency is the basis for the hierarchy of cell types (Figure 2). In scientific rhetoric concerning stem cells, three levels of the argument from hierarchy are most important: "totipotent" fertilized eggs, "pluripotent" embryonic stem cells, and "multipotent" adult stem cells or progenitor cells. Weissman (2000b) maintains a hierarchy similar to this one, but the hierarchy of cell types has shifted up one rank, so that ES cells are totipotent, while adult stem cells are pluripotent. Yet, this hierarchy is then confused in Weissman (2000b), where ES cells are described as both totipotent and pluripotent, adult stem cells are multipotent, and

hematopoietic stem cells (another type of adult cell) are described as pluripotent. The association of totipotency with embryonic stem cells is not widespread and has been criticized as confusing embryonic stem cells with more primitive cells like the egg, which can produce trophectoderm (Smith, 2001). Totipotent cells – fertilized eggs – are unavailable for research for ethical and legal reasons, but "totipotency" represents an ideal in scientific rhetoric about stem cells. An understanding of the "total power" of fertilized eggs would help scientists understand the earliest stages of mammalian development – one of the scientific applications of stem cells – and harnessing that power would allow scientists to create all the cell types in the human body, allowing scientists to create many different types of cells for pharmaceutical and medical applications as well.

Totipotency is associated with cells capable of becoming any other type of cell. These are fertilized eggs or "reprogrammed" cells that can be implanted in the uterus to produce a clone (Bjornson et al., 1999; Gage, 2000). Some individuals also identify embryonic stem cells as "totipotent" (Clarke et al., 2000; Weissman, 2000a, 2000b).

Pluripotency is usually associated with embryonic stem cells. This association appears in three different forms. First, some review articles make the entire hierarchy of potency and the associated cell types explicit (Gage, 2000; Nichols, 2001; Watt & Hogan, 2000). Many other articles make the connection between pluripotency and embryonic stem cells apparent and provide only one other level of the double hierarchies as a point of contrast: Tada, Takahama, Abe, Nakatsuji and Tada (2001), Thomson et al. (1995), and Thomson et al. (1998), contrast pluripotent embryonic stem cells with totipotent cells like the fertilized egg, while others contrast embryonic stem cells with the next level down, multipotent adult stem cells (Pittenger et al., 1999; Smith, 2001; Verfaillie, 2002; Wulf et al., 2001). Finally, some authors describe

embryonic stem cells as pluripotent without providing a point of contrast from the argument from hierarchy (Amit et al., 2000; Evans & Kaufman, 1981; Martin, 1981; Nichols et al., 1998; Thomson & Odorico, 2000).

The next level, multipotency, is usually associated with adult stem cells. The most explicit presentations of the argument from hierarchy make this association (Gage, 2000; Nichols, 2001; Watt, 2001; Watt & Hogan, 2000). It also appears in a number of other review and research articles that focus primarily on tissue-specific stem cells from adults, like epithelial, hematopoietic, and mesenchymal stem cells (Ferrari et al., 1998; Goodell et al., 1996; Jackson et al., 2001; Lagasse et al., 2000; Pittenger et al., 1999; Slack, 2000; Springer, Brazelton, & Blau, 2001; Weissman et al., 2001).

In addition to this association, "multipotent" is also used to describe progenitor cells – a level of cells usually described as intermediaries between stem cells and the differentiated cells that constitute the body. Weissman (2000a) and Jackson et al. (2001) use "multipotent" to refer to both stem cells and progenitor cells, and researchers from the Stem Cell Institute at the University of Minnesota have isolated a group of cells they describe as multipotent adult progenitor cells (MAPCs) (Reyes et al., 2002; Reyes & Verfaillie, 2001; Schwartz et al., 2002; Verfaillie, 2002). Even with this overlap of terminology, researchers still describe progenitor cells as a lower level of the hierarchy, just a step above those cells that have no capacity for differentiation.

The hierarchy of potency terms and cell types provides a discursive basis for deliberative claims about which types of stem cells will provide the most efficacious route to the applications valued by scientific stem cell rhetoric. After examining the research on both adult and embryonic stem cells, Watt and Hogan (2000) conclude their review with the observation, "[Embryonic

stem cells] hold great promise not only for unexpected insights into biology but ultimately for the alleviation of human suffering" (p. 1430). For Watt and Hogan, embryonic stem cells will help scientists achieve two of the purposes of stem cell research. In a similar move, Gage (2000) identifies embryonic stem cells as the type of cell most likely to be used for clinical and commercial applications. After contrasting embryonic and adult stem cells, Nichols (2001) says, "stem cells derived from embryos are likely to prove to be the most efficient route for tissue replacement therapy" (p. R503), and Smith (2001) claims that it will be more difficult to transform adult stem cells into cell-replacement therapies than embryonic stem cells. These arguments develop out of the hierarchical placement of embryonic and adult stem cells and tie the use of that hierarchy to the potential applications of stem cell research. Since embryonic stem cells are more potent – able to create more types of cells – researchers can do more research and produce more cell-replacement therapies than they could with the more limited adult stem cells.

Ambiguity in the Scientific Argument from hierarchy

The argument from hierarchy provides in part the basis for deliberative claims that embryonic stem cells will provide efficacious medical applications. The ambiguity within the argument from hierarchy does two things. First, it provides the basis for counter claims that adult stem cells are as efficacious as embryonic stem cells and that adult stem cells have the added benefit of sidestepping ethical issues surrounding the use of embryonic tissue. Second, ambiguity muddles the relationship between adult stem cells and committed progenitor cells, and this ambiguity is productive of further scientific work.

Ambiguity appears in two places. First, there is a semantic ambiguity in the potency hierarchy that destabilizes the hierarchy of cell types. This semantic ambiguity arises between

the terms "pluripotency" and "multipotency." According to the *Oxford English Dictionary* (2002), the prefix pluri- means "much" or "several," and the prefix multi- means "many" or "much." Neither prefix provides an exact amount: it is not clear how many objects must come together to count as "much," and it is not clear in the scientific literature how many different cell types must be produced by a stem cell to count as multipotency or pluripotency.[15] The two prefixes overlap, and terms into which they are incorporated share that overlap and ambiguity in meaning. Both terms refer to an uncertain degree of power or potency, and it is only the assertion by scientists that defines pluripotency as a greater degree of power.

Yet, not all scientists follow this trend. Some confuse the use of pluri- and multipotency. In a discussion of hematopoietic stem cells, Lagasse et al. (2000) comment, "If resident bone marrow HSCs can form a variety of cell types, they may be more multipotent than the phrase 'pluripotent hematopoietic stem cell' indicates" (p. 1232). Here, the normal ranking of the two terms is troubled, if not completely reversed. Both terms are used to indicate potency, with multipotent being used to indicate an even greater degree of supposed potency in hematopoietic stem cells than normally assumed. This unique concatenation of potency terms becomes possible in part because the meaning of the terms is vague: it is not clear *how much* potency is implied by either term, and both terms seem to refer to a large but similarly uncertain amount of potency.

The quotation from Lagasse et al. also highlights another issue that arises from the ambiguity of the two terms. The ambiguity allows for shifting the hierarchy of cell types, so that hematopoietic stem cells (i.e. adult stem cells) can count as pluripotent, which is the level usually associated with embryonic stem cells. Usually, as with the above quotation, this undermining of the cell type hierarchy is phrased as a question or speculation. Wulf et al. (2001) in their

[15] Slack (2000) is one of the few to provide an exact count. In his usage, multipotency refers to stem cells that can produce four unique differentiated progeny.

discussion of adult stem cells note, “Still an open question is whether there are somatic [adult] stem cells with true pluripotency, or whether tissue regeneration is based on developmental trees” (p. 1368). The question implies that adult stem cells might be more powerful than previously thought. The possibility of undermining the cell type hierarchy gains most of its power through discursive and rhetorical means, since the laboratory evidence is not clear on the exact potencies of the various types of cells. This situation is made explicit by Verfaillie (2002), who says, “There is currently no definitive proof that true pluripotent cells exist *in vivo* during post-natal life” (p. 506) and later remarks, “Although the discussion above indicates that stem cell plasticity is not proven, there is sufficient evidence to warrant continued efforts to prove or disprove that some adult stem cells might be more pluripotent” (p. 507).

This ambiguity performs two functions. First, it provides the justification for continued research into adult stem cells. Since the power of these cells is ambiguous and not clear, scientists need to study them to answer these questions. This ambiguity and the need for more research also provides a justification for still considering adult stem cells as potential objects of medical applications, despite their uncertain potency. In the conclusion of their review article, Wulf et al. (2001) note, “The recent findings in stem cell biology reviewed here, together with their projected therapeutic implications in transplantation medicine, justify our optimistic attention to the future in somatic [adult] stem cells” (p. 1368). The evidence is unclear, but the way cells are named – for example, the previously noted tendency to identify adult stem cells as possibly pluripotential – strengthens claims that adult stem cells could have medical applications (see also Mezey, Chandross, Harta, Maki, & McKercher, 2000; Watt & Hogan, 2000). Jackson, Mi and Goodell (1999) continue this claim and also implicitly refer to the moral objections individuals have with using embryonic stem cells: “If stem cells from adult tissues are generally

found to have a broad potential to differentiate, it may not be necessary to use embryonic stem cells in some medical and experimental settings" (p. 14485). The presumably greater potential of adult stem cells not only justifies their use in experimental and laboratory settings, but it also makes them an alternative to embryonic stem cells, which some people find morally objectionable (see also Wurmser & Gage, 2002).

Second, ambiguity arises from the range of power attributed to the term multipotency and ambiguity over what types of cells are associated with that term. According to this argument, adult stem cells are multipotent and can become more types of cells than progenitor cells. Yet, discussions of adult stem cells and their exact number of progeny confuses the clear rankings provided by the argument from hierarchy. For example, Bjornson et al. (1999) identify neural stem cells as "tripotent" – as being able to produce three different types of cells. Mitaka (2001) and Theise et al. (2000) describe liver stem cells as being bipotent. Slack (2000) claims that many adult stem cells are normally unipotent (see also Daniels et al., 2001). In each case, the authors of these pieces also describe the adult stem cells they discuss as multipotent. Multipotency covers these different capacities for differentiating into other cells, including the ability to become only one type of cell. Yet, others describe committed progenitor cells that have a greater degree of potency. Weissman (2000a; 2000b; Weissman et al., 2001) describes progenitor cells that can produce two to four different progeny. Additionally, there is the existence of MAPCs – *multipotent* adult progenitor cells – that reportedly can become multiple cell types from different embryonic layers, which is not thought possible for progenitors and most adult stem cells (Reyes et al., 2002; Schwartz et al., 2002). According to Reyes and Verfaillie (2001), multipotent adult progenitor cells can be differentiated into *eleven* different

cell types, more than almost all adult stem cell types. These "potent" multipotent progenitors disturb the ranking that places merely tri- or bipotent adult stem cells above them.

This confusion of progenitors and stem cells and the disruption of the hierarchy that it represents might appear to be a failure in the scientific enterprise caused by disparate groups using terminology in inexact ways. Yet, this ambiguity and the apparent confusion of hierarchies it engenders are productive in many of the senses that Keller (2002) identifies. First, the ambiguity drives scientist to perform further experiments on these objects – especially adult stem cells – to identify the nature, and extent of, their potency. Second, the ambiguity provides a stopgap explanatory measure. The continuum upon which potency terms and cells are placed provides a description of stem and progenitor cells that explains the function of differentiation as an identical process occurring among different objects. This claim is implicit in the hierarchy; explicitly, scientists note that the molecular mechanisms by which cells differentiate are not clearly understood and may differ between different stem and progenitor cells (Gage, 2000; Smith, 2001). This stopgap explanation also covers over the inability of scientists to fully explain stem cell differentiation. By treating all stem and progenitor cells as performing the same functions with various degrees of success, the argument from hierarchy (and its attendant ambiguities) reduces the number of issues that scientists cannot address at any one point during research. For example, because the hierarchy transforms the differences between cell types into a difference of degree, scientists do not have to confront the issue of whether all stem cell types use the same cellular machinery to differentiate; rather, the hierarchy allows for the temporary assumption that all stem cells differentiate in the same way. Finally, the ambiguity of the argument from hierarchy allows scientists to speak across different research domains. While the work on embryonic stem cells uses different molecular markers and slightly different techniques

from adult stem cells, the ambiguity in language allows scientists to bridge the different laboratory and experimental contexts that produced the results they report.

Political Uses of the Argument from Hierarchy

The move into the political realm brings a shift in the applications about which rhetors are most concerned. Instead of dealing with three different applications, political rhetoric about stem cells focuses primarily on medical applications, and concerns about closely approximating the conditions of early mammalian life – necessary for applying stem cells to basic research on mammalian development – disappear. Now the concern is solely about creating the most efficacious therapies for curing numerous conditions, but this change does not displace the argument from hierarchy. Although the number of applications considered has changed, the applications considered by politics overlaps with those discussed in science. Because of this overlap, the argument from hierarchy developed in scientific rhetoric is also deployed in political rhetoric. The translation of this argument is better described as a *low-fidelity transcription*: the scientific hierarchies appear in political rhetoric, but the ambiguities already existing in the argument from hierarchy are further accentuated by ambiguity produced by political rhetors using commonsense definitions of the potency terms. The hierarchy and its ambiguities appear in political rhetoric in four ways: it is deployed within a narrative of development; its ambiguities are used to attack ES cell research; it is reaffirmed in responses to these attacks; and it is used to establish an ambivalent position that advocates research into both adult and embryonic stem cells.

Defining "Potency" and Deploying the Hierarchy

One thing rhetors must do to be successful in the debate about stem cells is translate those elements of the scientific rhetoric they wish to deploy into politics and establish their meanings. In part, this requires rhetors who wish to borrow from the scientific vernacular to introduce the rhetorical pattern or formation used to provide context and meaning for the term. In the case of potency terms and stem cell research, this usually means establishing the hierarchy of potency terms and cell types. The rhetoric establishing the hierarchy occurs during the earliest Congressional testimony and in the earliest chapters of the NIH report on stem cell research. This occurs because the hierarchy must be deployed before claims depending on it can be deployed or the ambiguities within it can be recognized and exploited. Rhetors deploying the hierarchy use a developmental narrative that strengthens the hierarchy and claims based on it by adding temporal priority to the logical and categorical priorities built into the hierarchy.[16] The order within which a story is told can be used to strengthen a "timeless" categorical or logical organization: the temporal priority of a narrative becomes imbricated with a logical order. Some narrative orderings are subtle. For example, Thomas Okarma of Geron Corporation notes,

> hES [human embryonic stem] cells can form virtually any cell in the body. Specifically they have the potential to form derivatives of all three cellular layers… Other later stage human stem cells have only a limited capability to form certain cell types such as blood cells (CD34+ stem cells) or connective tissues (mesenchymal stem cells). (*Hearing on stem cell research*, 1998)

The use of "later" creates a temporal order that links the potency of the two categories of stem cells to temporal "stage" in the human body.

[16] Michael D. West of Advanced Cell Technology deploys the hierarchy, but strengthens the appeal of the hierarchy with arboreal metaphors that activate the *stem* metaphor embedded in "stem cell." Yet, West is the only one to employ this metaphorical device in the Congressional testimony, and transcripts of the hearings and prepared

The most explicit use of development in the deployment of the hierarchy occurs in the testimony of Dr. Allen Spiegel in April 2000:

> Stem cells are self-renewing and can give rise to the more specialized cells of the human body, such as muscle cells, blood cells and brain cells. They are best described in the context of normal human development. When a sperm fertilizes an egg, the product is a single cell that has the potential to form an entire organism. This fertilized egg is a totipotent stem cell, which has the potential to develop into a complete organism. In the first hours and days after fertilization, this cell begins to divide into identical totipotent stem cells. Then, approximately four days after fertilization, these totipotent stem cells begin to specialize, forming a hollow sphere of cells called a blastocyst. One part of the blastocyst is a cluster of cells called the inner cell mass, which are the stem cells that will go on to form most of the cells and tissues of the human body. These are pluripotent stem cells, which are different than totipotent stem cells – pluripotent stem cells do not develop into a complete organism. (*Hearing on embryonic stem cell research*, 2000)

The hierarchy of potencies and stem cell types appears here as an integral element of the story of human fetal development. Totipotency is tied to the fertilized egg and the earliest cells of the embryo, and pluripotency and embryonic stem cells are associated with the inner cell mass of the blastocyst, the next stage of embryonic development. Each potency term and the associated cell type are tied to a specific stage in the story of development. An extended version of this development story appears in the testimony of NIH director Harold Varmus, during the very first

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testimony from December 1998 to April 2002 do not show any sign of other rhetors deploying similar metaphorical vehicles for the argument from hierarchy (Hearing on stem cell research, 1998a).

hearing on stem cell research held in 1998. Varmus adds the next stage of the story: the development of the embryos into a child and adult, and the concomitant rise of more limited adult stem cells:

> During fetal development, pluripotent stem cells become even more committed, i.e., they have the capacity to form only one or a few different kinds of cells. For example, hematopoietic stem cells can form all the blood cells, but no other tissue types. The adult human being continues to harbor many types of stem cells responsible for the body's ability to repair some but not all tissues. Stem cells that permit new skin growth and renewal of blood cells are two examples. (*Hearing on stem cell research*, 1998)

With the move from embryo through fetus to adult, the stem cells become even more restricted in their potency, continuing the narrative trend that increased temporal "distance" from the origin of conception and the fertilized egg results in diminished power.

The NIH report *Stem Cells: Scientific Progress and Future Research Directions* also deploys the developmental narrative, but it employs a didactic tone when describing the three stages of development and potency it discusses – totipotency, pluripotency and unipotency. At each stage of development and potency, the report provides an etymology of the Latin prefix used with the term, thus emphasizing its nature as didactic rhetoric meant to inform the public and the government about the state of stem cell research. The report begins by describing totipotency and tying it to the fertilized egg. Like narratives in congressional testimony, it then moves to pluripotency:

> Most scientists use the term pluripotent to describe stem cells that can give rise to cells derived from all three embryonic germ layers—mesoderm, endoderm, and

> ectoderm. These three germ layers are the embryonic source of all cells of the body (see Figure 1.1. Differentiation of Human Tissues). … Thus, pluripotent cells have the potential to give rise to any type of cell, a property observed in the natural course of embryonic development and under certain laboratory conditions. (2001, p. 1)

While not explicitly naming embryonic stem cells, the emphasis on embryonic and "the natural course of embryonic development" ties pluripotency to stem cells derived from the embryo. Finally, the report describes unipotent cells: "Unipotent stem cell, a term that is usually applied to a cell in adult organisms, means that the cells in question are capable of differentiating along only one lineage" (p. 1). With unipotency, one reaches the end of the developmental narrative and the bottom of the double hierarchies of potency and cell type.

While rhetors with a science background introduce a relatively faithful copy of the hierarchy argument, later rhetors, who usually lack a scientific background, turn to commonsense English definitions of terms from the hierarchy that are key to their arguments. For example, Richard Doerflinger defines pluripotency as "producing a wide array of different cells and tissues" (*Hearing on cloning issues*, 2001). This definition derives from the understanding of potency as involving power and development and the definition of "pluri-" as many. Other definitions develop out of a commonsense understanding of the elements of the word but tie it to specific cell types, like the definition of "pluripotent" provided by Q. Todd Dickinson:

> Some stem cells are "pluripotent" cell lines, meaning they can be made to develop into a variety of different specialized cells. (*Hearing on stem cell research: Patenting and health implications panel*, 1999).

The commonsense definition of "pluripotency" becomes linked to specific stem cell lines, and although Dickinson does not specifically mention human embryonic stem cells, his entire testimony and the Congressional hearing of which it is a part deals solely with the isolation of human embryonic stem cells and the commercial and medical implications of that discovery. In some cases, the meaning of the term "pluripotency" is developed by associating the fragment with other fragments from scientific rhetoric. Michael J. Fox ties pluripotency to the term "undifferentiated," a term from science that Fox defines through commonsense understanding of the word's components:

> Those cells that are undifferentiated, pluripotent in the sense that they haven't been assigned to be things, they haven't – they don't know what they want to be, they're early in development, they are pluripotent in the sense that they can be anything. (*Hearing on the scientific and ethical impact of embryonic stem cell research*, 2000)

This linkage depicts embryonic stem cells as a tabula rasa, a blank slate upon which doctors and scientists can develop any cell, tissue or organ. This linkage is common in the political arena and gains salience and power because of the common belief in children as a blank slate. If babies are blank slates, stem cells from embryos should also carry that property.

Although it appears rarely, one final use of the hierarchy overemphasizes the potency of embryonic stem cells to portray them as dangerous and medically unsafe. According to Dr. David Prentice, embryonic stem cells are more than pluripotent, and this near-totipotency is dangerous:

> Although human embryonic stem cells may exhibit impressive plasticity, this plasticity has been proven to be a double-edged sword, as embryonic stem cells

> have been difficult to control in laboratories. (*Hearing on opportunities and advancements in stem cell research*, 2001)

Here the association of embryonic stem cells with pluripotency is described as "plasticity," but greater potency now has dubious value. Prentice claims that embryonic stem cells may become many things, but scientists find this ability almost impossible to control. Embryonic stem cells become a Frankenstein monster in a Petri dish – a technological terror that could wreak havoc if it were to escape the laboratory and enter the hospital. The dangers of embryonic stem cells are also emphasized by Dr. Maria Michejda, who contrasts the out-of-control embryonic stem cells with the "tamer," less potent fetal stem cells obtained from spontaneous abortions:

> Fetal stem cells have most of the properties of embryonic stem cells but do not exhibit the uncontrolled replication that is a characteristic of embryonic cells, which leads to teratomas, malignancies and chromosomal mosaicism upon transplantation. (*Hearing on cloning*, 2002)

According to Michejda, embryonic stem cells cause cancer – teratomas and malignancies – or create chimeras, individuals who have a mosaic of DNA from multiple source animals.[17] The threat of cancer is meant to arouse fear, and the concern about mosaicism, which leads to chimeric individuals, replays fears embodied in the Frankenstein myth of half-human monsters running amok (Rushing & Frentz, 1989).

Low-fidelity transcription makes statements about the out-of-control plasticity or potency of embryonic stem cells possible. These statements recognize the placement of embryonic stem in relation to adult stem cells in the hierarchy argument: embryonic stem cells are more potent than adult stem cells. Yet, while these statements transcribe the elements of the hierarchy dealing

[17] Judy Norsigian makes the same claim in testimony before a Senate Committee (*Hearing on scientific impact of cloning ban*, 2002b).

with adult and embryonic stem cells, they blur the demarcation between embryonic stem cells and totipotent fertilized eggs. By selectively choosing elements from the scientific literature to transcribe, these rhetors create the picture of uncontrollable embryonic stem cells, a picture that does not find support in the scientific literature extant at that time. Early research on embryonic stem cells from mice and humans had involved the creation of teratomas and mouse chimeras (Evans & Kaufman, 1981; Martin, 1981; Thomson et al., 1998; Thomson et al., 1995; NIH, 2001). In order to establish that the cells they had isolated were in fact embryonic stem cells able to produce all three germ layers that constitute the early embryo, researchers would inject the stem cells under the skin of mice whose immune systems were incapable of rejecting foreign tissue. They would then remove the resulting tumor and examine it under a microscope to determine what types of tissues had developed inside. Another test for stem cells involved injecting them into developing mouse embryos. If the embryo successfully developed, scientists could employ a number of visual and genetic tests to determine if the putative stem cells had successfully differentiated and been incorporate into the new animal, a mouse chimera with chromosomal mosaicism. The picture of dangerous and out of control embryonic stem cells wreaking havoc in an unsuspecting patient gains its credibility by portraying the early research on embryonic stem cells *as the actual medical application of embryonic stem cells*. Yet, as the NIH report on stem cell research notes,

> The lines of unaltered human embryonic stem cells that exist will not be suitable for direct use in patients. These cells will need to be differentiated or otherwise modified before they can be used clinically. (p. ES-5)

Injecting any form of stem cell directly into an individual is a dangerous and risky practice. Scientists do not plan on creating teratomas in individuals by randomly injecting stem cells into unsuspecting patients.

Deploying Ambiguity

Along with the deployment of the potency-based hierarchy, the ambiguities resulting from that hierarchy are also available for use. Critics use the ambiguities, along with the concept of adult stem cell plasticity, to discredit embryonic stem cell research and claim that adult stem cells are at least as potent, if not more so, than embryonic stem cells. Claims of greater or equivalent potency function enthememically: Potent cells can become many cell types; degree of differentiation (potency) increases the likelihood of medical application; therefore, greater potency means a greater number of applications. Rhetors often pair the claim of equivalent potency with claims about the existing medical applications of adult stem cells or the lack of existing medical applications for embryonic stem cells.

Rhetors often use the word "versatility" to refer to the potency of adult stem cells. For example, Rep. Jay Dickey (R-AR) claims, "numerous reports over just the last few months have shown remarkable discoveries about the versatility and possible uses of stem cells found in adults" (*Hearing on embryonic stem cell research*, 1999). "Versatility" is directly tied to use or application. Dr. Micheline Mathews-Roth ties her claim about adult stem cell "versatility" to the accusation that the NIH ignores it when it created its first set of guidelines for stem cell research in 2000: "The Guidelines… seem to ignore the mounting evidence in the current scientific literature of the versatility of adult stem cells" (*Hearing on the scientific and ethical impact of embryonic stem cell research*, 2000). Not only is the evidence of versatility ignored, Mathews-Roth argues, the amount of evidence continues to grow making such ignorance unconvincing.

Another approach to arguing that adult stem cells have equivalent potency or "versatility" treats adult stem cells as a collective whole. According to Judy Norsigian, founder of Boston Women's Health Book Collective, "it turns out that taken as a collective, the population of adult stem cells has as a wide a potential as embryo stem cells" (*Hearing on scientific impact of cloning ban*, 2002). This perspective argues that while any single type of adult stem cell might not have as much potency as embryonic stem cells, all adult stem cells, taken as a whole, have potency equivalent to an embryonic stem cell.

At least one opponent of embryonic stem cell research and advocate for adult stem cells moves beyond the general claim of equivalent "versatility" to argue that adult stem cells should be understood as "pluripotent" – the level of potency normally associated with embryonic stem cells. According to Dr. David Prentice,

> One of the common criticisms leveled against adult stem cells is that there are only a few types, and they are not pluripotent, lacking the range of ability to differentiate into all tissues which is claimed for embryonic stem cells. … However, in June of this year, a group in Sweden performed an experiment with mice using adult neural stem cells which shows that these adult cells are pluripotent. (*Hearing on the scientific and ethical impact of embryonic stem cell research*, 2000)[18]

Less than a year later, Prentice expands on this claim before the House Judiciary committee's subcommittee on crime:

[18] Mathews-Roth makes a similar claim during the same committee hearing when she argues, "The exciting thing about these bone-marrow stem cells is that they are able to be transformed into all three embryonic layers." Differentiation into all three embryonic layers is a sign of pluripotency and is associated with embryonic stem and embryonic germ cells.

> However, various studies now show that adult stem cells from many tissues are "pluripotent," that is, they have the ability to form many different tissues in the body, not just regenerate the one tissue from which they were taken. In fact, the indications are that adult stem cells can regenerate all human tissues. This potential answers another criticism, that an individual stem cell has not yet been found for each of the 210 tissues of the human body. The proven potential of adult stem cells to transform from one tissue type to another negates the necessity to find 210 different adult stem cells, since one or a small set can suffice. (2001)

Prentice argues that adult stem cells are pluripotent and capable of regenerating many, if not all, tissues that constitute the human body. Building off this claim, Prentice then argues that one of the common arguments against the usefulness of adult stem cells for scientific and medical applications – that stem cells for all tissues have not been found – is in fact not a limitation, since only a few "pluripotent" adult stem cells need exist in only a handful of tissues in order to regenerate all the cells of the body.[19]

Additionally, claims about adult stem cell potency are tied to three different types of claims about the medical application of stem cells. First, some assert that the existence of adult stem cells makes embryonic stem cells irrelevant. Richard Doerflinger claims, "Adult stem cells may be more versatile than was once thought [and, therefore,] offer the promise that embryonic stem cells may simply be irrelevant to medical progress" (*Hearing on stem cell research: HHS legal ruling*, 1999). Adult stem cell versatility "promises" to make stem cells irrelevant and unnecessary. Later the same year, Dr. Frank Young advances a similar claim about adult stem cells: "Recent studies have demonstrated that these cells might be a suitable substitute for ES and EG cells" (1999). What makes adult stem cells "suitable" is not articulated, but the use of

"substitute" clearly indicates that embryonic stem and germ cells are not necessary for medical and research applications.

Second, some rhetors tie the claim of adult stem cell potency to an argument that the therapeutic potential of embryonic stem cells is an uncertain path, at best, to relieving suffering. An extended version of this claim appears in Rep. Mark Souder's (R-IN) opening statement to the House Committee on Government Reform's subcommittee on criminal justice's hearing on embryonic stem cell research:

> "Adult" stem cells capable of transforming into countless cells and tissue types have been located throughout the human body, including in the brain, muscles, blood, placentas and even in fat. Researchers have only begun to unlock the potential of these adult stem cells.
>
> Stem cells from fat have been transformed into cartilage, muscle and bone. Adult bone marrow stem cells have been transformed into muscle, cardiac tissues, neural cells, liver, bone, cartilage and fat. And just this May, researchers announced that they had identified an adult cell that appears capable of becoming virtually any cell in the body.
>
> Contrary to the impressions created by advocates of embryonic stem cell research, the potential of such cells remain entirely speculative, because embryonic stem cells have never been successfully used in clinical applications with human patients. … There is no reason, therefore, to believe that adult stem cells do not have the same – if not greater – potential than stem cells derived from embryos. (*Hearing on opportunities and advancements in stem cell research*, 2001)

[19] While an interesting speculation, the veracity of this claim is not established during the time period studied.

The argument begins with a general claim about adult stem cell versatility – they can become "countless" tissue types. It also notes that this potential versatility is only now becoming understood. Souder then moves to enumerate several different adult stem cells and the tissues into which they differentiate, and the third adult stem cell is one that appears to have as much potency as embryonic stem cells, since it can become all cell types. Embryonic stem cells now move from an uncertain path to medical applications – as they were in Dickey's testimony – to a complete speculation. Souder concludes this argument by affirming that adult stem cells have as much, if not more, potency than embryonic stem cells.

Like claims about the dangers of embryonic stem cells, the claims about the medical applications of adult stem cells, while having some truth, may mislead audiences. The NIH report *Stem Cells: Scientific Progress and Future Research Directions* (2001) claims that the belief that adult stem cells are ready for therapeutic use is a misconception:

> A second misconception is that adult stem cells are ready to use as therapies. With the exception of the clinical application of hematopoietic stem cells to restore the blood and immune system, this is not the case. The therapeutic use of this mixture of cells has proven safe because the mixture is place [*sic*] back into the environment from which it was taken, e.g., the bone marrow. In fact, many of the adult stem cell preparations currently being developed in the laboratory represent multiple cell types that are not fully characterized. In order to safely use stem cells or cells differentiated from them in tissues other than the tissue from which they were isolated, researchers will need purified populations (clonal lines) of adult stem cells. (2001, p. ES-5)

Adult stem cell lines are no closer than embryonic stem cell lines to the therapeutic uses advertised for stem cell research – curing diseases like Alzheimer's disease, Parkinson's disease, and diabetes. Hematopoietic stem cells are used to restore blood production and the immune system in certain cases, but that type of therapy, while important, is different from the types of regenerative medicine that have generated so much interest in stem cells, especially embryonic stem cells.

Responding to Ambiguity

Advocates of stem cell research do not let the challenges described above go unanswered. Advocates primarily reassert the claims based on the link between embryonic stem cells and "pluripotency" that places embryonic stem cells higher in the ranking produced by the hierarchy argument. For example, Dr. Doug Melton says, "While adult stem cells have some similar properties, based on what we know today adult stem cells do not have all the properties of embryonic stem cells" (*Hearing on stem cell research*, 2001). Dr. Paul Berg claims, "Embryonic stem cells are far more versatile for medical therapies" (*Hearing on stem cell research*, 2001). Melton asserts that the two categories are different but leaves the difference unspecified, while Berg uses "versatility" to describe the difference and explicitly ties it to medical therapies. West describes the greater potency of embryonic stem cells as "self-assembly":

> There's much discussion about their relative merit compared to the adult stem cell, but just as one simple example of their relative benefit, the embryonic stem cell can self-assemble into a complex tissue given the right circumstances. It can actually form intestine and other – kidney and other important tissues. We've never seen this before in the history of medicine. (*Hearing on the implications of cloning legislation on stem cell-based therapies*, 2001)

The ability to form many different types of tissue becomes a matter of self-assembly, and although his choice of descriptor – assembly – differs from the language of potency and versatility, the same phenomena is described and emphasized, as in some other descriptions, as a unique occurrence.

Because the placement of cell types through the hierarchy has been challenged, pro-embryonic stem cell rhetoric must tie the reassertion of the hierarchy to some other element used to define stem cells. Some rhetors incorporate prominent fragments from scientific fora into the political discussion of stem cells, and because the applications motivating the discourse have shifted, the meaning and purpose of the fragments that are translated shifts as well. For example, some rhetors tie the pluripotency of embryonic stem cells to "self-renewal." Lawrence Goldstein notes that stem cells from embryos, fetuses and adults are qualitatively different, and also remarks, "it is far too early to know if adult stem cells have the same potential as embryonic stem cells, whether they can be harvested in sufficient quantities to treat or cure disease, and whether they can grow indefinitely as can ES cells" (*Hearing on embryonic stem cell research*, 2000). For Goldstein, the issue of self-renewal shifts from being an important quality for stem cells because of research applications to being an important quality for medical applications: self-renewal – indefinite growth and reproduction of cells – becomes tied, along with potency, to medical applications. Spiegel also raises the issue of self-renewal:

> More importantly, pluripotent and adult stem cells are not qualitatively alike. Pluripotent stem cells have truly amazing abilities to self-renew and to form many different cell types, even complex tissues, but in contrast the full potential of adult stem cells is uncertain, and, in fact, there is evidence to suggest they may be more limited. Unlike pluripotent stem cells, the adult stem cells may be able to divide

> only a limited number of times, which would limit their usefulness in the production of adequate numbers of well characterized cells for reliable therapies. (*Hearing on embryonic stem cell research*, 2000)

According to Spiegel, self-renewal becomes tied with pluripotency, and both qualities become necessary for producing adequate amounts of cells for medical applications. Self-renewal becomes intertwined with pluripotency, and both qualities become the basis for arguing that embryonic stem cells will be more effective than adult stem cells in producing therapies.

A second strategy reaffirms the issue of timeliness. Pluripotency becomes tied to the timeliness with which medical applications will be produced: embryonic stem cells will produce medical applications quickly, in contrast to adult stem cells. According to Christopher Reeve, "If the government forces scientists to attempt to make adult stem cells behave like embryonic stem cells, they might waste five years or more and fail. In the meantime, hundreds of thousands will have died" (*Hearing on scientific impact of cloning ban*, 2002). Devoting time and resources into adult stem cell research in an attempt to make adult stem cells act like embryonic stem cells will waste valuable time that could be spent researching embryonic stem cells and producing medical applications. This move, according to Reeve, would be a disaster, resulting in countless deaths.

Senator Orrin Hatch (R-UT) also deploys the issue of timeliness, but he frames it in terms of the respective "stages" of embryonic and adult stem cell research. During testimony following the publication of NIH's report on the state of stem cell research in 2001, Hatch stated,

> While I am not a scientist, my preliminary reading of the report strongly suggests that embryonic stem cell research may have some substantial advantages over adult stem cells – at least at this stage of the research. … However, it is important to note what the NIH report does not say. It does not say that the promise of

> embryonic stem cell research obviates the need to pursue adult stem cell research. The report indicates that both embryonic and adult stem cell research hold great promise. I believe that both avenues should be zealously pursued. (*Hearing on embryonic stem cell research*, 2001)

Embryonic stem cells currently show more promise for producing medical applications; the stage at which that research exists places it closer to potential applications. Yet, Hatch notes, both avenues of research hold promise and should both be pursued "zealously" – the two avenues of research, despite the apparent advantage of embryonic over adult stem cells, complement one another in their "great promise" for future therapies.

The language of "time lost" from Reeve's testimony and Hatch's comments about the "stages" of research are combined in testimony by Richard O. Hynes, the president of the American Association for Cell Biology. Hynes says,

> Critics argue that embryonic stem cell research is unnecessary because stem cells derived from adult tissues may be used with equal effectiveness. I regret that this claim is ill-informed and misleading. Scientists are indeed guardedly encouraged by recent reports of plasticity of some adult stem cells, but this line of research is in its very early stages and far from definitive. We know little about the availability of adult stem cells, their differentiation, or their potential for prolonged maintenance outside the body. While we strongly support continued research on adult stem cells, it is far too early to conclude that they will be as effective in treating and preventing disease as embryonic stem cells seem certain to be. If embryonic stem cell research were to be halted based on that hope, it is entirely possible that years would pass before scientists determine whether or not

> adult stem cells are of equivalent value. (*Hearing on the scientific and ethical impact of embryonic stem cell research*, 2000)

Adult stem cell research is in its earliest stages, and claims that it could replace research on embryonic stem cells are ill informed. Hynes emphasizes the issue of the time it would take to produce therapies by making an assertion about the danger of stopping embryonic stem cell research. Years of research could be lost in the, potentially futile, quest to determine if adult stem cells have potency equivalent to embryonic stem cells, Hynes claims, though his language is more restrained than Reeve's language in making this claim.

Agnosticism and Equivocation

A final response to the debate about stem cell potencies takes comments about the complementarity of adult and embryonic stem cells from Hatch and Hynes to the point of equivocation. This argument treats neither adult nor embryonic stem cells as better than the other type. The equivocation develops out of issues of uncertainty and concerns about timeliness. These equivocal responses appear less frequently than the other types of arguments comparing adult and embryonic stem cells, and they appear for the most part during the month immediately before and the two months after President Bush's decision on embryonic stem cell research.

The majority of equivocal responses come from non-scientists. For example, Senator Tom Harkin (D-IA) notes,

> Embryonic and adult stem cells are different and BOTH present immense research opportunities for potential therapies. It would be irresponsible to wait for years to determine the potential of adult stem cells before studying the benefits of embryonic stem cells. (*Hearing on embryonic stem cell research*, 2001)

Although he argues here for continued study of embryonic stem cells, the basis for his argument is that embryonic stem cells *and* adult stem cells both represent promising routes to medical therapies; waiting to advance both types of research would be "irresponsible." The ethicists Arthur Caplan and Glenn McGee note,

> The fact is that no one can be sure what research on adult stem cells will produce… It is absolutely true that embryonic stem cell research is also so new that it can only accurately be described as promising. (*Hearing on patents and ethical issues raised by embryonic stem cell research*, 2001)

The argument is based on the uncertainty inherent in describing future applications: Caplan and McGee argue that both areas of research are too new to be described as anything other than promising. Based on this, they conclude, "Both lines of research must be pursued." Senator Edward Kennedy comes to a similar conclusion: "I believe that research on adult stem cells should proceed in parallel with [a] vigorous research program on embryonic stem cells" (*Hearing on stem cell research*, 2001). All three equivocal responses appear in the months surrounding President Bush's decision on embryonic stem cell research, a period of intense debate about the respective value of adult and embryonic stem cell research. These equivocal responses represent a covering strategy that attempts to find a middle ground between the two sides of the debate. Since the speakers are not biologists, these statements allow the speakers to take a position on the issue that obviates a need to take a stand on the scientific issues surrounding the two stem cell types. Instead of reasserting or refuting the claims based on the hierarchy argument from science – and related claims about self-renewal and the isolation of stem cells – the equivocal claim avoids involvement with these issues and removes the issue from the realm of politics. Political actors who claim the equivocal position are not required to

decide which strands of scientific research – those emphasizing the potency of adult stem cells or those questioning it – deserve attention: they can simply claim that research is ongoing or evolving and promise to support all relevant research.

Scientists occasionally make equivocal claims, though these appear less often than equivocal claims from nonscientists and claims from scientists asserting or reasserting the argument from hierarchy. For example, Dr. Darwin Prockop, who studies adult stem cells at Tulane University's medical center, testifies,

> We simply cannot be certain in advance which therapies will work and which will not. … In my opinion, it would be a serious mistake to stop all research on human embryonic stem cells and tissues because of the exciting discoveries my laboratory and others have recently made about adult stem cells. We are simply not ready for a moon shot-like strategy in which we place all our bets on adult stem cells. (*Hearing on the scientific and ethical impact of embryonic stem cell research*, 2000)

Prockop argues against stopping embryonic stem cell research on the basis of research produced in his laboratory as well as the labs of others. Placing all of one's "bets" for medical therapies in adult stem cells, Prockop argues, is a "moon shot-like strategy." While it is uncertain which types of research and which therapies will be effective, choosing only adult stem cells decreases the likelihood of therapies. The strongest claim that can be made is that both avenues of research must be pursued in order to produce medical therapies.

A different scientific use of the equivocation strategy comes from Dr. James Thomson, the biologist who first isolated human embryonic stem cells. He claims, "The debate about whether adult or embryonic stem cells are 'better' is a political debate not shared by mainstream

stem cell biologists" (*Hearing on stem cell research*, 2001). His testimony, which comes almost three months after Bush's decision on embryonic stem cell research, attempts to demarcate science from politics: debates about which category of stem cells is better comes from politics instead of science, he argues. Thomson tries to portray science as non-political or non-ideological; science, on this view, becomes detached from messy policy debates. This move hinges on the ambiguity of the word "better" – the word remains undefined, but the implication of this claim is that "better" does not refer to potency. Instead, claims about which type of stem cell would provide a "better" route to medical therapies is decoupled from scientific debates about stem cell potency.

Conclusion

Both scientific and political rhetoric makes use of the argument from hierarchy. In it, stem cells are identified as belong to the same category or kind – cells that have a degree of potency, or capacity to differentiate – but they are separated by the *degree* of potency they have. This organization of stem cells by degree of potency provides the basis for making arguments about the value of different stem cells for research and medical applications. Both science and politics makes use of the argument from hierarchy: it is transcribed from one discursive realm to the other, instead of being translated, because it can be use to generate claims about which stem cells will be ideal for applications valued in both scientific and political rhetoric. Yet, this transcription still only presents a *fragment* of scientific discourse to the public, which leads to opponents producing many false claims about embryonic stem cell research. This fragmentation changes the nature of deliberation, elevating equivocation to the level of ideal course of action.

The hierarchy forms the basis for claims that embryonic stem cells represent the ideal means to realizing the research and medical applications valued by science and politics. Yet, the hierarchy that undergirds this argument also contains a number of ambiguities. These ambiguities provide the basis for counterclaims that adult stem cells are still prime possibilities for medical applications that lack the attendant moral issues raised by embryonic stem cells. Furthermore, these ambiguities are productive of further scientific work. They allow scientists to speak across different contexts, provide short-term explanations and answers (often answers for questions that are not currently answerable), and act as a goad to scientists to design experiments to clear up some of the ambiguity.

In politics, the argument from hierarchy and its ambiguities are deployed in four ways. First, proponents of embryonic stem cell research present the hierarchy, but they tie it to narratives of human development from fertilization of the egg through birth. Opponents of embryonic stem cell research deploy the ambiguities of the argument with a host of other claims about the potential applications from both types of stem cells to argue for the versatility – the potency and plasticity – of adult stem cells. Responses to this development in the debate involve either a reassertion of the hierarchy or equivocations that result in calls for both types of research to go forward.

Developmental narratives are supposed to strengthen the hierarchy as well as providing a context for embryonic and adult stem cells that helps make them understandable to non-scientists, but the developmental narrative does not eliminate the ambiguities of the hierarchy. Opponents of embryonic stem cells still draw on those ambiguities. Yet, their arguments are often tied to claims that distort the available evidence from science to make embryonic stem cells appear dangerous and to make adult stem cells appear as a workhorse already doing the work

that embryonic stem cells should theoretically be doing. Although inaccurate, making these claims becomes possible because of the fragmentation of contemporary culture and the increased speed with which culture moves and presents new fragments (McGee, 1990). Outside of highly controlled fields of argument where all participants ideally have most, if not all, the fragments at hand, no single audience will have access to all the fragments that constitute a given field of discourse. Furthermore, various constellations of fragments – different arguments, testimonies, speeches, etc. – pass quickly before the eyes and ears of audiences, allowing less time for sustained attention and deliberation. This occurs even in Congressional hearings. While more time might exist for debate and deliberation there, congresspersons must consider so many different issues and pieces of legislation that the time they can devote to any single issue becomes diminished. Only those who have taken the issue of stem cell research up as a favorite cause – such as Senator Arlen Specter (R-PA) – might have sufficient knowledge to sift through the variety of claims and make accurate judgments about them.

This lack of knowledge and time for deliberation, along with the inherent uncertainties about predicting the results of science, therefore make the strategy of equivocation more appealing and more rhetorically powerful. Political actors do not have the time to consider all the issues concerning any one debate, but they still must make a decision that will influence the debate. This is especially true of developments in scientific research, which are funded by federal organizations like the CDC and the NIH.

Equivocations provide political actors a way of dealing with debates where the issues are too complex or too numerous to allow for effective deliberation. Equivocations are a covering strategy that results in all potential research avenues being funded. They also allow politicians to avoid debating what avenues of research are viable. Because they cannot effectively deliberate,

political rhetors delay making the decision in hopes that future developments along one of the funded lines of research will change the nature of the debate and make deliberating and deciding easier.

Given the lack of knowledge that political actors have about developments in research on adult and embryonic stem cells, equivocation represents the ideal strategy for funding research that might lead to medical applications. It allows the politician to take credit eventually for funding the research that led to a successful therapy while avoiding a decision in the present. Yet the strategy does have its limits. First, restrictions in funding could make such a decision difficulty: if funding were limited, it might not be possible to cover multiple avenues of research. Second, while supporting both adult and embryonic stem cell research appears as a compromise position, an increase in the number of disparate research agendas (e.g. if Congress had to choose between funding multiple conflicting research programs to cure degenerative diseases) could make forging an equivocal, middle-of-the-road position difficult. Finally, the strategy of equivocation cannot sidestep the moral and ethical attacks on embryonic stem cell research – namely, that research on embryonic stem cells is akin to abortion. Other strategies are necessary to respond to the moral issues.

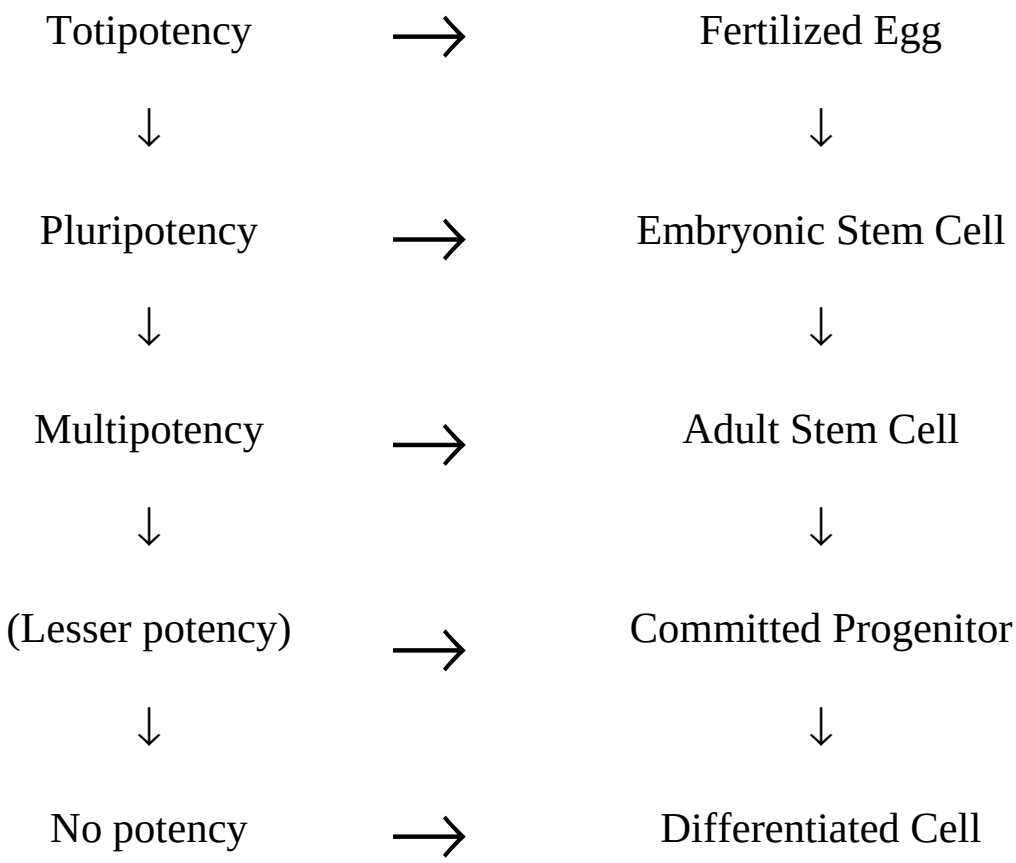

Figure 2: The hierarchy of potency terms and cell types.

Chapter 6.

Conclusion:

"Perfecting" a Stalemate

On August 9, 2001, President George W. Bush delivered his first presidential address to the nation. He spoke about embryonic stem cell research, an issue he described as "one of the most profound of our time" (¶ 1). He noted that embryonic stem cells could save lives, but that some people had objections to that research because it destroyed embryos: "At its core, this issue forces us to confront fundamental questions about the beginnings of life and the ends of science. It lies at a difficult moral intersection, juxtaposing the need to protect life in all its phases with the prospect of saving and improving life in all its stages" (¶ 16). Bush used this speech to present a policy in which he would balance the "great promise and great peril" of this research (¶ 23): "I have concluded that we should allow federal funds to be used for research on these existing stem cell lines, where the life and death decision has already been made" (¶ 24). Bush's policy for embryonic stem cell research limited federal funding to those stem cell lines that had been derived before he gave his speech.

The compromise that Bush announced was not well received. Democrats and Republicans, as well as proponents and opponents of embryonic stem cell research, criticized it. According to House Minority Leader Richard Gephardt (D-MO), "The president has done the bare minimum in order to try and publicly posture himself with the majority of the Americans, but Americans know this is not the decision that the science community needs to go forward full

force" (Goldstein & Allen, 2001). Former NIH director Harold Varmus described the policy as "a very poor investment and a very cruel investment" (Scientists, anti-abortion advocates dislike stem cell decision, 2001). House Majority Whip Tom DeLay (R-TX) said, "This initial research may ultimately serve as a pretext for vastly expanded research that does require the destruction of new living embryos" (Goldstein & Allen, 2001), and the United States Conference of Catholic Bishops called the decision "morally unacceptable" (Page & Hall, 2001). Very few people, if anybody, liked the decision Bush made.

Bush's speech embodies the conflict in debates about stem cell research and the inability to resolve the differences between definitions of embryonic stem cells as murder of a developing form of life and a miracle cure for countless patients. Bush presents arguments for and against embryonic stem cell research in a way that leaves no middle ground available for compromise. For example, he presents definitions of the embryo based on the dissociations used by proponents and the incrementum, or series logic, used by opponents together:

> On the first issue, are these embryos human life – well, one researcher told me he believes this five-day-old cluster of cells is not an embryo, not yet an individual, but a pre-embryo. He argued that it has the potential for life, but it is not a life because it cannot develop on its own.
>
> An ethicist dismissed that as a callous attempt at rationalization. Make no mistake, he told me, that cluster of cells is the same way you and I, and all the rest of us, started our lives. One goes with a heavy heart if we use these, he said, because we are dealing with the seeds of the next generation. (¶ 13-14)

The first paragraph, where Bush paraphrases a scientist, reflects the strategy of dissociation where early forms of developing life are divided into embryos and pre-embryos. Immediately

following that is the incrementum that emphasizes the continuity of human life from its earliest stages to adults. Following, these two paragraphs, Bush raises the issue of "spare embryos":

> And to the other crucial question, if these are going to be destroyed anyway, why not use them for good purpose -- I also found different answers. Many argue these embryos are byproducts of a process that helps create life, and we should allow couples to donate them to science so they can be used for good purpose instead of wasting their potential. Others will argue there's no such thing as excess life, and the fact that a living being is going to die does not justify experimenting on it or exploiting it as a natural resource. (¶ 15)

These paragraphs replay the debate about the status of the "embryo" and "spare embryos" as they played out in the Congressional debate. Bush's speech does not overtly resolve the tension between the issues of preserving the life of the embryo and promoting research that could improve the quality of life for many people.

The inability of Bush's speech to create a middle ground between the two sides of this debate about the status of the embryo and embryonic stem cells reflects the status of the greater political debate. Bush's speech also reflects other elements of this debate: it contains the strategies of definition and key fragments that have shaped the debate about stem cells. Bush discusses the possibility of medical applications at several points in the speech. Near the beginning of the speech, he notes,

> Based on preliminary work that has been privately funded, scientists believe further research using stem cells offers great promise that could help improve the lives of those who suffer from many terrible diseases – from juvenile diabetes to Alzheimer's, from Parkinson's to spinal cord injuries. (¶ 6)

Later, he remarks,

> Research offers hope that millions of our loved ones may be cured of a disease and rid of their suffering. I have friends whose children suffer from juvenile diabetes. Nancy Reagan has written me about President Reagan's struggle with Alzheimer's. My own family has confronted the tragedy of childhood leukemia. And, like all Americans, I have great hope for cures. (¶21)

Bush highlights the medical applications of stem cells, and he refers to some of the diseases most often mentioned as targets for stem cell therapy – Alzheimer's disease, juvenile diabetes, Parkinson's disease and spinal cord injury. His use of "hope" in these passages also parallels the discussion of "promise" to describe the potential of embryonic stem cells to produce therapies. He also uses many of the same arguments deployed to praise adult stem cells:

> You should also know that stem cells can be derived from sources other than embryos -- from adult cells, from umbilical cords that are discarded after babies are born, from human placenta. And many scientists feel research on these type of stem cells is also promising. Many patients suffering from a range of diseases are already being helped with treatments developed from adult stem cells.
>
> However, most scientists, at least today, believe that research on embryonic stem cells offer the most promise because these cells have the potential to develop in all of the tissues in the body. (¶ 7-8)

In this passage, Bush discusses the potency of adult stem cells. He deploys both the hierarchy *and* its ambiguities to say that adult stem cells have potential to produce cures but embryonic stem cells are viewed by scientists as more promising than adult stem cells. He also borrows the

language used by advocates of embryo adoption to describe embryos: Like a snowflake, each of these embryos is unique, with the unique genetic potential of an individual human being" (¶ 10).

Bush's speech reflects the debate about stem cells that occurred in scientific and congressional discourse, but, as Kenneth Burke might notes, the speech also "perfects" the debate by taking the conflicting sides to the point of stalemate (Burke, 1966). Bush's speech announces a policy that is the culmination of the unresolved debate, and this is an element of presidential rhetoric on issues concerning science and technology. Just as the congressional debate could not resolve the status of the embryo in relation to embryonic stem cell research, Bush's speech does not resolve that issue. Scientific debate about embryonic stem cell research cannot definitively resolve whether embryonic or adult stem cells are more potent or more able to result in medical applications, and Bush's speech reflects that. Bush's speech and the policy it announces do not resolve any of the issues that exist at this stage of the debate. Instead, all of the strategies used to define stem cells appear in this speech and produce a policy that recognizes and deploys all of those fragments without successfully adjudicating among them to produce the grounds for a coherent policy. Presidential rhetoric on scientific issues like stem cells will reflect the previous rhetoric and debate on the issue. When these speeches announce or propose policies on these issues, the issues in the debate become perfected. The policy takes part, or all, of debate and pushes them to their ultimate conclusion. The difficulty for George W. Bush was that the elements of the debate did not allow for a clear conclusion other than stalemate

The conflicted definitions that find their "perfection" in Bush's speech begin with fragments existing in both scientific and public discourse. These fragments move into scientific discourse and then onto the context of the laboratory where they produce technical definitions. These fragments can be returned to public discourse either as scientific fragments or as technical

definitions. Purpose, the fifth element of Burke's pentad of motives, shapes what fragments get filtered and selected at each stage.

The purposes driving stem cell research are threefold for scientists. Scientists hope to use stem cells to understand the earliest stages of mammalian, especially human, development, create "screens" for testing new pharmaceuticals, and to produce medical applications, cures for diseases such as Alzheimer's disease, Parkinson's disease, and diabetes. When the debate moves from scientific discourse to political discourse, the emphasis shifts from all three applications to medical applications because all individuals can identify with the medical application of stem cells: even if they do not personally suffer from Parkinson's or diabetes, for example, they will most likely know someone in their lifetime who will. In order to strengthen the definition of stem cells by purpose – in order to maximize the identification of stem cells with medical applications – political rhetors balance emphasizing the advantages, the number of cures, stem cells will bring and emphasizing the timeliness, or how quickly stem cells will bring results. Opponents of this research emphasize the uncertainty of these applications: since these applications are potential that will be realized in the future, opponents highlight the uncertainty of the future and the uncertainty of bringing scientific experiments to public application.

In order to begin realizing these applications, both scientific and political rhetors must create the rhetorical and conceptual space for their audiences to accept stem cell research. They create this space through the use of dissociation, a strategy that reshapes the fragments used to define the world: where one fragment initially exist, two are created through dissociation. In science, this requires separating out the various stem-like cells from each other: embryonic carcinoma cells, cells taken from tumors on fetuses, must be subordinated to embryonic stem cells as a less powerful and less realistic model for development. Scientists must also begin

establishing the grounds for dissociation between embryonic germ and embryonic stem cells in case future research establishes that one cell type is better for various applications than the other type. In politics, dissociation makes space for embryonic stem cell research by carving out exceptions to the ethical value given to embryos as a form of developing life. “Spare embryos” are separated from “embryos” because the former category is not needed for assisted reproduction and their long-term storage destroys the capacity to become a fully developed human being. Some proponents also dissociate the earliest stages of embryonic life, especially the 14-day blastocyst stage and earlier developmental forms, from later developing forms of life with a series of strategies to emphasize the differences between the blastocyst and other human forms, like the late-term fetus. In each case, these dissociations try to shape “the real,” the psychosocial consensus about the world in which we live.

Also, because multiple stem cell types exist, rhetors must be able to organize and categorize these different types of stem cells. Arguments from hierarchy provide the means of defining the various stem cell types according to their potency: embryonic stem cells are viewed as more powerful – more potent – than adult stem cells. Yet, this hierarchy contains several ambiguities that allow rhetors to argue that adult stem cells are equally as powerful as embryonic stem cells. The hierarchy works equally well for scientists and politicians: instead of being *translated* from science to politics, the argument from hierarchy is *transcribed with low fidelity*. Since the argument about stem cell types focuses on which types will more likely produce applications, the argument from hierarchy operates in a similar fashion in both science and politics. In both, one sees the hierarchy deployed – though it is explicitly tied to a narrative of development in political rhetoric – and also sees the ambiguities deployed to argue for adult stem cells. In politics, one sees two further developments in the use of the argument from hierarchy

that did not fully develop in science. First, proponents of stem cells rebut claims about adult stem cells based on ambiguities in the hierarchy. Often, these rebuttals deploy other elements of the definition of stem cells in order to shore up claims of greater potency in embryonic stem cells. Second, one sees a strategy of equivocation: rhetors, usually politicians, do not make claims about greater or lesser potency for adult and embryonic stem cells. They argue that both cell types might produce applications, so research on both types of stem cells should be supported at this time. Instead of becoming embroiled in a debate grounded in scientific findings – a debate for which many politicians are not suited – those who use the strategy of equivocation avoid making claims about the qualities of these cells as determined by scientific experiment. A decision about which cell type is better is delayed until new evidence is produced.

The fragments created and organized by these strategies form the answers to the question "What are stem cells?" These fragments and these strategies provide the basis for defining what stem cells are, what types of stem cells exist and what sort of hierarchy these cells exist along. Purpose plays a key role in these strategies of definition. Purpose creates the value and importance of these objects: to the extent that they fulfill our needs, whether "we" are scientists, politicians or lay individuals, stem cells become important. The shift in purpose from science to politics is one of the primary forces that translate definitional fragments as they move from one discursive arena to the next. Even opponents of embryonic stem cell research must grapple with the issue of purpose.

Furthermore, these definitions shape a community's sense of what is "real." To the extent that groups and individuals are persuaded to accept a definition, that definition becomes "real" for them; it has the power to shape their perception of the world and their discourse about it. Yet, definitions are not, as Weaver (1952) would argue the discursive sign of an eternal

essence. Rather, definitions are quasi-stable points of agreement. To the extent that individuals during the period of 1998 to 2002 are persuaded that embryonic stem cells will produce the cures for Alzheimer's and Parkinson's diseases, then embryonic stem cells "really" become the means to that cure. This definition was a point of agreement for proponents of embryonic stem cell research and become a part of their agreed-upon sense of "reality." To the extent that individuals see embryonic stem cells as the murder of embryos, research on those cells is "really" murder; this was a point of agreement for opponents of embryonic stem cell research. Discourse developing from these points, from these definitions, will be somewhat predictable. Yet, definitions are only partially stable. If definitions are not essences, but rather points of agreement or points on which people have been persuaded, then the definition can change. Furthermore, since definitions are concatenations of fragments, the words and phrases that constitute them have little or no necessary connection to each other. The connections between these fragments are produced through rhetorical strategies. Like all symbol use, these fragments and strategies contain ambiguities at their hearts, and these ambiguities and uncertainties can be used to undo definition. The debate on stem cell research embodies this. A number of strategies exist to define stem cells as an ideal way to produce certain scientific and medical applications. Embryonic stem cells are a type of stem cell that has been defined as an ideal means of attaining these applications, but they have also been defined as the murder of a developing human life. Ambiguity and uncertainty allows these definitions to be undone – the fragments upon which they are based can be shifted, modified or removed from debate. The debate around stem cell research embodies the shifting dynamics of definition and redefinition. The ultimate outcome is not yet certain.

In fact, the debate about stem cells has reached equilibrium. Neither side can undo as yet the key definitional moves made by the other: in the public debate, embryonic stem cells are murder *and* medical miracle, positions that condense all the fragments of definition and the strategies used to deploy them. The scientific findings since President Bush's decision have not immediately changed the nature of the debate in the political sphere. Since the reports by Ying et al. (2002) and Terada et al. (2002) that some examples of adult stem cell potency and plasticity mistook the phenomenon of cell fusion, where two or more cells merge into one, for the plasticity of stem cells, scientists have emphasized that embryonic stem cells appear more potent and more likely to produce cures for Parkinson's and similar degenerative diseases (Daley, 2004; Phimister & Drazen, 2004). Yet, reports of adult stem cells, especially hematopoietic (blood-producing) stem cells, producing cures for a number of degenerative conditions and disorders also exist (Child et al., 2003; Körbling & Estrov, 2003; Krivit et al., 1998; Milpied et al., 2004).

Two possible events seem most likely to shift the debate and provide new fragments and new points upon which to redefine stem cells and change the debate. First, if scientists manage to produce medical applications from stem cells, the promise of medical application will become a reality. The debate about application will shift from a deliberation about the promises of scientific research to whether and how society will use the medical application. Once medical applications exist, even if they are only early prototypes not ready for mass distribution, the balance of the argument will change, increasing support for embryonic stem cell research. Second, a major shift in the circulation of fragments surrounding the fetus and embryos can also alter the debate about stem cells. If pro-life fragments extending the definition of person to include the earliest forms of developing life predominate and become persuasive for the largest number of people, that would harm the prospects of future embryonic stem cell research, if not

foreclose the possibility of that research entirely. Yet, if fragments undermining the extension of personhood to the embryo predominate – for example, if the rhetoric of "spare embryos" circulates extensively – it could shift the grounds of the debate and make embryonic stem cell research more palatable for greater numbers of people.

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Appendix A:

Glossary of Scientific Fragments

Differentiate. Differentiate is used to describe the capacity of stem cells to become many different types of cells, including neurons and blood cells. According to the OED, scientists first used the term in this fashion in 1858, but the scientific usage of the term does not differ radically from everyday usage.

Embryonic Carcinoma (EC) Cells. Embryonic carcinoma cells are cells taken from tumors (carcinomas or teratocarcinomas) taken from fetuses. Some researchers define them as a type of stem cell (Gardner & Beddington, 1988; Smith, 2001). There are many similarities between ES and EC cells, but researchers usually note the differences between them (Evans & Kaufman, 1981; Martin, 1981; Nichols et al., 1998; Thomson et al., 1998; Thomson et al., 1995). Researchers in the stem cell field dissociate embryonic carcinoma cells from embryonic stem cells.

Embryonic Germ (EG) Cells. Embryonic germ cells are a type of cell derived from the primordial germ cells of the gonadal ridges of fetuses (Gardner & Beddington, 1988; Shamblott et al., 1998; Smith, 2001; Thomson & Odorico, 2000). They also have a number of characteristics in common with embryonic stem cells. Scientists have created the grounds for dissociating embryonic germ and embryonic stem cells during the time period examined, but that

dissociation is not completed because the scientific justification for the dissociation and the need to complete the dissociation are not present.

Embryonic and Adult Stem Cells. The terms "embryonic" and "adult" modify "stem cell" and identify stem cells of different origin – those from fetuses and those from adults. These two types of stem cells are often placed in opposition to each other, and the distinction between the two is one element of the scientific definition most often translated into the public sphere. This distinction is examined in Chapter 5.

Hematopoietic Stem Cells. Stem cells that produce a person's blood. The existence of these stem cells was first established in the 1950s (Weissman, 2000b). Often, these cells are used as an exemplar for all adult stem cells (Verfaillie, 2002; Weissman, 2000a; Weissman et al., 2001).

Potency terms. This represents a group of related terms that describe the power of stem cells to become other types of cells. They range from "totipotency" – the ability to become all types of cells – down to "unipotency" – the ability to become one other type of cell. Here, as with differentiation terms, the meanings are based on the cultural accepted meanings of the term "potency" and the prefixes used to modify it (OED). Two of the most common derivatives are "pluripotency" and "multipotency." According to the OED, totipotency and pluripotency have been used by scientists to describe the power of cells to become different types of cells since the early 1900s. Neither term has acquired a specific technical definition (q.v.). Based on cultural understandings, multipotency has roughly the same meaning as pluripotency, but scientists have tried differentiating them through the use of arguments from hierarchy (for more, see Chapter 5).

Plasticity. This term is used exclusively in discussions of adult stem cells. It refers to the capacity for adult stem cells committed to producing progeny for a certain type of organ to produce cells for different organs. According to the Oxford English Dictionary, scientists first used “plasticity” to discuss the ability of animals to adapt to new environments, and this usage of the term borrowed directly from the common understanding of the plasticity as the property of being moldable.

Self-renewal. This concept is considered vital for a cell or group of cells to be considered stem cells. Stem cells must be able to continually divide and produce more copies of themselves, thus maintaining a specific population. In other words, cells that are considered stem cells have the capacity to renew their population by themselves without the help of other types of cells.