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Best-Fit Bioethics: The Formation of Ethical and Political Positions on Stem Cell Research

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Abstract
Few issues in bioethics inspire controversy and garner headlines like human embryonic stem cell research. This cutting-edge research can be at once confusing, exciting, and disturbing. Scientists eagerly tout the potentially life-saving therapies this research could produce, giving hope to the millions who suffer from debilitating diseases and to their loved ones. However, to obtain these longed-for miracles of modern science, human embryos must be destroyed. And many people object to this aspect of the research. Despite being sympathetic to those who suffer, these people do not believe that any benefits merit the large-scale destruction of what they consider to be a unique individual human life. Others believe that the embryo, though deserving of respect, should never be equated with a developed human person in a way that precludes its use to potentially benefit humanity. Most people seem to be caught somewhere in the middle. They are pulled in two directions— between helping people and protecting life—and it is this pull that characterizes the debate over stem cell research.

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BEST-FIT BIOETHICS: THE FORMATION OF ETHICAL AND POLITICAL POSITIONS ON STEM CELL RESEARCH

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To my parents

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INTRODUCTION

Few issues in bioethics inspire controversy and garner headlines like human embryonic stem cell research. This cutting-edge research can be at once confusing, exciting, and disturbing. Scientists eagerly tout the potentially life-saving therapies this research could produce, giving hope to the millions who suffer from debilitating diseases and to their loved ones. However, to obtain these longed-for miracles of modern science, human embryos must be destroyed. And many people object to this aspect of the research. Despite being sympathetic to those who suffer, these people do not believe that any benefits merit the large-scale destruction of what they consider to be a unique individual human life. Others believe that the embryo, though deserving of respect, should never be equated with a developed human person in a way that precludes its use to potentially benefit humanity. Most people seem to be caught somewhere in the middle. They are pulled in two directions—between helping people and protecting life—and it is this pull that characterizes the debate over stem cell research.

Stem cell research is, in one sense, entirely modern and unprecedented. But the questions it raises about the origins of life and the alleviation of suffering have concerned people for hundreds of years. There are sources available for people to look to for guidance in untangling the ethical issues involved. Ethicists, and others, can use reason and logic to find and sort out the relevant issues and the best

arguments. They try to discover or create clear distinctions and boundaries, puzzling out their positions and attempting to justify their chosen courses of action. Some find these arguments convincing, and others take the parts of these views that fit best with their own beliefs and values.

Other fundamental sources of guidance to the decisions that people make concerning stem cell research are religious texts and traditions. On issues of life and death, those who are religious desire to make decisions that are consistent with their faiths. Religious sources can give guidance on new and confusing issues based on the treatment of similar cases from the past. However, since these sources always address analogous problems, rather than the circumstances of stem cell research itself, they often lend themselves to competing interpretations. There is no one religious position on stem cell research in the U.S. nor in Christianity alone nor even within individual denominations. The faithful have access to texts and traditions, but they still interpret these traditions in light of their own consciences and values.

This thesis articulates the ways that people and organizations have determined, justified, and put into practice their own "best-fit" positions on the morality of stem cell research. It is a primer on the scientific, ethical, religious, and political aspects of stem cell research. In the first chapter, I explain the relevant science, to provide a basic foundation and to dispel some of the confusion that pervades public understanding of this research. In chapter two, I delve into the secular arguments made by ethicists who look to reason to provide clarity and answers. The third chapter details the various religious positions taken by people of faith. I note the ways they avail themselves of the traditions and sacred texts of their faith, as well as their own interpretations. Finally, in the fourth chapter, I explain the current policy on stem cell research and look at the role of personal

beliefs in shaping policy decisions. I conclude that, because this issue has so many elements that tug in different directions, it lends itself well to individual interpretation. People take from all of the sources available to them, and based on their previous beliefs and values, they craft a solution with which they can be comfortable.

CHAPTER ONE

ONTO NEW GROUND

Despite widespread knowledge that stem cell research exists, there remains a great amount of confusion over its exact nature and purpose. Explanations of stem cell research often fall into one of two camps: those that are overly simplified and lack any real depth, and those in scientific journals that are too technical for the lay-person. It is difficult to engage in debates over the ethics or funding of this research with only a passing familiarity of the science involved, so this chapter provides a basic foundation for understanding this complicated subject. I will introduce the concept of stem cells and their properties and kinds, as well as discuss the potential for this research and the obstacles that must be overcome in order to realize this potential. I will briefly compare adult and embryonic stem cell research, give a sense of some current developments, and explain the disagreements among scientists and the questions with which they are struggling.

The Properties and Acquisition of Stem Cells

Definition and classification. Stem cells are a very diverse group, but generally they are characterized by their capacity for self-renewal—that is, to divide and produce more cells like themselves—and their potential for differentiation into

another kind of cell or, often, many other kinds of cells.[1] While these cells are present from very early in development, they also permeate every part of the adult body and keep the cells of the body renewed. These cells can be classified by their origins or by their developmental capacities.[2] The main categories by origins are embryonic stem cells, which are derived from the cells of a pre-implantation embryo, and adult stem cells, which can be derived from the cells of many tissues in the human body. These cells are classified according to their capacities for differentiation, as totipotent, pluripotent, multipotent, or unipotent. Though these terms are often used in different ways, the assertion about the capacities of the cells is the same. Something is 'totipotent' if it has the capacity to produce any type of cell in the body (e.g., a fertilized egg).[3] 'Pluripotent' cells have the capacity to become any type of cell in the body, save one. 'Multipotent' cells can become a small number of types of cells, and 'unipotent' cells can only become one type. Often 'totipotent' and 'pluripotent' are used interchangeably to refer to embryonic stem cells, as the only type of cell that they cannot become is the "trophoblast," which aids in developing the early embryo.[4] For most purposes, it is said that embryonic stem cells are capable of becoming any type of cell. As the embryo develops, these cells differentiate into all of the different types of cells in the body, and lose their pluripotentiality. Adult stem cells are thus multipotent, and can produce a limited range of cell types, according to their kind (neural, muscle, skin, etc.).

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[1] President's Council on Bioethics (PCBE), "Recent Developments in Stem Cell Research and Therapy," *Monitoring Stem Cell Research* (Washington, D.C.: Government Printing Office, 2004), 111.

[2] PCBE, "Research and Therapy," 113.

[3] National Institutes of Health (NIH), "Basic Questions," FAQs [Stem Cell Information], available at http://stemcells.nih.gov (10 November 2004), no. 2.

[4] "Medical Promise of Embryonic Stem Cell Research (Present and Projected): Dr. John Gearhart," transcript of the proceedings of the President's Council on Bioethics, 25 April 2002, available at www.bioethics.gov (2 April 2005).

Derivation. Embryonic stem cells are derived from the "blastocyst," which is the pre-implantation embryo (see Appendix A). It is only a few days old, and consists of two main parts: an outer layer, called the trophectoderm, and an inner cell mass (ICM). The blastocyst only contains about 150-200 cells, and of these, only about 15-20 can be cultivated into stem cells.[5] The ICM cells are extracted, isolated, grown, and converted under appropriate conditions to become "embryonic stem cells" as the term is used for research.[6] Extracting the cells, of course, destroys any potential the embryo may have had for developing any further. The process is somewhat inefficient, in that a large number of these ICM cells are needed in order to produce a few good stem lines.[7] This inefficiency is partly due to the relative infancy of the research, as the method for the isolation and growth of these cells was first developed in 1998, by a group headed by Dr. James Thomson at the University of Wisconsin.[8]

Related Terms. While it can be correct to speak of 'stem cells,' some observers consider the use of a term such as 'lines,' 'derivations,' or 'preparations' to be more appropriate.[9] 'Preparations' is a fairly broad term, which simply points out that the conditions governing the cultivation of these cells differ in each laboratory, so that each has its own preparation of a cell culture.[10] 'Derivations' come from a preparation. Before cells are injected or grafted in an experiment, the stem cells in a preparation are coaxed to differentiate into a specific type of cell, and this is a

[5] "Medical Promise of Embryonic Stem Cell Research," PCBE transcript.
[6] PCBE, "Research and Therapy," 113-114.
[7] "Medical Promise of Embryonic Stem Cell Research," PCBE transcript.
[8] NIH, "Healthcare Questions," FAQs [Stem Cell Information], available at http://stemcells.nih.gov (10 November 2004), no. 2.
[9] For this paper, 'stem cells' and 'stem cell research' used alone refer to embryonic stem cells.
[10] PCBE, "Research and Therapy," 114.

derivation. These cells are not simply 'stem cells,' in the broader sense.[11] 'Lines' is a genetic term, which means that the cells in a population are descended from an original population that has the ability to self-replicate and be frozen indefinitely. One would not have to go back and destroy more embryos, but instead could use these lines for research.[12] When people speak of stem lines as "immortal" or "eternal," this only means that the cells can continue to divide indefinitely, but whether or not they are usable for research purposes is altogether different. Genetic changes can occur and biological properties can become degraded over time.[13] It is important to understand that scientists do not simply pluck out stem cells; they must carefully cultivate and prepare these cells in specific conditions in order to elicit the desired biological properties.

Potential Benefits

General Knowledge. The most important and exciting property of embryonic stem cells is their ability to differentiate into any type of cell, and it is on this ability that the vast potential of this research rests. Scientists hope that research in this area could add greatly to the general understanding of cell biology, to new therapies for treating and curing diseases, and to the possibility of new methods of drug testing. There are many diseases such as Parkinson's, Huntington's, and Alzheimer's that are due to cell loss, despite the presence in the body of naturally available stem cells.[14] Scientists hope to learn how to re-activate those cells that are already present. As well, scientists do not entirely understand

[11] "Medical Promise of Embryonic Stem Cell Research," PCBE transcript.
[12] NIH, "Basic Questions," no. 4.
[13] For more information on this point, see chapter four.
[14] Jingli Cai and Mahendra Rao, "Aging and Neural Stem Cells," in *Stem Cells: A Cellular Fountain of Youth,* ed. Mark Mattson and Gary Van Zant (Amsterdam: Elsevier Science, 2002), 109.

the process by which cells are directed to differentiate. The genes that direct this process can be manipulated, but the signals that normally (or abnormally) turn these genes on and off are not fully understood. Cancers and birth defects are often caused by abnormal differentiation and division, so advances in knowledge in this area could be extremely important.[15] In many ways, the research done on both adult and embryonic stem cells could be mutually beneficial, as advances in one could lend insight into the other. Many scientists hope that cell culturing is just transitional, and that with the knowledge gained from it, there may be ways to simply direct a patient's own cells to behave in a certain manner.[16]

Therapies. Much of the optimism for the results of this research centers on its possibilities for therapeutic uses, or 'regenerative medicine' as it is sometimes called. After scientists coax stem cells into differentiating into a certain type, they may be able to graft or transplant this derivation onto the damaged site in the body. Also, specialized researchers hope to create tissues from these cells and graft these tissues where needed. These techniques may reduce or eliminate the need for an organ donor waiting list if the process is successful enough and becomes widely available. Treatments could also be developed for diseases such as diabetes. This condition results when insulin-producing cells are destroyed by a diabetic's immune system, but it might be possible to craft cells immune to such destruction.[17] Genetic engineering plays a large role in the potential for regenerative medicine. Instead of grafting tissue or cells, scientists could replace damaged genes or repair them, or add new genes that are lacking. The National Institutes of Health (NIH) stem cell

[15] NIH, "Stem Cell Basics: Introduction [Stem Cell Information]," available at http://stemcells.nih.gov (9 January 2005), section VI.

[16] "Medical Promise of Embryonic Stem Cell Research," PCBE transcript.

[17] NIH, "Basic Questions," no. 4.

resource center provides a nice summary of the hopes for therapeutic uses of stem cells:

> Pluripotent stem cells offer the possibility of a renewable source of replacement cells and tissues to treat a myriad of diseases, conditions, and disabilities including Parkinson's and Alzheimer's diseases, spinal cord injury, stroke, burns, heart disease, diabetes, osteoarthritis and rheumatoid arthritis.[18]

Beyond these uses, it may also be possible to use stem cells for the chemicals that they secrete or even to develop a synthetic version.[19]

Drug Testing. In addition to the advancement of scientific knowledge and the potential for curing diseases, it may also be possible for stem cells to revolutionize the way drugs are tested. If researchers can reliably differentiate stem cells, they could produce a wide range of cell types for a variety of tests. Already, anti-tumor drugs are being tested on cancer cell lines.[20] It may be possible to dramatically reduce the number of human and animal subjects needed for such testing. Clearly, the possibilities for this research are both exciting and extremely speculative. It is difficult to predict whether some outcomes are more or less likely than others, but the results of preliminary studies appear to be consistent with scientists' goals and expectations.[21]

Obstacles

For experiments to be reliable and successful, certain conditions must be in place. The NIH states that to realize the promise of this research, "scientists must be able to easily and reproducibly manipulate stem cells so that they possess the necessary characteristics for successful differentiation, transplantation, and

[18] NIH, "Healthcare Questions," no. 1.
[19] "Medical Promise of Embryonic Stem Cell Research," PCBE transcript.
[20] NIH, "Stem Cell Basics," section VI.
[21] "Medical Promise of Embryonic Stem Cell Research," PCBE transcript.

engraftment."[22] While this sounds simple enough, there are numerous obstacles in the paths of scientists who work toward this goal. A scientist working with stem cells needs to be able to take these cells that can become anything and make all of them become just one thing, dividing reliably, without errors, and doing so safely in a patient. This is a tall order. The problems include the difficulty of controlling cell development, the possibility for mutations, and the rejection of foreign cells by the immune system.

Control and sorting. There are a number of reasons for the difficulty of obtaining stable and homogeneous populations. Scientists have figured out ways to manipulate these cells and to change their growth conditions, and they can make the cells differentiate, but it is hard to make them all differentiate at the same rate and into the same kind of cell.[23] Furthermore, since the result of any bout of differentiation is a mixed culture, scientists must sort these cells to isolate the types they need. Antibiotics can purify the culture of foreign matter and contaminants, but researchers use a technique called 'flow sorting' to sort the cells themselves. This technique separates cell types based on the characteristics of their surfaces to obtain all one kind of cell, such as muscles cells, nerve cells, etc.[24] Yet even with this sorting method, the results are always a certain percentage pure and are not completely homogeneous. Complicating the process further, these cells have the tendency to differentiate spontaneously, and they may also have the capacity to revert after sorting.[25]

[22] NIH, "Stem Cell Basics," section VI.
[23] "Medical Promise of Embryonic Stem Cell Research," PCBE transcript.
[24] Ibid.
[25] PCBE, "Research and Therapy," 116.

Feeder layers. Another problem for the goal of homogeneity is the presence of "feeder layers" in cell preparations. Researchers grow and maintain human embryonic stem cells on top of mouse cells that have been irradiated to prevent their division. The mouse feeder layers secrete a substance that keeps the stem cells relatively undifferentiated while they divide.[26] Although this method has been very helpful and productive in the past, it does create problems. First, it introduces the possibility of endogenic viruses, or viruses that originate in the mouse cells and contaminate the human ones. Second, regardless of whether any contamination has taken place, any treatment in patients with lines maintained in this way qualify as "xenotransplants," or cross-species transplants, for Food and Drug Administration purposes. This qualification brings stringent guidelines and requirements that scientists prefer to avoid.[27] Recently, researchers have developed ways to use human feeder layers instead, but many of the older preparations still contain mouse cells.[28] To prevent contamination and increase homogeneity, scientists can perform "single-cell cloning," where they keep a single cell isolated so that all of its progeny will be completely identical. This approach produces a culture that is genetically homogeneous, at least to begin with.[29] Even in these populations, growth conditions can influence rates of differentiation.

Mutations. All cell division introduces the possibility of mutations. Since stem cells are cultivated into lines that are subjected to prolonged division, mutations can accumulate over time.[30] It is possible that "subtle changes in the growth conditions or other variables may give rise to 'selective pressures' that can

[26] Ibid., 117.
[27] American Academy for the Advancement of Science (AAAS), "AAAS Policy Brief: Stem Cell Research," available at www.aaas.org (2 April 2005).
[28] NIH, "Basic Questions," section III, B.
[29] PCBE, "Research and Therapy," 117.
[30] "Medical Promise of Embryonic Stem Cell Research," PCBE transcript.

increase the heterogeneity in a stem cell preparation by favoring the multiplication of advantaged cell variants in the population."[31] These mutations can take even a single-cell cloned population and make it heterogeneous. More seriously, there is the possibility for these cells to become tumorigenic (tumor-causing). In a study of the mutation rates of certain mouse cell lines, researchers found that the mutations that did occur resulted in the elimination of the dominant tumor-suppressing genes.[32] If these tissues are going to be present in humans for 20 or more years, they need to be safe. Since stem cells can turn into any other kind of cell, including tumors, scientists do not simply inject or graft stem cells in an undifferentiated state. They must first stimulate the cells to develop into certain types.[33] Unfortunately, as many experiments involve mice or rats with very short lifespans, it is difficult to identify long-term effects of these treatments. The possibility for tumorigenicity represents a major obstacle to plans for large-scale testing on human subjects.

Immune system. Since stem cells are foreign to a patient's body, the patient's immune system fights the grafted or injected cells. There are both theoretical and practical options for dealing with this problem. There are, of course, powerful immunosuppressive drugs that transplant patients already use. Though these are indeed available, scientists are trying to find other ways of precluding immune rejection, as these drugs have many adverse side effects. Another option is to derive hundreds of different kinds of stem lines with the greatest possible variations in order to find the best match for each patient. Unfortunately, this is not very practical. "Sequestering grafts" could possibly be developed, where cells act on the body but are not themselves acted on by the immune system, but this is only

[31] PCBE, "Research and Therapy," 118.
[32] "Medical Promise of Embryonic Stem Cell Research," PCBE transcript.
[33] Ibid.

speculative at the moment.[34] Other speculative solutions include genetically modifying stem cells so that the body does not see them as foreign or possibly developing "universal donor" cells that offend no patient's system. The immuno-suppression problem is decades old, but stem cells offer potential solutions.

Therapeutic cloning. In addition to the theoretical solutions to immune rejection, there is also the demonstrated possibility for nuclear transfer, or 'therapeutic cloning.' This method involves taking a cell from a patient and fusing it into an enucleated egg, which forms a new blastocyst. The process is then the same for normal culturing, where the ICM cells are extracted, isolated, cultured, and the lines are derived. Since the cells come from the patient's own body, the body recognizes them as such and does not reject them. However, this method is not feasible for large-scale patient care. It is too time-consuming and costs far too much to derive stem cells using this technique for each patient individually. Scientists instead hope that the results of experimental uses of nuclear transfer may point the way to more practical solutions.

Adult stem cells. As adult stem cells have shown proven results in bone marrow transplants and other treatments, observers often contend that these cells might be sufficient to achieve scientists' goals without the ethical problems inherent in the use of embryos. However, the two qualities that researchers most prize in embryonic stem cells are present in only a limited capacity in their more developed counterparts; the latter have far less capability to divide indefinitely, and they are limited in the range of cell types that they can become.[35] That said, recent

[34] Ibid.

[35] Kenneth R. Boehler and Anna M. Wobus, "Myocardial Aging and Embryonic Stem Cell Biology," in *Stem Cells: A Cellular Fountain of Youth,* ed. Mark Mattson and Gary Van Zant (Amsterdam: Elsevier Science, 2002), 169.

developments suggest that these cells have more plasticity than scientists originally expected.[36] Some researchers have been able to coax adult stem cells of one type into another in ways heretofore deemed impossible. It remains to be seen how much more of a capacity for differentiation these cells have. If scientists can make adult stem cells pluripotent, then these cells would have advantages over embryonic stem cells, as the former are less likely to become malignant and less prone to immune system rejection.[37] The prevailing wisdom is that, despite these developments, adult stem cells do lack certain biological properties found only in embryonic stem cells, and that research on both of these types of cells should continue. Both of these areas of research are still in the very early stages, and it is likely that the resultant treatments will be suited to different kinds of diseases.

Research Results and Unanswered Questions

Selected studies. In one study at Johns Hopkins, researchers gave rats and mice a virus that destroys motor neurons and permanently paralyzes them. The scientists injected the animals with human stem cell derivations, and within a matter of a few months, these animals had regained part of their ability to walk and to support their own weight.[38] The precise role played by the stem cells is unclear. Chemicals secreted by the human cells may help the animals' own cells rescue and regenerate themselves. A recent study at Memorial Sloan-Kettering Cancer Center in New York suggests similar results in mice treated with these drug-like chemicals. These mice had an inherited heart defect that is normally fatal without exception,

[36] "Medical Promise of Adult Stem Cell Research (Present and Projected): Dr. Catherine Verfaillie," transcript of the proceedings of the President's Council on Bioethics, 25 April 2002, available at www.bioethics.gov (2 April 2005).

[37] Boehler and Wobus, "Myocardial Aging," 168.

[38] Douglas Kerr et al., "Human Embryonic Germ Cell Derivatives Facilitate Motor Recovery of Rats with Diffuse Motor Neuron Injury," *Journal of Neuroscience* 23 (2003): 5137.

but stem cell secretions helped their own tissues to repair and regenerate themselves.[39] Oddly enough, the researchers injected the cells into pregnant mother mice, not directly into the embryos of the mice with the damaged hearts. The cells could not cross into the developing mouse embryo, but the chemicals they secreted were able to, and thus the damaged heart had the opportunity to repair itself before birth. The complete success of the heart repair suggests that a strong focus of stem cell research in future will be on such chemicals. In addition, a study in April 2004 at the University of Pittsburgh Medical Center showed that injections of adult stem cell derivations into damaged heart tissue in humans improved heart function.[40] This study was the largest and most reliable of its kind; it was randomized, it included a control group, and it involved a relatively large number of patients. The preliminary results of these and other studies are consistent with researchers' hopes for both embryonic and adult stem cell research.

Unanswered questions. The main question that scientists are trying to answer is, how do stem cells work with cells that are already present? Scientists do not know whether the benefits of stem cells are due to their much-vaunted potential to be any type of cell, or whether the factors they produce simply allow cells to help themselves. If stem cell chemicals are the primary mechanism of aid, the focus then shifts to finding ways to isolate and study these chemicals with the goal of producing them synthetically or in drug form. In addition to these theoretical questions, scientists disagree over which biological entities qualify as embryos. Technology blurs formerly distinct lines. For instance, it is possible to create a "parthenote,"

[39] Diego Fraidenraich et al., "Rescue of Cardiac Defects in *Id* Knockout Embryos by Injection of Embryonic Stem Cells," *Science* 306 (2004): 247-248.

[40] "First Randomized Trial of Adult Stem Cell Injections In Heart Failure Patients Shows Benefit," *Science Daily*, 25 April 2004, available at www.sciencedaily.com (9 January 2005).

which is an egg that is stimulated to form an embryo.[41] Also, it is possible to use a rabbit or other animal for the enucleated egg in performing a nuclear transfer, so that the embryo and resulting stem cells have rabbit mitochondria and human nuclei.[42] In terms of structure, these embryos are similar enough to be treated and classified as such, but they start to expand the limits of the definition of an embryo. These limits, as they are maintained or expanded, have consequences for the ethical debates over this research.

IVF 'spares.' Finally, many supporters of stem cell research often say that the embryos used for research come from in-vitro fertilization (IVF) clinics that would have discarded them. While this is true in many cases, it is not actually the best way to obtain optimum results from this research. The cells at IVF clinics are often frozen at a stage when they are not well-characterized, and they subsequently have to be brought up to the stage of the blastocyst, if it is going to be possible to derive any stem cells at all (that is, if an inner cell mass is even present or can be manipulated into forming).[43] In other words, scientists can use these discarded cells, but they are of generally lesser quality in terms of their biological capabilities. While this is not a scientific disagreement as such, it casts a small shadow on any claims that stem cell research only involves discarded embryos.

Embryonic stem cell research has a long way to go before it can realize the enormous potential that scientists and observers predict of it. It is easy to understand their excitement, considering the nature of these cells and their apparent capabilities. That the public appears to be taking notice of the research in

[41] "Medical Promise of Embryonic Stem Cell Research," PCBE transcript.
[42] Ibid.
[43] Ibid.

this area more than in any other may be due to the controversy over the use of the embryos. However, I think the public's fascination is also due to the hope that many people have for the future benefits of this research for their loved ones and for themselves. People have grown accustomed to scientific miracles, and they have faith that modern technology and modern science will continue to improve their lives. However, there is another side to this limitless progress and quest for knowledge, and in many ways these same people are unsure about the consequences of tampering with human life. It can be difficult to balance sympathy for those suffering from diseases with uneasiness or outrage over the destruction of what some deem to be human beings. It is to these concerns that we now turn.

CHAPTER TWO

SEARCHING FOR BRIGHT LINES

Human embryonic stem cell research has been controversial since its inception. As it necessarily involves the destruction of human embryos, discussion of this matter often resembles the entrenched abortion debate, in which the moral status of the embryo plays a key role. This disagreement over the status and concomitant rights of the embryo is the central reason for much of the continuing controversy, and one's position on this issue likely determines one's initial views on the permissibility of this research. However, the unique circumstances of in-vitro fertilization (IVF) pull the traditional debate in entirely new directions. Stem cell research presents observers with complicated ethical quandaries, whose moral precedents are often contestable. Yet there are ethical theories and principles that provide a framework within which to consider the relevant moral features of the research; "utilitarian" arguments weigh the elements of a situation and try to maximize the overall good, while "deontological" arguments appeal to the existence of principles that all have a duty to obey. Individual arguments generally reflect this distinction, but individual people often incorporate elements of both kinds in their decisions.

This chapter inquires into the concept of potential in the context of the current debate. I review the major arguments for the moral status of the embryo, and examine the capacities commonly offered by ethicists as the basis for the

possession or conferral of human rights. Next, I consider the unique circumstances of, and ethical questions raised by, the practice of IVF, which I then contrast with the questions raised by therapeutic embryo research and the practice of abortion. Finally, this chapter reviews the concerns many observers have about respect for human life and its potential commodification, as well as concerns about the lack of clearly defined limits on ethically suspect technologies and practices.

The Nature of Potential

Two Senses. Many of the arguments about the status of the early embryo reference the idea of its potential or lack thereof. Though the term 'potential' is in no sense technical and is widely used, there is some confusion over its meaning in the context of the debate over stem cell research. In this context, one can use 'potential' in a practical or probabilistic way, to indicate the likelihood of an outcome such as birth. One can also use it as a biological term, to indicate the properties or capacities that an entity could have in virtue of its current form. These two senses of the term have arisen as a consequence of modern medical technology, and often participants in the current debate are unaware that their use of the term assumes one of these two meanings.

Practical Context. Those favoring the practical meaning argue that while it makes sense to speak of the developing embryo's potential in the body of a woman, the potential of the embryo *ex vivo* is far more problematic. For some, the potential of any entity cannot be spoken of "independently of the context in which that entity exists, and independently of the probability of that entity developing in a certain

way."[44] IVF clinics discard or freeze the vast majority of unused embryos; they will never enter a uterus. Since there is no possible way for these embryos to develop, they cannot be "potential persons," and "therefore using them in research involves no loss of possible life."[45] An embryo, some argue, is not a future person if there is no practical way for it to be born. They reiterate this point in the context of Somatic Cell Nuclear Transfer (SCNT), or cloned, embryos. Experiments with animals have shown that it is extremely difficult to implant cloned embryos and bring them to term. Furthermore, opposition to the idea of reproductive cloning remains vigorous in most countries. Given these facts, it is unlikely that any embryo produced by SCNT could ever be born; to some, this indicates that their use is less morally problematic than that of a "normal" embryo.[46]

Biological Properties. Others argue that the potential of an organism does not depend on its external circumstances, but rather on the kind of thing that it is. In the case of two embryos, one implanted and one in a Petri dish, the potential of the embryos is the same, regardless of their differing probabilities for further development. One commentator argues that potential must be biological rather than merely "statistical."[47] If potential is reduced to possibilities, then there are simply too many of these, allowing for external circumstances; an acorn could potentially be an oak tree, but it could also be lunch for an animal or trash in a landfill. Claims about potential are instead about its potency, or "the power it possesses in virtue of

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[44] Peter Singer and Karen Dawson, "IVF Technology and the Argument from Potential," in *Embryo Experimentation,* ed. Peter Singer et al. (Cambridge: Cambridge University Press, 1990), 77.

[45] L. M. Guenin, "Morals and Primordials," *Science* 292 (2001): 1659-1660; quoted in President's Council on Bioethics "Recent Developments in the Ethical and Policy Debates," *Monitoring Stem Cell Research* (Washington, D.C.: Government Printing Office, 2004), 87.

[46] Nikolaus Knoepffler, "Stem Cell Research: An Ethical Evaluation of Policy Options," *Kennedy Institute of Ethics Journal* 14, no. 1 (March 2004): 65.

[47] Stephen Buckle, "Arguing from Potential," in *Embryo Experimentation,* ed. Peter Singer et al. (Cambridge: Cambridge University Press, 1990), 90.

its specific constitution."[48] The embryo in the womb and the one in the petri dish have the same potential, because given the appropriate environment, both will develop into a human being.

Human actions. It is clear that a biological entity such as an embryo needs favorable conditions in which to realize its potential; it is not clear whether its potential should be regarded as contingent on the presence of these conditions. Moreover, human actions usually determine the circumstances of an embryo, further complicating the disagreement. One can draw a distinction between situations where human positive action is required for further development and situations in which development occurs on its own in the absence of direct human intervention to prevent it. An implanted embryo continues to develop unless humans interfere, but an embryo in the laboratory requires that humans actively use technology to place it in a womb if it is to develop.

Peter Singer uses this distinction to argue that sperm and eggs mixing in a dish have the same status as that of an embryo. Prior to IVF technology, some argued that an embryo was not like an egg and sperm separately, due to their differing probabilities of becoming a child. Singer contends that, for a dish containing an egg and some sperm, there is an average success rate of fertilization of 80% (in 1990). Combining this figure with a rate of success of 10% for all embryos implanted in a uterus, this yields an 8% chance of the egg and sperm producing a child, as opposed to 10% for an already-formed embryo.[49] The technique of micro-injecting small amount of sperm into the egg provides a higher rate for any one combination of the two. He relates this to the idea of potential:

[48] Ibid., 95.
[49] Singer and Dawson, "IVF Technology," 77-79.

> Whereas the embryo inside the female body has some definite chance of developing into a child unless a deliberate human act interrupts its growth, the egg and sperm can only develop into a child if there is a deliberate human act. In this respect the embryo in the laboratory is like the egg and sperm, and not like the embryo in the human body. This is of fundamental importance for the notion of potential, because lurking in the background of discussions of the embryo's potential is the idea that there is a 'natural' course of events, governed by the 'inherent' potential of the embryo. We have seen, however, that this notion of 'natural' development, not requiring the assistance of a deliberate human act, has no application to the IVF embryo.[50]

This view of potential is not universally shared, but any proponent of a biological meaning of potential who invokes the concept of 'favorable circumstances' needs to decide whether humans are required to provide those circumstances.

Boundaries for Moral Status

Continuity. Much of the debate over the moral status of the embryo amounts to a search for boundaries and sorting conditions. Human beings clearly have rights, but the question is whether the early embryo is a human being, and at what point it becomes one if it does not yet qualify. Many commentators argue that only fertilization is capable of serving as an appropriate boundary, because it is the point at which a new individual enters the world. After this point, the individual is the same throughout the development process. Certainly there are changes that occur and stages that can be marked off for convenience, but through it all, it is the same embryo that is on a continuous path toward birth.[51] This is the argument from continuity: if one has rights at birth, there is no special point in the development of the embryo or fetus at which these rights suddenly exist where they previously did not. Only fertilization, which begins the continuous process, can be a meaningful point at which rights originate.

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[50] Ibid., 87.

[51] President's Council on Bioethics (PCBE), "Recent Developments in the Ethical and Policy Debates," *Monitoring Stem Cell Research* (Washington, D.C.: Government Printing Office, 2004), 77.

Discontinuity. Critics of this view believe that the process of development is itself significant to the possession of rights, so they try to draw attention to certain "meaningful discontinuities" in embryonic development. These are capacities that the embryo gradually develops that should be taken into consideration: the capacity to feel pain, signs of neural functioning, the ability to exist outside the body of another, and other such things.[52] Some contend that the potential of the embryo to develop these capacities makes them special, but it does not give them rights equal to fully developed humans. There are problems involved in tying rights to capacities, but it is important to note that some sort of line must be drawn after which the organism has certain rights, even though the developmental process is gradual.[53] Some supporters of embryonic stem cell research believe that implantation could serve as this line, because it is at this point that true continuity and development begin. However, this argument grounds the rights of an entity in external circumstances. Some people reject this view, because they believe rights to be inherent within an organism and not subject to conferral or revocation based on particular circumstances.

Individuality. The individuality argument is the most contentious, partly because it retains its intuitive appeal despite the existence of some very good objections to it. At fertilization, there is a new genetic combination constituting a certain individual, and this combination does not undergo major changes at birth or throughout a person's life. Given that each specific embryo in a womb will develop into a specific person if allowed to do so, and that everyone was once a unique

[52] Ibid., 79.
[53] For more on this point, see the section entitled 'human rights' below.

embryo, the embryo is identical to a future human person.[54] This conclusion, when applied to the early embryo, is directly challenged by the phenomena of twinning and the formation of chimeras (when two embryos fuse to form one), which can occur in the first two weeks of gestation. Some argue that "the process of becoming *a* human being has not yet ended" if there is the possibility that one embryo can become two, or vice-versa.[55] Thus, the embryo cannot be said to be an individual until after the first 14 days, and given that individuality is essential to personhood, the embryo is not yet a person.

Common dismissals of this argument often fail to understand that it is advanced as a counterexample to the argument from individuality. First, critics point out that the rate of twinning is very low, and that it appears to be caused more by the external environment than by any drive within the embryo itself.[56] Some also point to the very obvious fact that an embryo cannot become two if it is not first a single individual embryo.[57] One commentator simply declared that life begins at conception for single births, and at the point of twinning for twins.[58] However, the twinning objection is not primarily an attempt to draw a different line for the beginning of life.[59] It also does not entail that the embryos are not numerically individuals prior to twinning, as in the second objection. The issue of twinning is a conceptual problem for the argument from individuality. As such, it does not matter if twinning rarely happens, if its causes are known, or if one can look back in

[54] Berit Brogaard, "The Moral Status of the Human Embryo: The Twinning Argument," *Free Inquiry* 22, no. 1 (Winter 2002): 45.
[55] Ibid., 46.
[56] PCBE, "Ethical and Policy Debates," 80.
[57] Don Marquis, "Stem Cell Research: The Failure of Bioethics," *Free Inquiry* 22, no. 1 (Winter 2002): 42.
[58] Alfonso Gómez-Lobo, "On the Ethical Evaluation of Stem Cell Research: Remarks on a Paper by N. Knoepffler," *Kennedy Institute of Ethics Journal* 14, no. 1 (March 2004): 79.
[59] Though it is usually for this reason that 14 days is a commonly proposed boundary for the beginning of individuality.

hindsight and declare that an embryo never twinned. The question is, what is the status of a given embryo *e* at time *t*, where *t* is prior to 14 days after fertilization? If *e* is said at *t* to be genetically and continually identical to a future human individual, one then has to account for what happened to that posited future individual in the event of twinning.

To illustrate this problem, one can posit the existence of an early embryo with a unique genetic blueprint, say, Becky. On Day 8, the cells that are Becky split into two, forming two embryos. Which is Becky? There seem to be no good reasons for saying that one embryo is Becky and that one is not, as they share the same genetic code, and the process is symmetrical. They cannot both be Becky if the individuality argument is right, as one embryo was supposed to be identical to a single future individual, not two separate individuals. One answer is that Becky ceased to exist and that two new individuals were formed, say, Nancy and Fran, but this would imply that somehow Becky died without leaving any remains.[60] A similar example could be given for chimeras. The two embryos, Nancy and Fran, are identical to two future human babies, but then they fuse. The new embryo, Becky, carries parts of the genetic codes of both Nancy and Fran. Yet there were two individuals and now there is only one, so either Nancy or Fran or both have ceased to exist, again without leaving a trace.[61]

There are certainly ways that proponents of the individuality argument can attempt to overcome these problems. Indeed, it is easy to see why the argument retains its intuitive appeal. All people were once embryos, so there is a sense that

[60] Helga Kuhse and Peter Singer, "Individuals, Humans and Persons: The Issue of Moral Status," in *Embryo Experimentation,* ed. Peter Singer et al. (Cambridge: Cambridge University Press, 1990), 66-67.

[61] Ibid.

they should treat others as they were treated; people are glad that no one aborted or destroyed them for research, so they should not in turn destroy other potential people and deprive them of a life that they would value.[62] Yet people are glad as well that their parents did not use contraceptives, or that their parents and grandparents even met at all, and that any number of other contingent events happened. It becomes clear that the life of an individual living person with a history of thoughts and feelings is highly valued by that person, but he or she very well could have failed to exist, and someone else would have existed instead and been equally glad to have been born. No one mourns the individuals that never existed because their prospective parents used contraceptives, even though a person today whose parents did not is quite grateful for that fact. However, it can still be difficult to simply dismiss the potential lives of future persons, even if the persons themselves would never live to be aware of this lost potential.

Natural Loss. The argument from "natural loss" claims that human sentiment is relevant to the moral status of the embryo. In normal procreation, the majority of naturally created embryos fail to attach to the uterus, or succeed but later detach. Some commentators argue that if embryos are fully human persons with equal moral status to adults, this situation should be considered "a great fountain of tragedy and carnage," as so many human lives are being created and destroyed.[63] Those who are aware of this fact do not appear to be troubled by it, and this lack of any real concern perhaps indicates that the embryos do not have full moral status. Critics of this argument assert that the moral status of an entity should be independent of popular sentiment, and that it is quite possible for embryos

[62] Ibid., 72.
[63] PCBE, "Ethical and Policy Debates," 88.

to possess full moral status despite the fact that some find it counter-intuitive. They point out that the moral status of certain ethnic groups, for instance, should never be subject to popular whims. This is, theoretically, a good reply to the criticism. Popular sentiment is clearly not enough to establish moral status; instead, the argument merely indicates, for some, that there are good reasons to be suspicious that some people show sorrow for lost embryos in some contexts and not in others. It insinuates that few consistently view embryos as fully persons. For people trying to figure out the issue of stem cell research, their own lack of sympathy for natural loss may be relevant in forming their decisions about the embryo's moral status.

Sentience. The final contender for an appropriate line at which to begin moral status is the development of a rudimentary capacity for sentience. Proponents of this view argue that sentience is more than just a "meaningful discontinuity" in development, but that it is the point at which an organism has interests. It is morally relevant, they claim, that prior to developing the capacity to feel pain, the embryo cannot in any sense care about its own welfare, or even be aware of anything that is done to it. Thus, it cannot be said to be harmed by its own destruction in any morally relevant sense.[64] Critics of this position are quick to note that relying on the presence of certain capacities for the possession of human rights is dangerous, as some humans deserving of these rights might nonetheless lack the required capacity. Yet it is not possible to simply discuss the temporal origins of the acquisition of human rights without venturing onto this dangerous ground, and inquiring as to the relevant criteria for the possession of human rights.

[64] Kuhse and Singer, "Individuals," 73.

Sentience. If it is sentience that bestows upon people their rights, it is clear that this quality is shared by most higher-order animals as well. These animals have the capacity to feel pain and actively try to avoid it. In addition, if sentience is the relevant criterion, people who have certain brain injuries or those in comas may be excluded from these rights if they cannot properly register pain. However, since even these patients tend to register pain in some section of the brain or nervous system, it is not their exclusion that is the primary concern with the criterion of sentience. It is rather that most humans prefer that animals be excluded from those rights that only humans enjoy, so most judge the capacity for sentience to be overly permissive.

Biological Humanity. It is a logical move to posit membership in the human species as the required characteristic for the possession of human rights. Yet this cannot be the only basis humans have for their rights, as it is unacceptably arbitrary. If intelligent aliens were to be found that had relationships, felt pain, had hopes and dreams, and experienced love, presumably it would not be acceptable to treat them like animals. This idea is often espoused in science-fiction movies, wherein the audience sympathizes with an android or robot who is denied human status despite possessing most human characteristics. Also, if group membership alone is an acceptable basis for rights, then perhaps other arbitrary group-based distinctions are justifiable, such as race. Something else must be unique about humans that gives them value.[65]

Rationality. Unlike animals, humans alone have rationality and the ability to be moral agents in a community. No one considers predatory animals evil when

[65] Roger Brownsword, "Bioethics Today, Bioethics Tomorrow: Stem Cell Research and the 'Dignitarian Alliance'," *Notre Dame Journal of Law, Ethics and Public Policy* 17, no. 1 (2003): 22.

they kill their prey, because morality does not meaningfully apply to those who cannot reflect on their actions. Humans as a community have the ability to form partnerships and establish a system of reciprocity, whereby moral standards are upheld. The objection to this is that infants and young children, as well as some mentally challenged people, cannot be considered moral agents. Those in comas and those who are senile may be excluded from consideration as "rational." However, it could be claimed that most humans get their rights from the possession of this capability, but others get them because they remain part of the community despite their inability to participate fully. This would indicate that some humans have inherent rights due to their capacities, but that others have these rights extended to them by the larger community.

Some commentators are comfortable with the idea that rights can be conferred, while others contend that rights are inherent or natural, regardless of human actions or decisions. Proponents of the latter view argue that "these properties cannot be given or granted. An organism either has them or does not have them."[66] Some who believe rationality and moral agency are the best foundations on which to base rights recognize that "there is a tension between the logic of this view, which restricts moral status to agents, and the jurisprudence of human rights, which allows moral status to all born members of the human species."[67] Those who believe rights are inherent in persons are disturbed by the idea that rights can be conferred, as it implies that the community could withdraw these rights if it so chose. The reply to this objection is that if the community finds this revocation of rights disturbing, it will presumably continue to protect those rights because it

[66] Gómez-Lobo, "Remarks," 79.
[67] Brownsword, "Bioethics Today," 41.

values them. This dispute is relevant to the status of the embryo, as some believe that this status is a fact to be discovered, while others assume it is a human decision. There is nothing about either of these positions that necesarily commands allegiance; whether one views rights as inherent, conferred, or a combination of the two is a function of one's previous beliefs and values.

Kinds of Humanity. It is possible to deny human rights to the embryo by claiming that the embryo is not yet a human being or person in some relevant sense. The reason for this denial is that there is an underlying assumption that all human beings have a right to life. Some observers instead grant that the embryo is a human being (in that it is a member of the human species), but contend that the sense in which an embryo is a human being differs from the sense in which humans have a right to life.[68] This marks a distinction between "biological" humanity and "moral" humanity. Critics of this view find such a distinction unacceptable, dangerous, and overly subjective. It would certainly be preferable if human rights were based on firmly established and objective criteria that produced no difficult borderline cases. Unfortunately, the contentious status of the embryo brings into sharp relief the difficulties in establishing a firm foundation for these rights.

In-Vitro Fertilization

The practice of in-vitro fertilization raises unique ethical questions. Since unused embryos in IVF clinics are either perpetually frozen or discarded, some argue that they are already doomed. These spare embryos should be used for research "to at least redeem some possible good from their existence and

[68] Kuhse and Singer, "Individuals," 69.

unavoidable demise."[69] Many observers who believe that embryos are persons still wish to balance this status against the embryos' lack of a future. They do not wish to see embryos destroyed, but they sympathize with people who have diseases that may be helped by stem cell research. Gene Outka argues that the application of the principle of "nothing is lost" to this situation allows experimentation on discarded IVF embryos.

"Nothing is lost." The principle of "nothing is lost" was originally meant to establish exceptions to the general prohibition against taking innocent life. The principle asserts that one may kill when the innocent life will die anyway, and when other innocent life could be saved by this act. It usually addresses narrow situations set up in thought experiments, rather than acting as a justification for a policy of such killing; Outka admits that this application of the principle stretches it almost to the breaking-point.[70] He defends it as "nothing *more* is lost" or "less is lost" because at least someone will be potentially saved. Critics argue that the principle only applies to situations beyond human control, but the doomed embryos are a result of human actions. They charge that commentary often makes the embryos' plight sound like a natural situation that is regrettably beyond human control.

Outka believes that "nothing is lost" may be the only choice for such created situations. It is simply the case that the decision to create these embryos has been and continues to be made, producing a situation wherein large numbers of embryos are alive but have no future prospects.[71] These are special circumstances, and one

[69] PCBE, "Ethical and Policy Debates," 85.
[70] Gene Outka, "The Ethics of Human Stem Cell Research," *Kennedy Institute of Ethics Journal* 12, no. 2 (2002): 193.
[71] PCBE, "Ethical and Policy Debates," 85.

does not have to approve of the situation in order to produce some good from it.[72] The ethical problem does not originate in stem cell research as such, but in the practice of IVF that creates these embryos. The alternative to their use for research is to refuse to allow IVF to continue, and to deny that couples have the right to pursue this treatment; otherwise, the situation will continue to demand some kind of resolution.[73]

Intentions. Commentators like Outka often occupy a "middle ground" position. They believe that it is possible to redeem some good from what they consider to be a tragic situation, without encouraging further tragedy. This leads many to support research on IVF discards while condemning "therapeutic" research, in which scientists create embryos specifically for research purposes. For them, the difference in intentions between the two is paramount. The creation of embryos in IVF clinics is done for a "noninstrumental rationale, namely, the promotion of fertility."[74] These embryos were not solely created to serve the interests of third parties, and their destruction was not intended "*from the start* as necessarily part of what one does."[75] These people argue that when scientists create embryos solely for research, they embrace and fully intend the embryos' destruction. Charles Krauthammer makes this distinction, calling IVF spares "unused and ultimately doomed," as opposed to those embryos "created purposely and wantonly for nothing but use by science."[76] This is a popular position that many consider to be a good compromise between respect for the embryo and the desire for scientific progress.

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[72] Outka, "Ethics of Human Stem Cell Research," 206.
[73] Ibid., 193.
[74] Ibid., 203.
[75] Ibid.
[76] Charles Krauthammer, "Why Lines Must Be Drawn," *Time*, 23 August 2004, 78.

This view has opponents on both sides of the debate. Many people feel that it is inconsistent to draw a distinction between the practice of IVF and the creation of embryos for research, and that one should either condemn or accept them both. These critics assert that in creating embryos for IVF, "there is a built-in presumption—really, an intention—that even most of the transferred embryos will die," even aside from the embryos that are not transferred.[77] One commentator noted that opponents of therapeutic stem cell research often appear unaware that at its inception, "the existence of in vitro fertilization depended entirely on embryo research and that every variation or innovation in IVF protocols involves experimentation on human embryos."[78] Nevertheless, these opponents could argue that the intentions of the researchers were always the promotion of fertility.

The problem with arguing about intentions is that they are private to each individual and thus difficult to discern; one could as easily claim that researchers intend only the advancement of scientific knowledge or to achieve profits for themselves. Yet most people occupy this middle ground and continue to maintain that there is a meaningful distinction between the creation of embryos for IVF and their creation for general research, despite the charge that this position is inconsistent.[79] There may indeed be a valid distinction between the two, but it is likely that these people maintain their position primarily because it feels intuitively right to them. They see the promotion of life in IVF and its destruction in stem cell research, and they judge the two differently according to their own consciences.

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[77] Michael Kinsley, "The False Controversy of Stem Cells," *Time*, 31 May 2004, 88.

[78] Paul Lauritzen, "Report on the Ethics of Stem Cell Research," in *Monitoring Stem Cell Research*, President's Council on Bioethics (Washington, D.C.: Government Printing Office, 2004), 246.

[79] Outka, "Ethics of Human Stem Cell Research," 203.

Abortion and IVF. While many of the ethical disputes that arise as a consequence of IVF also apply to abortion, there are ethically relevant differences between the two. In the context of the abortion debate, ethicists often weigh the rights of the embryo against those of the mother. In stem cell research, they weigh the rights of the embryo against the potential for treating or curing diseases. Another difference is that it is easier to consider the potential of the embryo when it is already attached to a womb, as opposed to being in a laboratory, where no womb is ever going to be available. Opponents of abortion find it relevant that the embryo in the womb is already a "power underway" that will follow a self-directed process toward birth unless it is actively prevented from doing so.[80] Of course, laboratory embryos cannot progress on their own without many positive human actions. However, opponents of stem cell research note that in most cases of abortion, the creation of the embryo was an unintended consequence of the mother's actions. In any case of IVF, more embryos are created than implanted, though it is debatable whether the death of the spare embryos is intended or whether it is an unfortunate corollary. Some observers equate stem cell research with abortion, while others believe these distinctions are relevant.

Though all three involve the destruction of embryos, IVF treatments for infertile couples tend to be far less controversial than stem cell research and abortion. People appear to be more sympathetic to couples who wish to conceive but cannot than to the needs of researchers or of women who do not want to carry children to term. For many, IVF primarily promotes life—even though it always results in some embryos' deaths—so they look upon it more favorably. Their sympathies, more than other considerations, guide their opinions.

[80] Ibid., 189.

Other Concerns

Respect. One of the aspects of stem cell research that people find disquieting is that the embryo is at least some form of human life, regardless of its ultimate moral status. As such, it should be accorded a measure of respect. Almost every commentator agrees to this, but some charge that respect without protection is meaningless. They contend that scientific research, including embryo research, is governed by a "respect for human subjects" principle, which entails that scientists may not intentionally harm their research subjects.[81] This is the strongest version of respect for the embryo, because it depends on the idea that embryos have the full moral status of adults. Most people instead confer on embryos a "special respect" that acknowledges their genetic humanity, but allows for some form of experimentation. Proponents of special respect hold a variety of positions on what this respect should actually permit or prohibit.[82]

Critics maintain that it is inconsistent with any form of respect to actively destroy that which is respected. One critic caustically remarked that this kind of respect was "an odd form of esteem, at once high-minded and altogether lethal."[83] However, given the existence of spare IVF embryos, others question "how flushing them respects them more, or is less evil, than employing them for research."[84] These commentators maintain that respect for the embryos is just as incompatible with discarding them as with performing research on them. It may be a consistent position to maintain that one should fully respect every embryo, but many people find it unsatisfying that such a position saves no embryos.

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[81] Marquis, "The Failure of Bioethics," 41.

[82] PCBE, "Ethical and Policy Debates," 83-84.

[83] Daniel Callahan, *Hastings Center Report* 25, no. 1 (1995): 39; quoted in Paul Lauritzen, "Report on the Ethics of Stem Cell Research," in *Monitoring Stem Cell Research*, President's Council on Bioethics (Washington, D.C.: Government Printing Office, 2004), 240.

[84] Outka, "Ethics of Human Stem Cell Research," 207.

Commodification. Though observers disagree over respect for the embryos, most find common ground over concerns that life is becoming a commodity, and that boundaries to research are either nonexistent or formed by default. When a couple donates an unused embryo, they are not allowed to take compensation for it, as this is prohibited by almost every ethical principle against buying and selling human life and tissue products. Yet when a stem cell line is established from an embryo, this line can be patented and sold as a human artifact. Any results scientists obtain by using this line for research can then be claimed by its original developer, who will also reap the profits of any technological advances.[85] Market practices have determined the way funding and property rights are worked out by the parties involved, but many people are concerned that these practices will become dehumanizing as more and more biological material is patented and treated as property.

Lack of research limits. The scientific community progresses virtually on its own, and others merely watch and comment. This is troubling when the research begins to challenge the very boundaries of life itself. Scientists can combine human and animal tissues and genetic material, or create pseudo-embryos whose status is not clearly defined. Charles Krauthammer urges that "something as protean, elemental, powerful and potentially dangerous as the manipulation and re-formation of the human embryo" engenders a need to draw boundaries to such actions.[86] Gene Outka laments the lack of boundaries in current IVF practices and procedures, which are "substantially free of society-wide oversight…and in which the profit

[85] Lauritzen, "Report," 253-254.
[86] Krauthammer, "Why Lines Must Be Drawn," 78.

motive plays a large but ill-considered role."[87] Though there are many bioethics advisory boards that regularly consider these issues, they do not have a great deal of regulatory power. People can sense that the progress of science continues virtually unregulated, and this frightens them. New technologies outpace ethicists' attempts to clearly understand their implications. People wary of this research are not opponents of science, but concerned individuals who see danger in such a lack of foresight. They do not value the unchecked pursuit of knowledge above their own bioethical concerns.

Ethicists often pursue objective moral principles that are supposed to dispel all confusion and clearly determine the appropriate solution. People want to find the correct answer to a moral quandary or the correct theory that could give the answer, but ultimately, individuals combine or abandon the theories to suit their personal consciences. Proponents of stem cell research tend toward the use of utilitarian arguments that weigh various considerations to find the maximum good for society, which usually favors such research. Opponents tend to rely on deontological arguments that one has a duty to respect the human right to life of the embryo, and they consider the greater social welfare to be irrelevant to these rights. Yet these arguments, which purport to determine the relevant features of stem cell research, often fail to consider features that are important to many people. This is not to say that there are none who make decisions solely within one or the other of these frameworks. But those who lean toward considerations of duty may find themselves weighing benefits, and those who normally weigh benefits may consider certain principles to be inviolable. In one sense, the theories guide and limit discussion of

[87] Outka, "Ethics of Human Stem Cell Research," 206.

the relevant points under consideration. Yet for individuals making their own decisions, these lines are rarely so easily drawn, and people often seek a compromise. In such a situation, it is not only understandable that people desire to establish boundaries, it is fitting that they propose so many different ones.

CHAPTER THREE

GUIDANCE AND INTERPRETATION

Research on embryos can be particularly troubling to those whose faith plays a strong role in their lives. For them, this issue is of the utmost importance because it involves the origins and creation of life. People of faith desire their decisions on matters of life and death to be pleasing to God and consistent with the tenets of their religion. There are at least four sources of guidance available to these people: scientific data, reason and secular arguments, revered texts, and the traditions of their faith. This chapter focuses on the texts and traditions that various religious groups and individuals have used to obtain insight and answers to the ethical questions raised by IVF and embryonic stem cell research.

As we have seen, the ethical issues surrounding stem cell research are complex and lend themselves to personal solutions of the many conflicting elements. The addition of religious passages gives many guidance and justification for their views, but the use of these sources also requires some amount of interpretation. Even when people look to their religions for guidance, they ultimately form views on this research from their own interpretations of what is consistent with their faiths and values. Indeed, opinions within a particular faith with a shared tradition are often quite diverse, while people of different faiths may find that they have come to the same conclusions despite very different backgrounds. From the Christian tradition, I examine commonly cited passages from the Bible and consider some

general Christian arguments. I present the views of various Christian denominations, focusing especially on Catholic views, both mainstream and dissenting. Next, I consider Judaism and Islam in turn, as well as the Eastern religious faiths of Buddhism, Hinduism, and Taoism. Finally, I draw attention to the great emphasis placed on certain social concerns that is shared by almost all religious communities.

Christianity

Biblical References. Nowhere in the Bible is there an explicit answer about the precise beginning of personhood, but there are numerous passages that address the early development of life. These passages provide guidance for many Christians, although they often disagree among themselves about what the passages actually establish. All can agree that humans are made in the image of God (Gen. 1:27).[88] A bit more ambiguous are the many references to the womb:

> You knit me together in my mother's womb. (Ps. 139:13)
>
> The Lord called me before I was born,
> while I was in my mother's womb he named me. (Is. 49:1)
>
> Before I formed you in the womb I knew you,
> and before you were born I consecrated you. (Jer. 1:5)

Certainly these all point to the intimate involvement of God in the process of creation. However, some Christians assert that these draw attention to God's awesome foreknowledge of the future and his predetermined plans, more so than they indicate when a person begins to be present. In fact, the last verse says that God knew Jeremiah *before* he was in the womb, but this is not supposed to indicate that the future Jeremiah existed in some way prior to his conception. For some, it is

[88] Unless otherwise noted, all verses are from the New Revised Standard Version (NRSV).

instead about "the surety of what God plans."[89] As well, the metaphor of knitting together a person indicates that God is involved in the psalmist's formation, but it does not say when that which is knitted becomes the psalmist himself.[90] However, many Christians believe that God's involvement from the very womb, as well as his foreknowledge and plans for each person, indicate that a person is present. Others contend that they, too, believe a person is present in the womb, but that the verses are compatible with this presence beginning some time after the first days of development.

One passage has been very influential because it specifically addresses the status of the fetus, although the text does allow for diverse interpretations:

> When people who are fighting injure a pregnant woman so that there is a miscarriage, and yet no further harm follows, the one responsible shall be fined what the woman's husband demands, paying as much as the judges determine. If any harm follows, then you shall give life for life. (Ex. 21:22-23)

This text seems to indicate that the loss of the fetus is worth compensation, but it is not treated at the level of an adult human. If the "further harm" of the woman's death occurs, then the offender is executed. However, the NIV translation gives this passage as "If men who are fighting hit a pregnant woman and she gives birth prematurely but there is no serious injury," which seems to indicate that the baby survived. The "serious injury" that entails a life for a life could then be seen as the death of the fetus. This version includes a note that "had a miscarriage" is the alternate reading for "gives birth prematurely." Jewish tradition has always held this passage to refer to a miscarriage. The original Hebrew text is ambiguous and lends itself to divergent translations.

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[89] James C. Peterson, "Is a Human Embryo a Human Being?" in *God and the Embryo: Religious Voices on Stem Cell Research and Cloning*, ed. Brent Waters and Ronald Cole-Turner (Washington, D.C.: Georgetown University Press, 2003), 79.

[90] Ibid.

Following the traditional Jewish interpretation, it seems unlikely that any baby could have survived if its birth had been induced by a blow to the mother. Even if such a situation occurred, it would be far less common than the standard interpretation, and would be unlikely to merit the creation of a law. Nevertheless, translations of this passage differ and are uncertain, so it cannot be used to establish one position over another. This passage illustrates how people view their religious texts through the lenses of the beliefs they already hold. They see the same text, but they interpret it differently based on what they believe it does or should mean. It is helpful to remember with such a contentious issue that people of faith all have the same aim—to understand and do what is right—but they sincerely differ in their views about what that is.[91]

General Christian concerns. Certain issues and arguments appeal to shared Christian ideas but are not tied to any one denomination. Some Christians, following ideas of St. Augustine, believe that people are continually in danger of being corrupted. There is always a temptation to usurp God's powers and to use human powers to do injustice.[92] Stem cell research is one more place where these dangers are present, and Christians need to be aware of this when they make decisions about its permissibility. It is also relevant that the Bible passages noted earlier can be seen as indicating that human love for the unborn should begin before birth. The concept of *agape* or unconditional divine love is an integral part of the Christian faith. Instead of focusing on specific moments for personhood, it might be better to simply emphasize that God loved each person before birth, and so "human

[91] Ronald Cole-Turner, "Religion Meets Research," in *God and the Embryo: Religious Voices on Stem Cell Research and Cloning*, ed. Brent Waters and Ronald Cole-Turner (Washington, D.C.: Georgetown University Press, 2003), 17.

[92] Gene Outka, "The Ethics of Human Stem Cell Research," *Kennedy Institute of Ethics Journal* 12, no. 2 (2002): 176-177.

love should correspond to far-reaching providential action."[93] Yet even those espousing this view are unsure as to whether there is a difference between love for persons before they become self-aware, and love for persons who will never be self-aware or develop at all.

The debate over the beginning of personhood is, for many Christians, a debate about ensoulment. The soul is the part of the person that makes him or her an individual before God, with the hope for eternal life. It is then of great religious significance to understand when "ensoulment" takes place, especially in light of embryo research. Many appropriate points have been proposed, as considered earlier for personhood: conception, 14 days (because of individuation), 28 days (because of the debut of a heartbeat), as well as traditional events from centuries past, like "quickening" or when movement is palpable. However, if the chosen moment is after conception, there is a risk that one could be wrong.

The "Prudential Argument" considers this risk. It states that regardless of the ambiguity of ensoulment, the possibility of killing even one human being with a unique soul is so serious that it mandates that one refrain from killing any embryos. Any benefit from stem cell research would be finite, but the killing of an ensouled person causes infinite harm.[94] If this is a cost-benefit calculation, clearly finite benefits never outweigh infinite harm. Yet this strategic hedging of one's bets works the same way for plants and animals; if one cannot be certain which creatures possess a soul, one should refrain from destroying them.[95] An appeal to the capacities of humans and their minds is difficult because souls are supposed to exist

[93] Ibid., 190.
[94] Nikolaus Knoepffler, "Stem Cell Research: An Ethical Evaluation of Policy Options," *Kennedy Institute of Ethics Journal* 14 (March 2004): 59.
[95] Ibid., 60.

independently of the body and its capacities. Other Christians believe that this argument weighs the potential to help people who are sick against the potential of an embryo to have a soul. They know that suffering adults do have souls and can be helped, and they weigh that possibility more heavily than the possibility that a days-old embryo has a soul with the same status as an adult.[96] Others respond that the benefits of this research are also mere possibilities and are far from certain, and that this, too, should be taken into consideration. While these moral quandaries are common to all denominations, individual groups and sects have worked out solutions with which they can be comfortable, though certainly these decisions are never unanimous.

Catholicism. The modern Roman Catholic position is that a human being has a right to its own life from conception until death. Embryos and fetuses must be respected, protected, and treated as full persons. The Church's stance on these matters can be found in earlier declarations relating to abortion, but in *Donum Vitae*, it responded directly to the unique issues raised by the practice of in-vitro fertilization. These issues include the dominion of man over nature, the dignity of marriage, and the destruction of excess embryos. First, the Church affirms that man's proper place is one of dominion over nature, and basic scientific research is one aspect of this dominion.[97] However, there is always the temptation to go beyond the reasonable limits of this power when the means to do so are developed. The ability to do something, *Donum* argues, does not entail that it is morally permissible. In creating and destroying embryos, man "sets himself up as the giver of life and

[96] Peterson, "Is the Human Embryo a Human Being?" 85.

[97] Congregation for the Doctrine of the Faith, *Instruction on Respect for Human Life in Its Origin and on the Dignity of Procreation 'Donum Vitae'* (Vatican City, 1987), i, no. 2.

death by decree," and this kind of violent domination over fellow human beings can lead to terrible consequences as life is devalued and controlled.[98]

Though the Church sympathizes with the plight of infertile married couples, it gives five additional reasons why IVF is unacceptable, aside from the destruction of embryos. First, it is analogous to contraception, because it separates the "goods and meanings of marriage."[99] In other words, the conjugal act and procreation should never be separated, either by removing the procreative aspect through contraceptives, or by removing the conjugal act, as in the case of IVF. Second, this act of procreation is inseparably corporeal, as well as spiritual, so it should never take place outside the body.[100] Third, it takes procreation out of the hands of parents and establishes technology's dominance over the process. Fourth, all of these aspects deprive procreation of the "dignity which is proper and connatural to it."[101] Finally, marriage does not give parents the right to have children; it only gives them the right to the act that normally produces children. Children are not objects of ownership to be commissioned or obtained, but are instead gifts of God.[102]

Over and above these reasons, the main problem is that IVF regularly produces more embryos than can be implanted. *Donum Vitae* does not give suggestions of what is to be done with them, but instead laments their "absurd fate," in that there is neither a way to save them, nor any other morally licit action that can be done to them.[103] The Church is critical of any alternative technologies that could produce artificial embryos, transgenic hybrids, or embryos created and engineered without the ability to develop. Some scientists think these embryos could

[98] Ibid., II.
[99] Ibid., II, no. 4, section a.
[100] Ibid., II, no. 4, section b.
[101] Ibid., II, no. 5.
[102] Ibid., II, no. 8.
[103] Ibid., I, no. 5.

be less controversial because they have no potential, but *Donum* rejects this strategy because it too runs contrary to the dignity of the conjugal act and procreation itself. The Pontifical Academy for Life's statement on embryonic stem cell research echoes the messages of *Donum* and asserts that "a good end does not make right an action which in itself is wrong." It also declares impermissible the use of stem lines that are already in existence, because this would imply "material cooperation" and complicity in the original illicit intentions of those who derived the lines.[104]

It is interesting to note that the language of these documents heavily emphasizes "rights" and is careful never to make reference to utilitarian-sounding judgments like "best for the promotion of well-being." This leads to odd rights, such as a child's right to be conceived by married parents who are the only two genetic donors. If a married couple obtained the services of a sperm or egg donor in conceiving and then raised that child as their own, this would violate the child's rights.[105] It seems that this might be better described as the "optimal situation," because in calling it a right, the church risks overusing and thereby undermining the concept. Presumably they do not intend the right to two married genetic parents to be considered on a par with other rights, such as the right to life. Also, the language of *Donum* can be divisive when it declares that it hopes, with regard to its opinions, "that all will understand the incompatibility between recognition of the dignity of the human person and contempt for life and love, between faith in the living God and the claim to decide arbitrarily the origin and fate of a human

[104] Pontifical Academy for Life, "Declaration on the Production and the Scientific and Therapeutic Use of Human Embryonic Stem Cells," in *God and the Embryo: Religious Voices on Stem Cell Research and Cloning*, ed. Brent Waters and Ronald Cole-Turner (Washington, D.C.: Georgetown University Press, 2003), 167-168.

[105] Congregation for the Doctrine of the Faith, *Donum Vitae*, II, no. 2.

being."[106] This statement harshly characterizes the opposition, who do not see themselves as being opposed to God, life, and love.

Dissenting Catholic views. When *Donum Vitae* asks rhetorically, "how could a human individual not be a human person?" some Catholic theologians answer that the Catholic tradition allows for a distinction between biological humanity and moral humanity, at least for a brief time after conception. They draw on precedents within the Church to support their view. St. Thomas Aquinas maintained that ensoulment took place at 40 days for boys, and at 90 days for girls.[107] The early church made a distinction between "formed" and "unformed" fetuses, and the two carried different punishments for abortions. From 1591 to 1869, Canon Law gave excommunication as the punishment for aborting a "formed" fetus, but aborting an "unformed" fetus was a lesser crime.[108] Some Catholics call for a return to this "original" position on abortion, and by extension, on the status of the embryo. Other theologians maintain that the time of ensoulment was always hotly debated, and that many early church leaders did not accept the formed/unformed distinction. They contend that the medieval view was based on the science of Aristotle and the physician Galen, and that 19th century microscopes and science confirmed the presence of life at conception, which caused the change in policy.[109]

Margaret Farley, a nun with the Sisters of Mercy and a professor at Yale Divinity School, believes that modern science might have pushed this line back to perhaps 28 or 14 days, but that before this point, or before implantation, the embryo

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[106] Ibid., conclusion.

[107] "A Theologian's Brief on the Place of the Human Embryo within the Christian Tradition, and the Theological Principles for Evaluating Its Moral Status," in *God and the Embryo: Religious Voices on Stem Cell Research and Cloning*, ed. Brent Waters and Ronald Cole-Turner (Washington, D.C.: Georgetown University Press, 2003), 191.

[108] Ibid.

[109] Ibid., 193.

is not an individual with the settled potential to become a person.[110] She believes that as a potential person it should be respected (it should not be sold or killed arbitrarily), but that its use for some types of research can be justified. Furthermore, she contends that therapeutic cloning may be justifiable, as long as there is a strong barrier between it and reproductive cloning. Farley and many other dissenting Catholics draw on previous traditions to support their view that some level of development is needed before an embryo can "bear the moral weight of personhood."[111] However, others note that although earlier abortion penalties differed, they were always harsh, and at no time did the church sanction this act.[112] Dissenting Catholics can appeal to the older tradition as a precedent for not giving embryos and adults the same moral status, but they cannot assume that this tradition fully supports the destruction of embryos. Neither side's position is entirely upheld by tradition, because traditional interpretations were formed and challenged in a climate of intense debate; this issue was contentious in the Church's earliest days, and it remains so. As such, Catholics must rely on their own interpretations of this tradition.

Orthodox and Protestant denominations. Despite different backgrounds, Eastern Orthodox Christians and Southern Baptists share the general Catholic view. They believe that the embryo is a fully human person with a soul, and that it should be protected from all harmful research. They also share a common disdain for utilitarian weighing of competing interests, and consider as relevant only the rights of the embryo. The Southern Baptist Convention condemns this "crass utilitarian

[110] Margaret Farley, "Roman Catholic Views on Research Involving Human Embryonic Stem Cells," in *Ethical Issues in Human Stem Cell Research, Volume III: Religious Perspectives*, National Bioethics Advisory Committee (Rockville, Md.: NBAC, 2000), D4.

[111] Ibid.

[112] "A Theologian's Brief," 192.

ethic" that allows research on the grounds of its potential benefits.[113] The Orthodox Church disapproves of the use of existing stem lines, asserting that "we may not profit from evil even to achieve a good and noble end."[114] These groups feel that the existence of frozen embryos is an unnecessary tragedy, and hence that couples should forgo IVF fertility treatments. Demetrios Demopulos, a priest in the Greek Orthodox Church, offers a unique argument for the status of the embryo. He asserts that all humans, whether embryo or adult, are striving to become fully authentic persons. They try to become "deified," that is, to attain the likeness of God, and this journey begins at conception. However, Demopulos contends that it may be permissible to use already-existing stem cell lines, as "wishing something had not been done will not undo it."[115] Despite a few disagreements, these groups share relatively broad support among their members for their pro-life policies. Even so, Demopulos is an example of how individuals can support the overall policies of their denomination while maintaining slightly modified positions based on their own ethical judgments.

The United Methodist Church's position is an interesting "bridge" between historically "pro-life" and "pro-choice" churches. The UMC, though pro-choice, did not originally support embryo research.[116] Though it continues to condemn therapeutic cloning, it now supports research on IVF spares, albeit with an air of

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[113] Southern Baptist Convention, "Resolution: On Human Embryonic and Stem Cell Research," in *God and the Embryo: Religious Voices on Stem Cell Research and Cloning*, ed. Brent Waters and Ronald Cole-Turner (Washington, D.C.: Georgetown University Press, 2003), 179.

[114] Holy Synod of Bishops of the Orthodox Church in America, "Embryonic Stem Cell Research in the Prospective of Orthodox Christianity," in *God and the Embryo: Religious Voices on Stem Cell Research and Cloning*, ed. Brent Waters and Ronald Cole-Turner (Washington, D.C.: Georgetown University Press, 2003), 173.

[115] Demetrios Demopulos, "An Eastern Orthodox View of Embryonic Stem Cell Research," in *Ethical Issues in Human Stem Cell Research, Volume III: Religious Perspectives*, National Bioethics Advisory Committee (Rockville, Md.: NBAC, 2000), B3.

[116] Cole-Turner, "Religion Meets Research," 15.

deeply felt regret. The board of the Church concludes that the problem with IVF is that if a woman produces enough eggs for several rounds of treatment, many of them will be discarded. Yet it is too harsh to recommend to women that they only produce a few eggs at a time, as this process is invasive and uncomfortable. The Church thus strongly advises its members to refrain from IVF treatments, as there are no practical ways of avoiding embryos' deaths in the process. The Church laments that people of faith did not speak out earlier about IVF, so that these spares now exist. Given this "tragic reality," and with "remorse and guilt," the Church affirms that it is "morally tolerable" to use these embryos.[117] The Church clearly does not approve of the destruction of embryos—and it correctly identifies IVF as the source of this problem—but it also realizes it must contend with the unfortunate results of this practice. Other mainline protestant churches come to similar conclusions, but the UMC is unique in its pronounced air of mourning and its clear sense of being morally torn over the issue.

The Episcopalian and Presbyterian Churches, as well as the United Church of Christ, support stem cell research. The Episcopalian church does not support therapeutic cloning, but it believes that given the three outcomes for spare IVF embryos—death, freezing, or use in research—it is "in keeping with our call to heal the afflicted to use these remaining embryos in promising research."[118] For Presbyterians, the respect due to embryos must be weighed against the potential for research, a unique potential that cannot be achieved by any other means. Their resolution contends that prohibiting this research would inappropriately "elevate the showing of respect to human embryos above that of helping persons whose pain and

[117] Public Witness and Advocacy, "The Ethics of Embryonic Stem Cell Research," *Christian Social Action* 16 (2003), available at http://www.umc.org.

[118] *Episcopal News Service*, 13 June 2003, available at http://www.episcopalchurch.org.

suffering might be alleviated."[119] Unlike the Episcopalians and the Presbyterians, the United Church of Christ does not object to therapeutic cloning. The Church has no official position on the status of the embryo, but most of its members and clergy view it as deserving of respect, though not fully a person.[120]

While there are numerous other Christian denominations aside from those mentioned here, most tend toward similar rationales for their positions, based on the ethical frameworks they accept. Those supporting research emphasize the existence of IVF spares and the potential to help others, while those opposed tend to view embryos as human persons who ought never be harmed or used, regardless of potential benefits. For Protestants, these divisions, more often than not, correspond to the traditional distinction between mainline and evangelical denominations. The members of these two broad categrories tend to share a wide range of assumptions and views about the world. These shared viewpoints create a common framework within which to even debate positions, and thus, they affect the decisions that the members of these groups reach.

Judaism

Jews and Christians may share the Hebrew Bible, but Jewish views stem from a very different set of cultural and religious traditions. Judaism has no central authority, but it does have a long and established tradition of rabbinical commentary. These commentaries are full of scholarly arguments and textual interpretations, and the tradition embraces an openness and willingness to consider

[119] Presbyterian Church (USA), "Overture 01-50," in *God and the Embryo: Religious Voices on Stem Cell Research and Cloning*, ed. Brent Waters and Ronald Cole-Turner (Washington, D.C.: Georgetown University Press, 2003), 188.

[120] Ronald Cole-Turner, untitled testimony in *Ethical Issues in Human Stem Cell Research, Volume III: Religious Perspectives*, National Bioethics Advisory Committee (Rockville, Md.: NBAC, 2000), A3.

alternative views. Moreover, the Jewish ethical focus is less on modern ideas of individual rights, and more on the duties and obligations that members of the community have to each other.[121] The overwhelming majority of Jews support embryo research, and this position does not appear to vary significantly among Judaism's three branches, that is, Orthodox, Reform, and Conservative. Jewish support for stem cell research is grounded primarily in traditional views about the status of the embryo, and in the importance that their faith places on divine mandates for partnership and healing.

Conception and development. The tradition Jewish view is that prior to 40 days in development, the embryo is "like water." Early term abortion is still prohibited, because of the potential of the fetus, but it is only considered homicide after 40 days.[122] However, as in the "fighting passage" (Ex. 21:22-23) quoted earlier, the loss of a fetus is not considered to be equal to the loss of an adult. The embryo and fetus are thought of as part of the woman's body, so an abortion would be like deforming or harming one's own body, which is traditionally prohibited.[123] For this reason, the destruction of embryos that are not implanted is morally equivalent to the "wasting of human seed."[124] Genetic material outside of a womb has no legal or moral status, because it has no potential and is part of no body; even if it were implanted, it would still only be considered, developmentally, as if it were water. This view then permits both research on IVF embryos, as well as therapeutic

[121] Laurie Zoloth, "The Ethics of the Eighth Day: Jewish Bioethics and Genetic Medicine," in *Ethical Issues in Human Stem Cell Research, Volume III: Religious Perspectives*, National Bioethics Advisory Committee (Rockville, Md.: NBAC, 2000), J4.

[122] Elliot N. Dorff, "Stem Cell Research," in *Ethical Issues in Human Stem Cell Research, Volume III: Religious Perspectives*, National Bioethics Advisory Committee (Rockville, Md.: NBAC, 2000), C4.

[123] Ibid., C3.

[124] Moshe David Tendler, "Stem Cell Research and Therapy: A Judeo-Biblical Perspective," in *Ethical Issues in Human Stem Cell Research, Volume III: Religious Perspectives*, National Bioethics Advisory Committee (Rockville, Md.: NBAC, 2000), H3.

cloning. Furthermore, it is worth noting that Jewish tradition holds that the edges of life and death are gradual. Babies are not named until 8 days after birth, and if a baby dies before it is 30 days old, no death rites are performed for it. Also, persons with terminal diseases and condemned criminals have a different moral status in the community, because in some sense, it is as if they are already dead.[125] This emphasis on context as being important to moral status and personhood makes sense if one remembers the emphasis that Jewish ethics places on reciprocity and obligations to a moral community, rather than on individual rights. It is a unique ethical framework from which to consider issues of life and death and community responsibility.

Divine mandates. The fundamental concerns for Jews in regard to embryo research are the mandates that God gives his people. One is the mandate for partnership, which says that humans are partners or co-creators with God in fixing and tending to the world. Jewish tradition does not see nature as sacred and perfect, but as constantly in need of repair and full of projects that need to be finished.[126] This alteration of nature is not passive but serious, violent, and dominating, as when humans dig the earth, poison insects, and kill birds in order to produce and protect a good harvest.[127] Humans are partners with God in the continuing process of creation, so they are encouraged to try to act more like God in all things (i.e. helping the poor, healing the sick, and the like). There is no horror about "playing God" or usurping his proper role, as in some Christian traditions.[128] However,

[125] Zoloth, "Eighth Day," J14.

[126] Laurie Zoloth, "Freedoms, Duties, and Limits: The Ethics of Research in Human Stem Cells," in *God and the Embryo: Religious Voices on Stem Cell Research and Cloning*, ed. Brent Waters and Ronald Cole-Turner (Washington, D.C.: Georgetown University Press, 2003), 147-148.

[127] Ibid.

[128] Zoloth, "Eighth Day," J11.

humans should be cautious as they try to be like God, as they do not have his omniscience.[129]

The mandate to heal entails that not only are medical pursuits available to humans and necessary for health, they are demanded by God. Jewish tradition sees God as the owner of human bodies, and one of his conditions for their use is that people seek to preserve their lives and health.[130] There is a traditional story that combines the mandates for partnership and for healing. A farmer is said to have asked two rabbis for medical advice, which they gave him. The man was confused at this, and asked the rabbis whether they were subverting the will of God, who gave him the illness. They answered:

> 'Foolish man…Just as if one does not weed, fertilize, and plow, the trees will not produce fruit, and if fruit is produced but not watered or fertilized, it will not live but die, so with regard to the body. Drugs and medicaments are the fertilizer, and the physician is the tiller of the soil.'[131]

The "natural" state of the world is not always the best, so humans need to actively maintain their health through medicines and technologies. Two early verses in the Torah are commonly seen as reinforcing this mandate:

> You shall not stand idly by the blood of your neighbor. (Lev. 19:16)
>
> You shall restore him to himself.
> *or* You shall restore what is lost [to your neighbor]. (Deut. 22:2)[132]

The Jewish tradition places a strong emphasis on saving life, or *pikuach nefesh*. Actions meant to save lives trump all other actions, and every other ethical principle

[129] Dorff, "Stem Cell Research," C3.
[130] Dorff, "Stem Cell Research," C3.
[131] Zoloth, "Eighth Day," J16.
[132] Zoloth, "Eighth Day," J15-J16. These are traditional translations and interpretations. The NRSV gives Lev. 19:16 as "You shall not profit by" or "you shall not stand against" the blood of your neighbor. It gives Deut. 22:2 as "you shall return it" in the context of one's neighbor's wandering livestock. The animals are interpreted as standing for the larger concept of property, which could include a neighbor's health as a kind of lost property.

in the Torah may be violated in this pursuit, save murder, adultery, and idolatry.[133] For these reasons, Jews tend to enthusiastically support stem cell research as one more way to fulfill their mandate to actively pursue therapies that improve people's lives and health. In-vitro fertilization, embryonic stem cell research, and therapeutic cloning have been officially endorsed by the Union of Orthodox Jewish Congregations of America and the Rabbinical Council of America.[134]

Islam

Textual references. Like Judaism, Islam has no central religious authority. It is a textual tradition, which entails that there are often differing interpretations of the same texts. Various leaders and scholars look to the text and issue their *fatwas* or opinions. Though there is room for disagreement, the vast majority of Muslims support research on embryos, as long as there is a potential therapeutic value in it.[135] Muslims traditionally hold that ensoulment takes place at some point further along in development than the first trimester. Relevant passages in the Koran include:

> Human progeny He creates from a drop of sperm; He fashions his limbs and organs in perfect proportion and breathes into him from his own spirit (*ruh*). (K. 41:9)
>
> And your Lord said to the angels: 'I am going to create human form from clay. And when I have given him form and breathed into him of My life force (*ruh*), you must all show respect by bowing down before him. (K. 38:72-73)[136]

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[133] Zoloth, "Eighth Day," J12.

[134] Union of Orthodox Jewish Congregations of America and Rabbinical Council of America, "Cloning Research, Jewish Tradition, and Public Policy," in *God and the Embryo: Religious Voices on Stem Cell Research and Cloning*, ed. Brent Waters and Ronald Cole-Turner (Washington, D.C.: Georgetown University Press, 2003), 204-205.

[135] Abdulaziz Sachedim, "Islamic Perspectives on Research with Human Embryonic Stem Cells," in *Ethical Issues in Human Stem Cell Research, Volume III: Religious Perspectives*, National Bioethics Advisory Committee (Rockville, Md.: NBAC, 2000), G3.

[136] Ibid., G4.

These verses are slightly ambiguous, but they seem to imply that formation precedes the inclusion of the life force. Another passage clarifies this issue:

> We created man of an extraction of clay, then We set him, a drop in a safe lodging, then We created of the drop a clot, then We created of the clot a tissue, then We created of the tissue bones, then we covered the bones in flesh; thereafter We produced it as another creature. So blessed be God, the Best of creators! (K. 24:12-14)[137]

The adverb 'thereafter,' as well as the chronological organization of the passage, implies that personhood is attained only after a period of development. Because the Koran is not explicit on this point, it is considered to be "silent" on the issue, which means that it is permissible to draw a distinction between biological and moral personhood.[138]

Ensoulment. Muslims have traditionally drawn the distinction for personhood at or around the fourth month of pregnancy. Early rulings for homicide focused on the beginnings of palpable movement that occur around this time. *The Book of Destiny* from the late 9th century places the time of ensoulment after three stages of 40 days each, or 120 days, at which point "the angel is sent to breathe life into him."[139] Before this time, the fetus is "like a plant" because it has no perception or voluntary movement. Some Muslim scholars nevertheless see pre-ensoulment abortion as a sin because the fetus is alive, while others find some early abortions justifiable.[140] Modern science has led some Muslims to believe that life and moral status begins at conception, but most still set a limit later than the blastocyst stage, such as 14 or 40 days. The majority of Muslims continue to set the limit somewhere between the first trimester and the fourth month, but all Muslims view the end of the 4th month as the absolute boundary for ensoulment and the protection of the

[137] Ibid.
[138] Ibid.
[139] Ibid.
[140] Ibid., G5.

fetus.[141] Due to these diverse views, policies on abortion and stem cell research in particular Muslim communities or countries are likely to be based on one scholar's chosen *fatwa* on the subject, which may or may not correspond to the views of the various individuals who make up that community.

Eastern Religions

Buddhism. There is no central authority for any of the religions of South and East Asia. Within Buddhism, there are a variety of issues to take into consideration. The first precept of Buddhism is the principle of *ahimsa*, or non-harming. Buddhists are not supposed to harm or kill any living creature.[142] This introduces a new element, as most Western religious traditions focus on the moment the embryo attains personhood, specifically as a human person. The Buddhist principle of *ahimsa* does not make a distinction between animals and humans, so the destruction of embryos is considered wrong for the same reasons that the killing of animals is wrong, regardless of any issues of personhood.[143] However, some challenge this view and contend that *ahimsa* only applies to sentient beings, in the same way that plants are living but do not fall under this principle.[144] In general, Buddhist precepts are seen as ethical guidelines, and not as unbreakable laws.

In Singapore, the Secretary General of the Singapore Buddhist Federation declared of embryo research that "Buddhism will look at it seriously from the point

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[141] Ibid.

[142] LeRoy Walters, "Human Embryonic Stem Cell Research: An Intercultural Perspective," *Kennedy Institute of Ethics Journal* 14 (2004): 23.

[143] Damien Keown. "No Clear Buddhist Stance on Stem Cell Research," *Science and Theology News*, April 2004, available at http://www.stnews.org/archives.

[144] Courtney Campbell, "Religious Perspectives on Human Cloning," in *Cloning Human Beings, Volume II: Commissioned Papers*, National Bioethics Advisory Committee (Rockville, Md.: NBAC, 1997), D25.

of intention."[145] This group emphasized that if the intentions of the research are to help humankind, then they are ethical. If the intentions are for material gain, then the research is unethical. It is interesting to note that Asian countries with large Buddhist populations tend to have fairly liberal views on abortion. South Korea was the site of a major breakthrough in human therapeutic cloning, and it is also said to have up to 1.5 million abortions yearly.[146] Clearly there are differences in opinion between those who hold that Buddhism opposes such practices, and those living in primarily Buddhist countries.

Hinduism. Hinduism has a long tradition of attributing the beginning of life to the first moments of conception. The Hindu ethical tradition condemns abortion, and only allows it to be performed in extreme circumstances, with a properly compassionate state of mind (*daya*).[147] Despite this generally protective stance, some Hindus have approved embryo research. The Hindu Endowment Board of Singapore declared:

> According to our Faith (Hinduism) killing a foetus is a sinful act (*bhroona hathya*). But whether the 14 day old foetus is endowed with all the qualities of life is not well regarded. Therefore, there is no non-acceptance to use these ES cells to protect human life and advance life by curing disease.[148]

This decision is clearly very tentative, as seen by the use of the phrase 'there is no non-acceptance.' One commentator interprets the Board's actions as suggesting that "the destruction of the pre-implantation embryo is not equivalent to abortion if the goal of the research being performed is compassionate."[149] This is likely to be a

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[145] Bioethics Advisory Committee (Singapore), *Ethical, Legal and Social Issues in Human Stem Cell Research, Reproductive and Therapeutic Cloning* (Singapore: BAC, 2002); quoted in Walters, "Intercultural Perspective," 22.

[146] Keown, "No Clear Buddhist Stance."

[147] S. Cromwell Crawford, *Dilemmas of Life and Death: Hindu Ethics in a North American Context* (Albany: State University of New York Press, 1995), 32; quoted in Walters, "Intercultural Perspectives," 24.

[148] BAC, *Ethical, Legal and Social Issues*; quoted in Walters, "Intercultural Perspectives," 24.

[149] Walters, "Intercultural Perspectives," 24.

contentious issue for Hindus, who must weigh their good intentions for the promotion of human health with their longstanding protection of the fetus.

Taoism. Taoists tend to be united in their opposition to this research. Taoists believe that it is unethical to harm any living creature, including embryos. According to this tradition, "All living creatures that breathe, including those that fly and crawl, should not be killed. Even wriggling creatures also treasure life, even mosquitos and other insects understand the avoidance of death."[150] Since Taoism values life so highly, it puts great importance on saving lives and on the promotion of the health of all creatures. However, it does not support any research that involves killing life, or that goes against its teachings. For these reasons, Taoists do not generally support IVF or embryonic stem cell research.

Comparisons. Western Buddhist and Hindu positions on stem cell research are surprisingly similar to those of Catholics and evangelical Protestant denominations. These faiths emphasize the importance of protecting life above all else, albeit for different reasons. However, many Buddhists and Hindus in Eastern countries do not share the positions of their Western counterparts. In the U.S., this discrepancy may be partially due to the contentious, ongoing debate over abortion, and to the emphasis here on finding and drawing firm boundaries. Such concerns do not seem to be as pressing to those in Eastern countries. Thus, cultural differences appear to affect the way individuals interpret the traditions and principles of their faiths.

It is tempting to conclude that those in the East simply do not put their beliefs into practice the way those in the West do, but this hypothesis is contradicted by the Eastern practioners' own words. The decisions of the Buddhist and Hindu

[150] BAC, *Ethical, Legal and Social Issues*; quoted in Walters, "Intercultural Perspectives," 25.

groups from Singapore were clearly based on how these groups interpreted the tenets of their respective traditions. They did not ignore their religious beliefs, but simply came to a different conclusion about the relevant aspects of the situation and the consistency of stem cell research with their religious principles. Though these principles are the same, the cultural context and the interpretations differ.

Common Social Concerns

Despite the many differences among all of these religions, certain concerns emerge as almost universal. Virtually all the Western religious groups emphasize the need for oversight, regardless of whether or not they support the research. Many call for greater public awareness and discussion of the ethical and moral implications of IVF and embryo research. Also, issues of social justice and access to the results of embryo research are of paramount concern to many religious groups, especially mainline Christian denominations and Jews. Though secular ethicists draw attention to this concern as well, they usually treat it as a relatively minor issue.

For some of these groups, social concerns are almost the top priority. The board of the Methodist Church notes the abject failure of wealthy Christians to provide for poor children's health care, and insists that any judgments about fertility treatments and new research technologies be made in light of this failure.[151] Many groups call on childless couples to use their time and financial resources to adopt, or to care for the poor, sick, and disabled, rather than to spend these resources on fertility treatments. Some may contend that such issues are beside the point and avoid the real ethical questions raised by stem cell research and IVF. Yet for certain

[151] Public Advocacy and Witness, "Ethics of Embryonic Stem Cell Research."

religious groups, the ethical issues cannot be separated from social concerns and the contexts in which these concerns are raised. Religious groups often consider the promotion of social justice to be one of their main purposes or ministries. They are deeply concerned that new technologies will be available only to wealthy patients, and call for as close to universal access as possible.

It is clear that there is no one "religious" position on embryo research, but rather a multitude of ways that religious groups and individuals deal with this difficult issue. As concerns about life and death are ancient fare for religions, many devout believers find answers and guidance where they have always sought them in the past, in the texts and traditions of their faiths. Yet the answers they find are based on the way they apply analogous cases and precedents to the situation of stem cell research, which is partly determined by their own values and beliefs. Even within the same tradition and using the same sacred texts, there are diverse interpretations of the meaning of these sources. Religious people desire to accommodate important medical research, but only if it is ethically justified in a way that is consistent with their own consciences. These people are able to come to solutions, both individually and collectively, that they feel are the best that can be made given their beliefs and the current situation. One hopes that these groups understand that others are doing the same, even when they do not share each other's conclusions.

CHAPTER FOUR

SETTING LIMITS AND SENDING MESSAGES

In 2001, President Bush established the policy that currently governs the funding of embryonic stem cell research in the United States. This policy is an attempt to work within the spirit of the existing law, and to try to accommodate both the desire for research and the belief of many that the embryo is a human being. However, in the more than three years since he announced his policy, new information and changed circumstances have led many to call for changes. There are numerous scientific and practical difficulties with the policy that render it inadequate for scientists' needs and cause many to forgo federally-funded research altogether. Yet despite these complaints, it is unlikely that the President will expand the policy. His decision emphasized certain convictions and moral principles that guided him, and these have not changed with the needs of researchers. Such a connection to personal ethical beliefs brings up questions as to the amount of influence on policymaking that religious considerations should be allowed to have. I will explain the current policy as well as the practical problems that have become clearer since its introduction. Next, I will consider the role of federal funding in this field, and describe the recent shift toward state and private funding that has occurred as a result of the current policy's limitations. Finally, I will consider how the President's decision raises questions about the proper contribution of religion to public policy.

The Current Policy

Background. The Dickey Amendment is the law that informs any decisions on funding for embryo research. In 1995, Congress attached it to the annual bill that appropriates funds for the Department of Health and Human Services (HHS) and the National Institutes of Health (NIH) for the next fiscal year. Congress has retained this amendment and passed it with the funding bill every year since. The Dickey Amendment specifies that no NIH funds may support research in which embryos are created or harmed.[152] After the team at the University of Wisconsin developed their groundbreaking technique for isolating and deriving human embryonic stem cells, the NIH sought advice from HHS on how it might fund this new research within the confines of the existing law. The Department found that federal funds could be used for this research, as long as the actual destruction of the embryos was done by scientists using private funds. In addition, certain guidelines were put in place: the embryos must have been left over from fertility treatments and obtained with the consent of their donors; donors could not accept money for their embryos; and no profits could be made from the sale of any embryos. By August 2000, the NIH had drawn up its new policy and, with President Clinton's support, it began to call for grant applications.[153]

President George W. Bush's campaign speeches in 2000 indicated that he did not support this funding, and he reiterated this position in a May, 2001 letter to the Culture of Life Foundation.[154] In late summer, the media gave the issue prominent coverage, and the President was pressured to make a decision on this matter. He

[152] American Academy for the Advancement of Science (AAAS), "AAAS Policy Brief: Stem Cell Research," available at www.aaas.org (2 April 2005).
[153] Ibid.
[154] Ibid.

was heavily lobbied by groups on both sides who hoped to convince him to favor their respective positions. The biotechnology industry, patient advocacy groups, and scientific organizations urged him to approve the funding, while conservative pro-life organizations and the Catholic church urged him to limit or ban this research altogether. In addition, even some conservative Republicans spoke out in support of the research, such as Orrin Hatch (R-UT) and the late Strom Thurmond (R-SC). Bill Frist (R-TN) expressed his support for research that was limited to a set number of cell lines.[155]

The current funding policy. On August 9, 2001, President Bush articulated the outlines of the current policy in a televised address to the nation. He endorsed stem cell research generally, but only allocated federal funding for embryonic research conducted on cell derivations that were in existence as of the date of his address.[156] No federal funds could be used for research on new embryos or on lines developed after this date. This limitation was in keeping with the Dickey Amendment, because it neither banned research on living embryos, nor supported it.[157] Both the amendment and the policy itself drew a clear distinction between the public and the private, which both troubled and pleased its critics. Some were glad that at least the research could continue unrestricted in the private sector, but others were angry that this distinction allowed for a complete lack of oversight over non-federally funded research.[158] Although neither side was entirely satisfied with the policy, both sides got some of the freedoms or limitations that they wanted. It is

[155] Ibid.

[156] George W. Bush, "Remarks by the President on Stem Cell Research," transcript of 9 August 2001 speech by the President, available at www.whitehouse.gov (10 November 2004).

[157] President's Council on Bioethics (PCBE), "Recent Developments in the Ethical and Policy Debates," *Monitoring Stem Cell Research* (Washington, D.C.: Government Printing Office, 2004), 71.

[158] Gene Outka, "The Ethics of Human Stem Cell Research," *Kennedy Institute of Ethics Journal* 12, no. 2 (2002): 183.

important to clarify, however, that there was no "ban" on this research, and that Bush did not "limit" existing funding, as some assert. The decision did not rule on the research's permissibility, but only on its funding.[159]

Practical Problems

Line availability. At the time, it appeared that this policy would, at the very least, fund productive research on the existing stem lines. Yet it has since become clear that the policy is, from a practical standpoint, unacceptable to researchers. In his speech, President Bush cited "sixty genetically diverse stem lines" that were eligible for this funding.[160] However, these were not lines, they were derivations or cultures. For example, Göteberg University in Sweden was listed as possessing 19 lines, but in fact, only 3 were established lines, while 4 were "being studied and described," and 12 were in the "early stages." A scientist at Göteberg said these 12 should be called "potential" cell lines, and remarked, "If we get three good lines out of them we'll be satisfied."[161] A total of 78 lines, worldwide, are eligible for funding, but as of the latest NIH figures, only 22 are available to researchers (see Appendix B).[162] The 22 that are currently available are an improvement over the two or three available in Spring 2002. This increase was a direct result of infrastructure awards the NIH gave to researchers to help them develop their derivations into well-characterized lines that are stable and suitable for distribution.[163] However, many

[159] "The Administration's Human Embryonic Stem Cell Research Funding Policy: Moral and Political Foundations," staff working paper for the PCBE, available at www.bioethics.gov (2 April 2005).

[160] Bush, "Remarks by the President," transcript.

[161] AAAS, "Policy Brief."

[162] Appendix B lists 19 available lines, rather than 22, because it uses numbers from 2004.

[163] NIH, "Cell Line Availability and the Registry," FAQs [Stem Cell Information], available at http://stemcells.nih.gov (10 November 2004), no. 4.

say this number is too small and that the lines are not diverse enough to provide reliable experimental data.

Line quality. Yet the main problem with these lines is that they are old, and so they suffer from numerous age-related problems. Moreover, all were developed using mouse feeder layers, which cause problems for researchers who plan on creating clinical human trials in the future. As endogenic or trans-species viruses are always a possibility with these feeder layers, they either cannot be placed in humans or are subject to prohibitively strict controls.[164] Since 2001, techniques have been developed that allow human cells to be used instead, so the older cell lines have quickly become obsolete. Furthermore, cell lines simply deteriorate with age. After so many successive doublings, they can accumulate mutations or become contaminated by foreign material. While they can technically replicate indefinitely, their quality suffers over time and they lose some of the biological properties needed by researchers.[165]

Funding regulations. Aside from the biological problems, there are excessive bureaucratic entanglements that accompany the procurement of and research on federally-funded lines. The NIH has a registry of available lines, but researchers must contact the providers and negotiate with them to purchase the lines directly. Also, the lines remain the properties of their owners.[166] Both parties have to agree to a Material Transfer Agreement (MTA), which specifies their respective rights to any future results or patents. Since these differ, scientists might have to give up most of their rights to their results in order to obtain research

[164] "Medical Promise of Embryonic Stem Cell Research (Present and Projected): Dr. John Gearhart," transcript of the proceedings of the President's Council on Bioethics, 25 April 2002, available at www.bioethics.gov (2 April 2005).

[165] Ibid.

[166] NIH, "Availability," no. 3.

materials.[167] In addition, if researchers do both federally-funded and non-federally-funded work, they must strictly separate their costs. For indirect costs, such as facilities and administration (F & A), the research activities must be kept physically and temporally separate enough so that even these costs can be clearly delineated and calculated accurately.[168] Typically, a portion of grant money goes to providing equipment for a lab; if this is the case, no activities that are ineligible for federal funding can ever be done using this equipment.[169] All of these problems result in an impractical arrangement for scientists, and contribute to their dissatisfaction with the current policy.

Impact of the Policy

Importance of federal funds. Some observers might doubt that funding restrictions can have any noticeable negative impact on this research, since after all, private sector funding remains unrestricted. But such a view would greatly underestimate the importance of federal funding in this country. Many researchers rely solely on federal funds to support their labs and are unprepared to establish separate private work.[170] Moreover, NIH-funded research is the "engine that drives" biological research in the world. One professor at Harvard Medical School states, "From a basic research perspective, the NIH—which spends about $27 billion a year on such research—is the single most important funder of biomedical science

[167] "Medical Promise of Embryonic Stem Cell Research," PCBE transcript.
[168] NIH, "Funding Questions," FAQs [Stem Cell Information], available at http://stemcells.nih.gov (10 November 2004), no. 4.
[169] Gareth Cook, "Stem Cell Center Eyed at Harvard," *Boston Globe*, 29 February 2004, available at www.boston.com (2 April 2005).
[170] NIH, "Healthcare Questions," FAQs [Stem Cell Information], available at http://stemcells.nih.gov (10 November 2004), no. 2.

worldwide."[171] The volume of federally-funded grants and research is enormous. Total private funding of all biomedical research, at a couple of hundred million dollars a year, is paltry by comparison.[172] There is no shortage of federal funds, just a shortage of eligible and desirable research materials. This is the reason why so many people desire an expanded policy; that which could be the most important scientific research ever is languishing as the NIH is forced to sit this one out.[173]

Brain drain. As a result of funding restrictions, talented students and scientists may go elsewhere to pursue their work. Many observers have predicted a coming "brain drain," and they point to the recent breakthroughs by a team in South Korea as evidence that America is already losing the cutting edge.[174] One researcher says that he often hears students saying, "If you want to do this [research], go to England for your postdoc," referring to postdoctoral research work.[175] One prominent researcher from the University of California system was given £1.5 million to do his work in the U.K.[176] However, the general consensus is that despite these fears and some isolated examples, there has not been any noticeable flight of scientists overseas.[177] Yet some scientists claim that the worry is not for any brain drain overseas, but for the lack of new scientists entering the field. Young scientists appear to be nervous about pursuing such an uncertain field of research and embarking on a career that might suddenly be declared illegal by their state or

[171] Jonathan Shaw, "Stem Cell Science: When Medicine Meets Moral Philosophy," *Harvard Magazine* (July-August 2004). Available at www.harvardmagazine.com (2 April 2005).
[172] "Medical Promise of Embryonic Stem Cell Research," PCBE transcript.
[173] Cook, "Stem Cell Center."
[174] Andis Robeznieks, "The Politics of Progress: How to Continue Stem Cell Research Despite Limitations," *American Medical News*, 09 August 2004, available at www.ama-assn.org (2 April 2005).
[175] "Medical Promise of Embryonic Stem Cell Research," PCBE transcript.
[176] Ibid.
[177] PCBE, "Ethical and Policy Debates," 65.

national government.[178] For many, it isn't worth jeopardizing one's research when there are other fields in which to work.[179] Some warn that although a gradual loss is harder to prove than a mass exodus from the country, by the time such a loss would become obvious, it would be too late to do anything about it.[180]

Few funding requests. Aside from these predictions and speculations about the future, today's scientists are indeed rejecting federally-funded stem cell research. NIH has received a very low number of actual requests for the cell lines.[181] Out of 3,000 available shipments, only 400 have actually been sent.[182] Some observers take this as evidence for a "chilling effect," in that complicated requirements and unsuitable materials have led researchers to forgo the research altogether.[183] While this may be the case for some, it is much more likely that scientists are reacting to the policy not by forgoing the research, but by seeking and obtaining other sources of funding that have recently become available.[184]

Funding shift. The responsibility for funding embryonic stem cell research has shifted to states, universities, and the private sector. In terms of private funding, investments by venture capitalists in the biotechnology industry as a whole increased 11% from 2003 to 2004.[185] Menlo Park-based Geron leads the fledgling stem cell industry, as it was the investor of the original Wisonsin team in 1998. As a result of this early involvement, it holds numerous patents. Geron has invested $96 million in 8 years, and is already planning to hold clinical trials for one of its

[178] Robeznieks, "The Politics of Progress."
[179] Cook, "Stem Cell Center."
[180] Robeznieks, "The Politics of Progress."
[181] PCBE, "Ethical and Policy Debates," 66.
[182] Robeznieks, "The Politics of Progress."
[183] PCBE, "Ethical and Policy Debates," 66.
[184] Robeznieks, "The Politics of Progress."
[185] Tom Still, "Wisconsin Research Plan is About More than Stem Cells," Wisconsin Technology Council, 26 January 2005. Available at www.wisconsintechnologycouncil.com (2 April 2005).

treatments in 2006.[186] Other companies are beginning to invest as well, hoping to reap the benefits of any future drugs or treatments.

The most significant recent development in alternative sources of funding has been state funding pledges. After voters in California approved Proposition 71, which committed $3 billion in state funds to be spent on this research over the next 10 years, other states scrambled to propose their own funding plans or risk losing their researchers.[187] New York has announced that it will spend $1 billion, citing competition from California as the impetus for the decision.[188] Similar plans have also been proposed in New Jersey, Wisconsin, Connecticut, Massachusetts, and Illinois.[189]

As universities have felt pressured to find funding to hold on to their scientists, they have likewise put pressure on their home states. One professor at Johns Hopkins claims that universities "are under big threat because all the postdocs now are going to be heading out to a university in California."[190] Harvard has responded by raising private funds to create the Harvard Stem Cell Institute. A professor involved in the Institute's planning asserts that "Harvard has the responsibility to be taking up the slack that the government is leaving."[191] In fact, recently Harvard researchers developed 17 new stem lines and made them available to all researchers, free of charge. This is in contrast to the NIH lines, which cost $5,000 each.[192] These developments have taken some of the pressure off of the Bush

[186] Roland Jones, "After California, More States Eye Stem Cell Research," *MSNBC.com*, 21 January 2005, available at http://msnbc.msn.com (2 April 2005).
[187] Ibid.
[188] Ibid.
[189] Still, "Wisconsin."
[190] Augustino Bono, "California Funding Shifts Stem-Cell Decisions to States, Says Expert," *Tidings*, 18 March 2005. Available at www.the-tidings.com (2 April 2005).
[191] Cook, "Stem Cell Center."
[192] Robeznieks, "The Politics of Progress."

administration to expand its policy, as the focus has now moved to alternative funding sources.[193]

These new sources help to keep researchers in the U.S., but they cause other problems. When states set the policy and funding, there is the fear that the country will have a division between "red-state medicine and blue-state medicine," with some residents and hospitals perhaps having limited access to certain treatments.[194] Legislators in Arkansas and Virginia are already working to ban or limit the research.[195] In terms of oversight, some claim it is far more desirable to have one unified federal policy, rather than 50 different policies. Congressman Orrin Hatch's communications director asserts that if the research is going on, it should be funded through the NIH so that the NIH can impose its own guidelines.[196]

Far more troubling than inconsistent policies is the tendency among these alternative sources to focus on material rewards as their primary motive in supporting this research. Recent reports of states' plans are replete with talk of the billions in economic benefits that might result from any miracle cures their researchers develop. In order to fund this research, states and private companies do need to convince their taxpayers and shareholders that they will reap financial rewards from the investment, but this focus on monetary success could negatively affect the research and its results. Private companies are likely to have much less interest in the noncommercial aspects of stem cell research. While NIH-funded labs are free to concentrate on advancing basic scientific knowledge or on certain aspects

[193] Bono, "Funding Shifts."
[194] Ibid.
[195] Jones, "After California."
[196] Robeznieks, "The Politics of Progress."

of patient care, these areas may be neglected if scientists need to work to produce profits for their investors.

Principles in Policymaking

Moral foundations of the policy. Despite that so many scientists are unsatisfied by President Bush's policy, it is unlikely that he will consent to its expansion. He appears to have made his decision not because it best accommodated the needs of the scientific community, but because it was the only acceptable way for him to fund the research at all. In his address to the nation, Bush said that his policy "allows us to explore the promise and potential of stem cell research without crossing a fundamental moral line, by providing taxpayer funding that would sanction or encourage further destruction of human embryos that have at least the potential for life."[197] The problem for the President was that, although he viewed the killing of embryos as wrong, he also wanted to be able to use the results of this action without encouraging its perpetuation. The only way to do this was to limit eligible research to already-existing lines. He felt that even allowing private companies to do the actual embryo killing would have encouraged and endorsed this action.[198]

Congress' appeals. When people make decisions based on "fundamental lines" that cannot be crossed, it is fair to say that practical limitations of their decisions will not cause them to reconsider. However, many members of Congress have attempted to convince the President that his policy should be expanded. A total of 206 Representatives and 58 Senators signed letters citing the "current challenges"

[197] Bush,"Remarks by the President," transcript.
[198] "Funding Policy," PCBE staff working paper.

of the policy, which included the lack of suitable lines available and the difficulty in recruiting new researchers to the field. The effort was fairly bipartisan. Republicans Trent Lott and Gordon Smith both called for an expansion, and interestingly, both also had personal experiences with in-vitro fertilization; Lott's grandson was conceived by this technique, and Smith and his wife attempted to conceive a child in this way.[199] However, they also emphasized that the President should be given credit for having funded the research at all, especially considering how many of his constituents were unhappy about the decision.

The significance of federal funds. It is important to note the extent to which the debate over funding is about a specific symbolic message, rather than about regulating conduct. For many, there is a sense that taxpayer money is connected to the larger convictions of a society, so that spending it in a certain way attests to these convictions.[200] The American public, with certain controversial issues, prefers that its money not go to fund actions or causes that offend its collective sensibilities.[201] To refrain from funding any research would perhaps imply a tacit disapproval, but it would not amount to a ban. In fact, IVF fertility treatments and research have also never received federal funds, despite being appreciably less controversial.[202]

The current Administration, like some others in the past, is trying to put into practice the working principle that life should not be destroyed in any of its forms. For many people, this principle is contestable and its promotion is an inappropriate guide for policy. Yet this argument—that the government should not attempt to

[199] Connolly, Ceci. "Two GOP Senators Defend Bush on Stem Cell Research." Washington Post, 13 August 2004, A02.
[200] Outka, "Ethics of Human Stem Cell Research," 183.
[201] "Funding Policy," PCBE staff working paper.
[202] Ibid.

impose a particular interpretation of controversial moral principles—is easier to establish when the government attempts to regulate conduct based such principles, such as when it attempts to censor speech. The current policy on stem cell research does not regulate conduct, but only stipulates the purposes for which its funds may be used. As the government tends to heavily consider the message federal funds send, one would have difficulty arguing that the promotion of a symbolic message in this instance is inappropriate. However, one commentator wryly notes that the President's policy doesn't actually save the lives of any embryos, so that in a way, it could be seen as weighing the promotion of a purely symbolic message more heavily than the lives of those this research might save.[203] Yet the weighing of benefits and problems factors only marginally into his decision. Instead, any expansion of his policy would contradict the principles that underlie it and the message he is sending with it, and this is not something he appears willing to do.

The appropriate role of religion. Some observers assert that the current policy on stem cell research is not merely based on society-wide, humanistic principles about promoting life; rather, it is based on a specific theological view about the origins of life that many Americans do not share. These concerns lead to debates about the appropriate role of religion in deciding policy on sensitive and controversial issues. Critics on both sides have charged their opponents with impermissibly sectarian religious motives. In his speech at the 2004 Democratic National Convention, Ron Reagan said that he understood that for some, it is an article of faith that killing an embryo amounts to murder. However, "it does not follow that the theology of the few should be allowed to forestall the health and well-

[203] Kinsley, Michael. "The False Controversy of Stem Cells." *Time*, 31 May 2004, 88.

being of the many."[204] On the other hand, conservative theologian Richard Doerflinger argued at the National Conference of Catholic Bishops in 2001 that Sen. Orrin Hatch's uniquely Mormon beliefs regarding ensoulment led him to support this research. Mormons believe that life exists in a spirit form before conception and is inserted into the body at a point after conception. He asserted, "I can't argue Senator Hatch out of his theological beliefs, but I don't think he should make the rest of us fund this research based on them."[205] Yet both sides have theological views that impact the way they view stem cell research. Lawmakers should never impose their religious beliefs on others, but they cannot entirely keep their personal views out of their political decisions. Neither side is happy when religious views they do not share are allowed to affect policy, but clearly both sides allow their own particular views to play a role in such decisions.

The President's decision. There is some evidence that the President did, at least in part, base his decision on specifically religious considerations. In his speech, he explained that his position on the issue was shaped by his "deeply held beliefs." He elaborated: "I also believe life is a sacred gift from our Creator. I worry about a culture that devalues life, and I believe as your President I have an important obligation to foster and encourage respect for life in America and throughout the world."[206] Although the language he uses is generic and unobjectionable, the religious beliefs that influence his position must be more specific than this if they form a basis for his policy. Since many people agree that life is the gift of a "Creator"

[204] Ron Reagan, "Transcripts- 2004 Democratic National Convention: Ron Reagan," available at www.dems2004.org (2 April 2005).

[205] Nicholas Wade, "Stem Cell Issue Causes Debate Over the Exact Moment Life Begins," *New York Times*, 15 August 2001, available at www.nytimes.com (4 April 2005).

[206] Bush, "Remarks by the President," transcript.

and still support embryo research, his position on this issue is likely to have been tacitly shaped by religious beliefs of a more sectarian kind.

Although Mr. Bush is not a Catholic, his views partially reiterate the messages given to him by the late Pope John Paul II, with whom he had discussed the issue less than three weeks before his address. The Pope advised:

> A free and virtuous society, which America aspires to be, must reject practices that devalue and violate human life at any stage from conception until natural death. In defending the right to life, in law and through a vibrant culture of life, America can show the world the path to a truly humane future in which man remains the master, not the product, of his technology.[207]

These statements are echoed in Bush's desire to encourage a culture of life throughout the world, and in his underlying assumption that this is a proper role for a representative of a secular government to play. He clearly takes these words and the overall mission to promote life very seriously.

The extent to which the current policy is a result of the President's religious beliefs is unclear. Though presumably he does not make decisions alone, his advisors and staff tend to be taciturn about the impetus for and process of decisionmaking in the White House. It appears that the decision was primarily his to make, and he certainly seemed to be morally torn over the issue in his address. Like most other people, President Bush drew from various sources in order to form his position on stem cell research. In his speech, he described conversations he had had with ethicists, whose advice he carefully considered. Furthermore, his views resemble those of the Pope, for instance, more so than they resemble those of the United Methodist Church, of which he is a member. He composed his position from others' views on the permissibility of this research and from his own pro-life principles.

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[207] Pope John Paul II, "Pope John Paul II Addresses President Bush," transcript of remarks given on 23 July 2001, available at www.americancatholic.org (10 November 2004).

Many claim that even if the President's beliefs wholly directed his decision, this connection between lawmakers' religions and their policies is natural and unavoidable. They point out that everyone comes from some background and holds some beliefs that others do not share. It would be impractical and undesirable for these people to have to avoid making decisions based on their beliefs.[208] Certainly it is inappropriate for government officials to specifically endorse the claims of one faith over those of another, but it does not appear to be the case that the outcomes of complex decisions about stem cell research have produced any impermissible endorsements. Indeed, the President's belief that certain moral lines should not be crossed, despite any potential benefits, articulates an ethical boundary that is widely shared by people of many different faiths.

Public Support

The public appears to be increasingly supportive of stem cell research, but this support is often divided along religious lines. A survey conducted in 2004 by the Pew Forum on Religion and Public Life found that, as a whole, Americans support the research by a small majority, at 52% (see Appendix C).[209] In 2002, that number was 9 percent lower. The numbers are lower among white evangelical Christians, but even in this group, support for this research rose from 26% to 33% in these two years. By contrast, white mainline protestant support rose from 51% to 65%, and white Catholic support rose 43% to 55%. Not only are there differences among

[208] Brent Waters, "What Is the Appropriate Contribution of Religious Communities in the Public Debate on Embryonic Stem Cell Research?" in *God and the Embryo: Religious Voices on Stem Cell Research and Cloning*, ed. Brent Waters and Ronald Cole-Turner (Washington, D.C.: Georgetown University Press, 2003), 20.

[209] "GOP the Religion-Friendly Party, But Stem Cell Issue May Help Democrats," survey results by the Pew Forum on Religion and Public Life, 24 August 2004, available at www.pewforum.org (10 November 2004).

religious faiths, there are also differences among people based on their level of religious commitment. Those with high, moderate, and low levels of religious commitment support the research at 34%, 55%, and 66%, respectively. Yet it is interesting that research support even among those with high and moderate levels of religiosity has risen dramatically between 2002 and 2004, with respective increases of 13% and 15%. Although education levels, ethnic backgrounds, and voting preferences undoubtedly play a role in these decisions, religion appears to be one of the major factors in people's views on this research. Overall, as people learn more about embryonic stem cell research and its potential benefits, they are more supportive of its efforts. Even those whose religions oppose this research show an increase in their support for it when they familiarize themselves with the issue. This illustrates the extent to which people draw from their religious faiths, and also from their own ethical judgments, to determine their positions.

The dispute over federal funding is, in many ways, a dispute between practical considerations and moral principles. Scientists see a situation in which vast amounts of federal funds, which could be used to finance important research, are unavailable because of one man's determination to legislate based on his personal moral opinions. The Administration sees a situation in which an expansion of its policy would tell the world that the United States officially approves of the destruction of embryos and views them as undeserving of protection. Because of this stalemate, other sources of funding have become available that allow this research to move forward, albeit with a few new concerns about the repercussions of this *ad hoc* solution. Since the policy's inception, public support for this research has grown, but it remains strongly divided along religious lines. Throughout his time in office,

President Bush has remained firm in his convictions and resistant to changing the courses he has chosen. His decision appears to have been based on his own moral values and beliefs, which were culled from a variety of sources. Most people's positions on the current policy were formed in a similar fashion, but the resultant views are very different, and they likely determine whether one sees the President as holding fast to his principles or as stubbornly clinging to ideology at the expense of scientific advances.

CONCLUSION

It is tempting to assume that any research involving the destruction of embryos must inevitably divide the populace into two intractable camps: those who believe life begins at conception and those who do not. Yet for the most part, the controversy over stem cell research does not neatly and predictably reinforce old battle-lines over abortion. The unique circumstances surrounding this research muddy what could have been clear waters, and it is not clear at the outset which positions on this research are entirely right or wrong.

The continuing practice of in-vitro fertilization at fertility clinics introduces a great deal of moral ambiguity into decisions about stem cell research. It is difficult for people to condemn fertility treatments because of the laudable intentions of the potential parents, but it is equally difficult to determine the most ethical course of action for the embryos that are no longer needed. Religious groups appear to be the most keenly aware that their concerns about stem cell research originate in the practice of IVF. They are unhappy with the use of embryos in research, but they realize that there are few options available for embryos that already exist as a result of IVF. For many, it is unacceptable to condone embryo research, but it is also unsatisfying that the absence of such research would save no embryos. Because of the results of IVF, and because of the possibility for life-saving benefits from stem cell research, many people who would normally oppose all embryo destruction feel pulled in two directions. They want to protect human life, but they know they need

to contend with the existence of spare embryos, whose use for research might help suffering people.

The nuances of the situation surrounding stem cell research lead people to look to a variety of sources for guidance in forming their own positions. They use some or all of these sources to find views that best suit them, which can be, but are not necessarily, shared by their political or religious affiliations. Though people may find guidance in religious texts or reasoned arguments, they also interpret them based on their own values and beliefs, filtering and drawing from them as their consciences demand. One always has starting points that determine the kind of solution one is looking for and the kind of answers one is willing to accept. If one approaches this moral quandary troubled about the lack of limits on tampering with human life, one will see different aspects as ethically relevant than another who views knowledge without limits to be an unmitigated good. The interpretation of and the emphasis on certain sources above others, and thus the position one ultimately holds, is due in large part to one's own values and beliefs. One creates one's own synthesis and solution.

This is not to say that all decisions are equally good and equally justified and that no position is better than any other. Instead, I have merely argued that this appears to be the way that people actually do make decisions on stem cell research. Of course, some views are undoubtedly better than others. They may have better arguments and justifications for their conclusions, or they may lead to a more satisfying solution for the greatest number of people. But it is important to see that even the way positions are viewed to be *better* by a given person is determined by his or her ethical framework. For instance, I might say that a position is the best if it somehow allows for almost unrestricted research while making the least possible

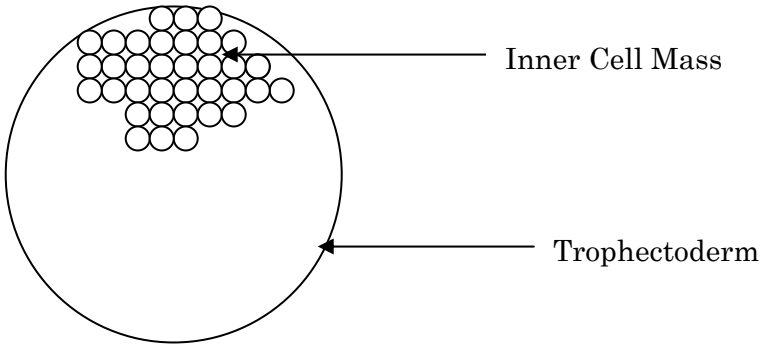
number of people upset in the process. Someone else may view people's feelings to be completely irrelevant in considering the best view, and may instead think the status of the early embryo is the only relevant issue at hand. Though I cannot argue here for or against the existence of an ethical "fact of the matter" that is objectively the best position, this does not preclude there being one. Yet it does seem that each individual's formation of their own personal "fact of the matter" is determined by the ethical frameworks and assumptions he or she already has in place.

This is not entirely surprising or unique to the ethical issues of stem cell research, but it implies that finding common ground will always be exceedingly difficult, despite the attempts of both supporters and opponents of the research to thoroughly examine the issue before deciding. The goal of finding one's own position is not to satisfy everyone, but to satisfy oneself. So it is with President Bush and his opponents. Both sides' views on embryo research are a result of their own values, but neither wants the other side's values to affect policy decisions. They want their opponents to see it their way, but they themselves are unwilling to adopt the other side's point of view.

Yet people are capable of change, as the survey results show. They are capable of examining an issue and changing their position if it better suits them to do so, and this could provide hope for some consensus. The ultimate goal of understanding how people form important ethical decisions is to realize that they are working out a unique position with which they can be comfortable. In looking at these decisions, one finds that others are not motivated by malice or blind dogma or any other such simple caricatures of peoples' motives. They are instead trying to find their own personal answers to the complex questions raised by a new technology that is at once promising and disturbing, that promises great benefits to humanity

but challenges our very conception of what it means to be human. Regardless of the positions we ultimately hold as individuals, we should recognize the momentous nature of the technology at hand and acknowledge our collective responsibility for its proper use. Scientists today have unprecedented power to control and redefine life, aging, disease, and even death. This power could be our greatest achievement, but we would do well to tread carefully on this new ground.

APPENDIX A



The Blastocyst. Embryonic stem cells are derived from cells in the Inner Cell Mass (ICM). These cells would eventually become the embryo. The trophectoderm eventually develops into the placental tissue.

APPENDIX B

How 78 Became 19

	LINES NOT AVAILABLE	LINES REMAINING
Eligible cell lines		78
Duplications of existing available lines	7	71
Failed to replicate	16	55
Donors withdrew consent	1	54
Controlling institutions in other countries have not sought NIH assistance to distribute	31	23
Lines being developed for distribution that could eventually be available	4	19
Available for federally-funded research		19

Source: Robeznieks, Andis. "The Politics of Progress: How to Continue Stem Cell Research Despite Limitations." *American Medical News*, 09 August 2004. Available at www.ama-assn.org (2 April 2005).

APPENDIX C

Shifting Views on Stem Cell Research

	March 2002	Aug 2004
Stem cell debate:		
Heard about...	%	%
A lot	27	42
A little	52	43
Nothing at all	20	15
Don't know	1	*
	100	100
More important to...		
Conduct research	43	52
Protect embryos	38	34
Don't know	19	14
	100	100

Most Attentive, Most Supportive

	Heard about stem cell debate...		
More important to...	A lot	A little	Nothing
	%	%	%
Conduct research	63	47	32
Not destroy embryo	28	37	40
Don't know	9	16	28
	100	100	100

More Support for Stem Cell Research

	More important to conduct research		
	2002	2004	'02-'04
	%	%	
Total	43	52	+9
18-29	46	54	+8
30-49	46	55	+9
50-64	40	52	+12
65+	34	44	+10
College Grad	55	61	+6
Some College	46	50	+4
High School Grad	34	49	+15
Less than HS Grad	36	47	+11
White Protestant	38	48	+10
– Evangelical	26	33	+7
– Mainline	51	65	+14
White Catholic	43	55	+12
Secular	66	68	+2
*Religious Commitment**			
High	21	34	+13
Moderate	40	55	+15
Low	61	66	+5
Conserv Republican	32	35	+3
Mod/Liberal Republican	48	54	+6
Independent	49	57	+8
Conserv/Mod Democrat	43	57	+14
Liberal Democrat	55	72	+17

* Combination of attendance and importance of religion.

Source: Pew Forum on Religion and Public Life

GLOSSARY

Adult stem cell: An undifferentiated cell found in a differentiated tissue that can renew itself and (with certain limitations) differentiate to yield all the specialized cell types of the tissue from which it originated.

Allogeneic cell transplantation: Transplantation of cells from one individual to another of the same species.

Autologous: In transplantation, referring to a graft in which the donor and recipient areas are in the same individual.

Blastocyst: (a) Name used for an organism at the blastocyst stage of development. (b) A preimplantation embryo of about 150 to 200 cells. The blastocyst consists of a sphere made up of an outer layer of cells (the trophectoderm), a fluid-filled cavity (the blastocoel), and a cluster of cells on the interior (the inner cell mass).

Blastocyst stage: An early stage in the development of embryos, when (in mammals) the embryo is a spherical body comprising an inner cell mass that will become the fetus surrounded by an outer ring of cells that will become part of the placenta.

Cell culture: Growth of cells in vitro on an artificial medium for experimental research.

Clone: A line of cells that is genetically identical to the originating cell.

Culture medium: The broth that covers cells in a culture dish, which contains nutrients to feed the cells as well as other growth factors that may be added to direct desired changes in the cells.

Embryo: (a) In humans, the developing organism from the time of fertilization until the end of the eighth week of gestation, when it becomes known as a fetus. (b) The developing organism from the time of fertilization until significant differentiation has occurred, when the organism becomes known as a fetus. An organism in the early stages of development.

Embryonic stem cells: Primitive (undifferentiated) cells from the embryo that have the potential to become a wide variety of specialized cell types.

Embryonic stem cell line: Embryonic stem cells, which have been cultured under in vitro conditions that allow proliferation without differentiation for months to years.

Ex vivo: Outside the body, frequently the equivalent of "in vitro."

Feeder layer: Cells used in co-culture to maintain pluripotent stem cells. In the past, these cells have usually consisted of mouse embryonic fibroblasts.

Fertilization: The process whereby male and female gametes unite.

Fetus: A developing human from usually two months after conception to birth.

Fibroblast: A stellate (star-shaped) or spindle-shaped cell with cytoplasmic processes present in connective tissue, capable of forming collagen fibers.

Gene: A functional unit of heredity that is a segment of DNA located in a specific site on a chromosome. A gene directs the formation of an enzyme or other protein.

Histocompatible: The immunological characteristic of cells or tissue that causes them to be tolerated by another cell or tissue; that allows some tissues to be grafted effectively to others.

ICM cells: Cells from the inner cell mass, a population of cells inside the blastula that give rise to the body of the new organism rather than to the chorion or other supporting structures.

Immunosuppressive drugs: Drugs that prevent or interfere with the development of an immunologic response. After a transplant, immunosuppressive drugs are usually necessary in order to prevent the recipient from rejecting the transplant.

Implantation: The attachment of the blastocyst to the uterine lining, and its subsequent embedding there.

In vitro fertilization (IVF): The union of an egg and sperm, where the event takes place outside the body and in an artificial environment (the literal meaning of "in vitro" is "in glass"; for example, in a test tube).

Inner cell mass: The cluster of cells inside the blastocyst. These cells give rise to the embryonic disk of the later embryo and, ultimately, the fetus.

Long-term self-renewal: The ability of stem cells to renew themselves by dividing into the same non-specialized cell type over long periods (many months to years) depending on the specific type of stem cell.

Multipotent: As applied to stem cells, the ability to differentiate into at least two kinds of descendant cells.

Pluripotent: having great developmental plasticity. Cells that can produce all the cell types of the developing body, such as the ICM cells of the blastocyst, are said to be pluripotent.

Population doublings: The number of times cells growing in vitro have increased the total number of cells by a factor of 2 compared to the initial number of cells.

"Single-cell cloned": A procedure pertaining to cells in vitro in which the descendants of a single cell are physically isolated from other cells growing in a dish, and then expanded into a larger population.

Somatic cell nuclear transfer (SCNT): A method of cloning, wherein the nucleus from a donor somatic cell is transferred into an enucleated egg to produce a cloned embryo.

Stem cells: Stem cells are undifferentiated multipotent precursor cells that are capable both of perpetuating themselves as stem cells and of undergoing differentiation into one or more specialized types of cells.

Trophoblast: The extraembryonic tissue responsible for implantation, developing into the placenta, and controlling the exchange of oxygen and metabolites between mother and embryo.

Xenotransplantion: A transplant of tissue from an animal of one species to an animal of another species.

Source: President's Council on Bioethics, *Monitoring Stem Cell Research* (Washington, D.C.: Government Printing Office, 2004), 147-156.

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