Philosophy and Science Policy in the American Cloning Debate

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Abstract: This thesis explores current United States policies prohibiting public funding for nonreproductive cloning, logically reconstructs their justification, and argues against it. I show that a common conceptual framework underlies the national prohibition on the use of public funds for cloning research, which I call *the simple argument*. This argument rests on two premises: that research harming human embryos is unethical and that embryos produced via fertilization are identical to those produced via cloning. In response to the simple argument, I challenge the latter premise. I demonstrate there are important ontological differences between human embryos (produced via fertilization) and clone embryos (produced via cloning). After considering the implications my argument has for the morality of publicly funding cloning for potential therapeutic purposes and potential responses to my position, I conclude that such funding is not only ethically permissible, but also humane national policy.

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PREFACE

The following work was inspired by a term paper for the first history course I took in graduate school, History of Science II, with Paolo Palmieri, in the Department of History and Philosophy of Science. Years later, after completing the coursework requirements for the M. A. in Bioethics, I faced a need for a thesis topic. I had already been inspired by my coursework in bioethics to focus my PhD dissertation in the HPS department on topics in philosophy of medicine and medical ethics. So it was only natural that I chose to take a topic from HPS and work it out in detail for my M. A. in Bioethics. Yes, only natural; such is the nature of my interdisciplinary approach to scholarship. I thank Paolo for providing me an opportunity to think about contemporary history of science funding policies and for supporting my inquiry into what did not appear particularly consistent with other scholarship I was becoming familiar with at the time.

Many others warrant thanks and recognition. My wife, Stephanie, has steadfastly supported my pursuit of wisdom and degrees. I hope they go hand in hand. And I hope that one day I learn how to write as well as she can so that I may share what I have learned articulately. Also, I have made many friends while pursuing my education in Pittsburgh. Some of them have influenced my thinking on this project in particular, including James Tabery, Yoichi Ishida, Peter Distelzweig, Jason Byron, and Peter Gildenhuys. Another friend, Kathryn Tabb, specifically helped me frame my discussion in § 2.1. She often helps me see forests where I see trees and trees where I see forests. I think she would agree the world is just composed of elephants.

During a conference at Arizona State University, Jane Maienschein challenged my thinking in this project. My response to her criticism helped clarify the thesis of the project and also anticipate one way it could be misconstrued. It is to her that I owe the objection described in § 4.1, although in my recollection she delivered it more clearly and persuasively than I render it.

Locally, I have been helped enormously by Lisa Parker. As a teacher, she introduced me to important material in bioethics and frequently challenged my intuitions. And as the Director of the M. A. Program in Bioethics, she strategized with me about how to complete the degree in a way that was most consistent with my own interests and the standards of the program. Moreover, she did this for over five years with consistent and utmost patience. Likewise, both Mark Wicclair and Douglas White have helped me mature as a scholar and work through this project in particular. During my prospectus defense they articulated an objection to my position that is now conveyed and responded to in § 4.2. I also profited in many ways from taking Theoretical Foundations of Bioethics with Mark, where I learned that my training in philosophy of science,

such as it was, did not prepare me sufficiently well to do good work in philosophical ethics, applied or otherwise. Insofar as I have learned that skill, it is directly correlated with the extent to which I have attended to the example he sets and to his specific criticisms of my work.

A number of institutions have directly or indirectly financially supported the completion of this project. Thanks go first and foremost to the HPS Department at the University of Pittsburgh, my generous academic home from 2005 to 2013. The Center for Bioethics and Health Law, also at Pitt, supported my attendance at the American Society for Bioethics and Humanities in 2010, where I enjoyed discussions about this project that helped move it along. Portions of the project were presented at the University of Pittsburgh Graduate Student Expo 2007, the History and Philosophy of Biology in the Desert Conference at ASU in 2011, and at the 2011 meeting of the International Society for the History, Philosophy, and Social Studies of Biology (ISHPSSB). I thank both ASU and ISHPSSB for their support. Currently I am employed at the University of Arkansas for Medical Sciences. I thank D. Micah Hester for supporting my completion of this project while transitioning to my current position.

Portions of this work have recently been published. I sincerely thank an anonymous reviewer (or a set of reviewers, one cannot be sure) for thorough, clear, and yet generally supportive criticisms of key parts of it. Without his or her (or their) effort(s), I would not have appreciated the relevance of my work to arguments concerning induced pluripotent stem cells (iPSCs). Much of this thesis appears in revised form in Cunningham (2013b), where specific acknowledgements to this anonymous reviewer (and others) may be found. While responding to her objections, I was motivated to learn more about iPSCs. Thus, when Mark Wicclair suggested I submit a proposal to an *AJOB* Open Peer commentary, I was ready with something to say. Thanks go to Mark for the suggestion, and to the reviewer for the motivation. The resulting essay is published as Cunningham (2013a) and forms the basis for § 3.3 of this thesis. Thanks to both Springer and Taylor Francis, which have given me permission to reuse the previously published work in this document.

Finally, if you are reading this, thank you for the time and effort. Enjoy.

1.0 INTRODUCTION

The nucleus of a somatic cell can be transferred to an enucleated egg cell, or oocyte, resulting in a unicellular product that can be activated by electrical stimulation to undergo some of the developmental processes typical of a human embryo. This process is called somatic cell nuclear transfer (SCNT). After a few days of subsequent development, under laboratory conditions the resulting cellular material can be used to derive stem cells matching the genetic profile of the initial somatic cell (Tachibana et al. 2013).[1] Stem cells produced in this fashion could be used to derive tissue that matched donor tissue well enough to circumvent the immunological responses that serve as major barriers to successful transplant and regenerative medicine (Hochedlinger and Jaenisch 2003). The products of SCNT might also be used for reproduction – to create human beings whose genomes would be nearly identical to the genomes of the donated somatic cells from which they originate.[2]

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[1] This research was funded via institutional funds from the Oregon Health Sciences University and funds from the Leducq Foundation, not from US public funding.

[2] In theory, a human reproduced by cloning would at most have only *nearly* identical DNA to the nucleus from which it originated because his or her mitochondrial DNA would come from the oocyte used in SCNT, rather than the somatic cell. Additionally, polar bodies and epigenetic mechanisms of inheritance would also influence what genes are expressed as that person develops, creating another source of genetic diversity.

Like all stem cell research, SCNT is controversial because it appears to deliberately create and destroy entities of the utmost moral concern, human embryos. But SCNT is also controversial because of its theoretical potential to be used for the cloning of human beings. For these reasons, United States federal funds are prohibited from supporting research employing SCNT, even though it is a biotechnology touted for having great potential to treat myriad human diseases, such as Parkinson's disease, diabetes, and congestive heart failure (Lanzendorf, Boyd, and Wright 2004).[3] It seems a choice must be made between protecting the sanctity of life at the expense of potentially lessening suffering or striving to lessen suffering at the expense of crossing a bright moral line prohibiting the killing of innocent human beings (embryos). The purpose of this thesis is to challenge this apparent dilemma by questioning the justification for the current ban on federal funding of SCNT for research purposes, also known as *nonreproductive cloning*. My thesis is that the justification for the ban rests on the false assumption that the product of SCNT is a human embryo or an entity deserving of the moral status of a human embryo. If one rejects this claim, as I do, then this challenging dilemma dissolves. I conclude that the funding of biomedical research employing SCNT aids the fight against human suffering without allowing the destruction or desecration of human life. If my

[3] The therapeutic potential of stem cell research (SCR) is extremely controversial and uncertain, and will remain so for the near future. Currently, it is only a theoretical potential, as few randomized controlled trials are underway for stem cell therapies, which would show its actual feasibility. Notably, a biotechnology leader in stem cell research has recently ceased all efforts in the field (Pollack 2011); however, recent preliminary results from another leading company suggest that some patients benefit from therapies derived from SCR (Schwartz et al. 2012). While currently stem cell therapies are unfortunately primarily the province of speculation and unethical treatment (see Enserink 2006), it is possible that with funding, federal oversight, and national and global regulation, ethical therapies could be developed that will benefit many suffering individuals.

argument is sound, then *even those who believe that human life begins at conception*, rather than at a later stage in human development, can endorse SCNT without choosing to protect some human beings at the expense of others.

In the remainder of this chapter, I trace the historical origins of the ban on the federal funding of SCNT in section 1 and demonstrate in section 2 that the ban was originally justified on the grounds of what I will call *the simple argument*: that funding SCNT is tantamount to funding research that harms human embryos. In chapter 2, I advance the core argument of this work, namely that the simple argument is unsound because it rests on a false premise stipulating an identity relationship between human embryos and the products of SCNT. The remainder of the thesis anticipates and responds to objections to this criticism of the simple argument. One might respond that, irrespective of the soundness of my position, the product of SCNT deserves the same moral status as a human embryo and hence it also deserves our protection – including a ban on such research. Or, one might argue for an alternative approach to justifying the prohibition, by appealing to the political realities of policymaking. I consider and counter these objections in Chapters Three and Four, respectively. Chapter Five concludes briefly by restating the argument for my view that the current prohibition on funding is unjustified. If my argument stands, a different justification for the ban on federally funding SCNT is required; otherwise, the potential for relieving suffering provides a sufficient justification for aggressively funding research employing SCNT using public funds.

1.1 A Ban on Federal Funding of Somatic Cell Nuclear Transfer

For decades, philosophers, politicians, and policymakers have debated the merits and ethics of scientific research upon human embryos. Historically, these debates have been tightly linked to

deliberations over reproductive rights, where participants frequently invoke positions on abortion and artificial reproductive technologies (Henig 2004). More recently, these debates have also focused on a new issue, human cloning, which has culminated in the current ban on federal funding of SCNT. In this sub-section I describe how these political debates have led to the ban, demonstrating that a common view pervades policymaking on cloning and embryo research, that it is unethical because it involves the destruction of human embryos.

From 1975 to 1993, federal law permitted using public funds for research on in vitro fertilization (IVF), provided it was first approved by an Ethics Advisory Board (EAB). However, political constraints entailed that no such funding was ever available: by failing to charter an EAB during their administrations, the Regan and (first) Bush administrations circumvented the only lawful mechanism for approving federal funding for IVF research (Fletcher 1995). In 1993, the Clinton administration repealed a federal moratorium on fetal tissue research. This signaled that administration's commitment to liberalizing federal regulations of scientific research set in place by the prior two administrations. Shortly thereafter, Congress repealed the EAB requirement for federal IVF funding and the National Institute of Health (NIH) created the Human Embryo Research Panel (HERP) to provide guidance on other types of research employing human embryos.

In 1994, HERP issued its report on embryo research. It distinguished three categories of embryonic research, one being research that was *prima facie* unacceptable, and hence for which funding was prohibited; another being research that was *prima facie* acceptable, and hence for which funding was permitted; and another for research whose acceptability was unclear, which would require further examination before funding decisions could be made. Notably, research

on parthenogenesis and somatic cell nuclear transfer both fell into the second category, of acceptable research (Riley and Merrill 2005, pp. 22-26).[4]

The HERP recommendations never became federal policy or found their way into legislation. Indeed, HERP received a considerably negative reaction because of its inclusion of embryos created expressly for research in its third category. Such research seemed patently impermissible to many Congressional conservatives, prompting them to rail against the HERP guidelines. After strong conservative gains in the elections of November 1994, the fate of the HERP report was sealed; on the day it was announced, President Clinton issued a statement barring funding for research that created embryos solely for research purposes (*ibid.*, p. 26).

The idea that scientists might begin creating embryos and destroying them for research purposes was anathema to many in Washington. Two Congressmen in particular, Jay Dickey and Roger Wicker, added what has become known as the Dickey-Wicker Amendment to what would become the *Balanced Budget Down-Payment Act* (Maienschein 2003, p. 3). The amendment reads, in full:

> None of the funds made available by Public Law 104–91 may be used for—(1) the creation of a human embryo or embryos for research purposes; or (2) research in which a human embryo or embryos are destroyed, discarded, or knowingly subjected to risk of injury or death greater than that allowed for research on fetuses in utero under 45 CFR 46.208(a)(2) and 42 U.S.C. 289g(b). For purposes of this section, the phrase ''human embryo or embryos'' shall include any organism, not protected as a human subject under

[4] The history of politics, philosophy, and embryo research policy during this era is fascinating and worthy of considerations, but beyond the scope of the present discussion. See Riley and Merrill (2005) and Green (2001) for detailed discussions.

> 45 CFR 46 as of the date of enactment of this Act, that is derived by fertilization, parthenogenesis, cloning, or any other means from one or more human gametes (Public Law 104-99 1996).

While this amendment clearly prohibits funding the creation of human embryos for research purposes, it is unclear whether it precludes funding research on entities whose status as human embryos is uncertain.

Consider, for example, cells *derived from* embryos. Seeking to comply with federal law, in 1998, the NIH requested that Harriet Rabb, the general counsel of the Department of Health and Human Services (DHHS), give legal counsel regarding whether the amendment permitted funding human embryonic stem cell research. Her response (known as the *Rabb Doctrine*) was that the Dickey-Wicker amendment "would not apply to research utilizing human pluripotent stem cells because such cells are not a human embryo within the statutory definition" (Rabb 1999). The Rabb Doctrine initially paved the way for federal funding of stem cell research utilizing cell lines that were derived from human embryos; however, it never permitted funding research on the derivation of those cell lines, which requires the destruction of embryos. Moreover, whatever clarity the doctrine initially provided was soon altered by the statements of President George W. Bush.[5]

A year before Rabb's work, scientists announced the cloning of a sheep named Dolly (Wilmut et al. 1997). This announcement animated members of the United States House of Representatives, who sought to pass the *Human Cloning Prohibition Act* in 2001. Though it

[5] The Rabb Doctrine has survived several Federal court challenges and remains in effect today. See Robertson (2010), Cohen and Adashi (2011), and Annas (2011) for recent discussions of the doctrine, this litigation, and its implications for federal funding of stem cell research. The most recent decision affirming the Rabb Doctrine came on August, 24, 2012 (*Sherley vs. Sebelius* 2012).

passed the House, the Senate never took up the bill. Yet, it is important because it shows that by 2001, members of Congress had identified human cloning via SCNT as a target for their opprobrium. Perhaps because of the maneuvering of the NIH, the House sought to be explicit in its prohibition of cloning. The bill prohibited any public or private person or entity from engaging in a number of activities related to human cloning, defined as:

> …human asexual reproduction, accomplished by introducing nuclear material from one or more human somatic cells into a fertilized or unfertilized oocyte whose nuclear material has been removed or inactivated so as to produce a living organism (at any stage of development) that is genetically virtually identical to an existing or previously existing human organism" (quoted in Maienschein 2003, pp. 288-289).

Less than two weeks after the U.S. House passed the cloning prohibition act, President George W. Bush gave his first major televised address to the nation. The President said he must decide "whether to allow federal funds, your tax dollars, to be used for scientific research on stem cells derived from human embryos." For Bush, this was a moral issue: "research on embryonic stem cells raises profound ethical questions because extracting the stem cell destroys the embryo and thus destroys its potential for life" (White House 2001). Bush decided to permit funding research on preexisting cell lines and to prohibit funding for any additional research involving the destruction of human embryos. He said this approach allowed Americans "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" (*ibid.*).

With his speech, the President set the terms of debate over embryonic stem cell research. He also announced a Presidential Order superseding much of the Rabb Doctrine, including the

prohibition of federal funding of any research involving new stem cell lines, even after their derivation. Finally, Bush also announced the creation of a President's Council on Bioethics (PCBE), which was charged with proposing guidelines and regulations for biomedical research and, in particular, cloning and stem cell research.

The result of the council's inquiry was published in July of 2002. It offered two distinct recommendations to the President and policymakers, with the majority of the council members (10/17) voting for "a congressionally enacted ban on all attempts at cloning-to-produce-children and a four-year national moratorium (a temporary ban) on human cloning-for-biomedical-research" (President's Council on Bioethics 2002a, p. 205), where, "cloning-for-biomedical-research" is synonymous with nonreproductive cloning, or SCNT for the purpose of research (*ibid.*, pp. 42-46).[6] The PCBE emphasized that the moral issue at hand was whether the federal government should fund research designed to create and destroy human embryos, including research utilizing somatic cell nuclear transfer (*ibid.*, p. 201).

With the conclusion of its deliberations and the publication of its report, the President's Council on Bioethics added yet another powerful voice to the chorus of opposition against federal funding of somatic cell nuclear transfer for the purpose of deriving cellular material for stem cell research. By the middle of 2002, two of the three branches of federal government had spoken out against federal funding of SCNT, and President Bush had adopted the PCBE majority recommendation.

With the election of President Barack Obama, advocates for stem cell research had high hopes that the new administration would change these policies. On March 11, 2009, their hopes

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[6] Consistent with the view argued for here, the minority recommended a total ban on reproductive cloning and federal regulation of nonreproductive cloning.

were partially met when President Obama issued an order revoking the Presidential Order of August 2001 (White House 2009). For many this move was unsatisfying because it failed to lift the ban on federal funding of SCNT and parthenogenesis put in place by the Dickey-Wicker Amendment (Robertson 2010).

1.2 A Simple Argument Against Federal Funding

Since 1996, politicians and policymakers who argue against the morality of federally funding somatic cell nuclear transfer have favored one line of reasoning in particular. It holds (i) that federal funds should not be used for scientific research that harms human embryos, and (ii) that SCNT is a member of this class of research methods. The PCBE claimed that cloning via SCNT should be permanently opposed because "it is immoral to create human embryos for purposes that are foreign to the embryos' own well-being and that necessarily require their destruction" (President's Council on Bioethics 2002a, p. 201). President Bush stated that the moral dilemma brought about by the prospect of funding stem cell research was precisely that such research required the destruction of human embryos. And, though it did not prohibit SCNT explicitly, the Dickey-Wicker amendment prohibited any technique that destroys or discards human embryos, specifically those derived by cloning.

In each of these cases, a prohibition on federal funding for nonreproductive cloning is justified by the following argument:

1. The federal government should be prohibited from funding unethical scientific research.
2. Research that harms human embryos is unethical because human embryos have a moral status that makes them deserving of our respect and protection.

3. If somatic cell nuclear transfer creates and destroys human embryos then it harms human embryos.
4. Somatic cell nuclear transfer creates and destroys human embryos.
5. Somatic cell nuclear transfer harms human embryos. [3, 4]
6. Somatic cell nuclear transfer is unethical because it harms human embryos. [2, 5]
7. The government should be prohibited from funding research utilizing somatic cell nuclear transfer. [1, 6]

For the purposes of this analysis, I will call this argument the Simple Argument From Identity or *the simple argument*.[7]

The simple argument is simple because it rests on four claims, two of which are fairly uncontroversial (1, 3) and two of which are not (2, 4). Thus, the soundness of the simple argument may be said to come down to the plausibility of just two claims.

Although one might challenge Premise 1, here it will be treated as uncontroversial. Premise 3 also seems acceptable: whether creating something harms it or not, destroying something certainly harms it. Out of the two contentious premises, it is common to attack Premise 2, which may be rejected on the grounds that human embryos lack a moral status and are not deserving of our respect and protection (*e.g.*, DeGrazia 2002).

In this analysis, however, the strategy will be different: I grant the truth of the first three premises as they stand for the sake of argument and instead target the fourth premise. I will argue that somatic cell nuclear transfer does not create human embryos, and consequently it does

[7] One might add another premise to the argument defining what constitutes harm to embryos, such as: To harm a human embryo includes such acts as destroying, discarding, or knowingly subjecting it to certain levels of risk of injury or death, as defined by United States law. For the sake of this analysis such a premise is assumed but suppressed.

not destroy human embryos.[8] Rather, SCNT creates clone embryos, which are ontologically and morally distinct from human embryos. If clone embryos are not identical to human embryos, then it follows that the fourth premise is false, because SCNT thus does not create and destroy human embryos. Therefore, the inference to the fifth premise fails and the rest of the argument fails to go through as well.

My argument requires considering knowledge from cellular developmental biology in some detail, in order to show that clone embryos and human embryos are ontologically distinct. Some of this knowledge is based on cutting edge experiments in embryology and stem cell research, which has yet to be replicated and the biological implications of which are not yet well understood. My argument is thus highly sensitive to empirical knowledge and may be altered or even invalidated as this knowledge accrues over time. Although in one sense this is a weakness of the argument, it is also its strength: by demonstrating that a careful consideration of the science of cloning bears on the question of whether funding this activity is morally permissible, I provide a means of relating descriptive claims about the nature of different types of entities (embryos) to normative claims about the permissibility of research using and destroying them. It

[8] It is important, at this point, to clarify a potential ambiguity. As stated here, the simple argument may be ambiguous in terms of how it defines SCNT, in that it could simply mean the singular act of nuclear transfer and none of the steps in the process of cloning that come thereafter. To define SCNT thusly would be to evade the reasons given for opposing it rather than to challenge them. To prevent this interpretation, it should be made clear that by SCNT, I mean not only the act of nuclear transfer, but also the following, discussed in detail below (§ 2.3): the preparation of donor cells (removal of nuclei from somatic cell and oocyte), the combination of somatic nucleus and oocyte (nuclear transfer), the activation of the reconstituted oocyte, and the initial divisions of this cell to the clone blastocyst stage, all of which are performed *ex vivo*. Thus, following a successful act of SCNT, clone embryonic stem cells could in theory be isolated from the inner cell mass of the clone blastocyst and used for the research of cell therapies for transplant and regenerative medicine, as in Tachibana et al. (2013).

may be the case that in the future our descriptive knowledge of embryology will change and that the similarities or dissimilarities between the developmental pathways of human and clone embryos consequently change. In the future, then, it may be the case that it no longer seems reasonable to hold that human and clone embryos are ontologically distinct. If so, then my view provides a means of understanding the moral implications of this change in perspective, should it arise. It would entail that the simple argument is valid, absent criticism of its other premises, and thus that prohibiting public funding of nonreproductive cloning research is morally permissible.

My argument also considers the extent to which it is possible to support the simple argument by arguing that clone embryos warrant moral status on grounds that are independent from, though often analogous to, the grounds for holding that human embryos warrant attribution of moral status. If my argument is sound, then it is also significant because of this. It shows that one's intuitions about the moral status of human embryos produced by fertilization (and their derivatives)[9] should be independent from, and have little or no bearing on, one's intuitions about the moral status of embryos produced by SCNT for the purposes of deriving cellular material for therapeutic research.

However, showing this does not preclude the possibility that clone embryos warrant the attribution of moral status. To support the view that clone embryos do not warrant attribution of moral status requires demonstrating that apparently valid reasons for holding clone embryos should be attributed moral status are not as valid as they seem, and by showing that whether they are valid ought to be determined by considering the developmental potentials of clone embryos, *qua clone embryos,* not by considering the developmental potentials of human embryos and then

[9] This includes human embryonic stem cells, which will be discussed below, when we consider objections to the argument presented here.

making an analogy to clone embryos. Thus, although my aim is to target Premise 4 of the simple argument, I anticipate that one response to my view will be to invoke an alternative version of Premise 2 where "human" is replaced with the word "clone" and the simple argument is altered accordingly, such that it now targets clone embryos rather than human embryos and now holds that clone embryos warrant moral status. In order to counter this move, I will also spend considerable effort discussing the extent to which clone embryos warrant moral status given traditional views on attributing status. So in this sense I will be concerned with Premise 2 as well as Premise 4, although only after Premise 2 is modified such that it targets clone embryos directly, rather than by analogy with or identity to human embryos.

2.0 A RESPONSE TO THE SIMPLE ARGUMENT

To engage with the proponent of a ban on federal funding of SCNT, I have fairly explained the recent history of this policy and I have also reconstructed the argument justifying its institution given by philosophers, politicians, and policymakers. In this chapter, I demonstrate this reasoning is flawed because it is based on a premise that is false; consequently, proponents of prohibition ought to revise their argument or invoke an alternative.

I begin, in section 2.1, by describing assumptions I make about reasonable argument in public policy deliberations. I do this because the opponent of public funding for SCNT might make different assumptions about how policies ought to be deliberated upon. Since this higher-order commitment might lead her to find my arguments unpersuasive, because they might be beside the point, I begin by making these assumptions clear. If my interlocutor accepts them, then I contend we begin from a shared starting point. In section 2.2, I move from this shared starting point to describing a possible point of contention between my view and my opponent's. I argue that we can describe the origins and early developmental stages of human embryos with some precision. If I am right, then I claim that human embryos are the products of fertilization, and this tells us something important about them. Similarly, I argue we can describe the origins and early developmental stages of the products of SCNT, which I suggest we call "clone embryos" for reasons given below (§ 2.3). If so, then I conclude this chapter by arguing that we can distinguish between human and clone embryos in terms of their origins, developmental

pathways, and thus, their developmental potentials. In section 2.4, I argue that these are ontological differences, and that these differences are important because they demonstrate that what many think is an innocuous premise in the simple argument (P4) is likely to be false. By arguing that clone embryos and human embryos are different entities, I challenge the identity claim upon which P4 rests. If my argument is sound, then the simple argument is invalid because it rests on a claim that evidence suggests is false. However, the proponent of the simple argument may offer a rejoinder by challenging my empirical premises, offering new empirical data, or putting forward objections on different grounds. I consider the latter possibility in subsequent chapters.

2.1 An "Unreasonable" Prohibition

My response to the simple argument relies on assumptions about the nature of policy justification, the contours of which warrant brief description. To put it succinctly, I contend that *justified public policies must be reasonable*. Thus, if a public policy is unreasonable, then it is unjustified; and, if a public policy is unjustified, then there is an imperative that it be revoked or refashioned such that it becomes reasonable. I understand reasonableness to entail certain norms of public discourse, which, when followed, lead to justified policies. I contend that if my interlocutor shares this commitment to reasonableness and the simple argument is shown to be unsound, then my interlocutor must reject that argument. In response, the proponent of prohibition must offer an alternative argument or agree to revise public policy to permit federal funding of nonreproductive cloning, which will necessitate further deliberations on how such funding ought to be regulated.

As a criterion for justification, reasonableness is meant to be a generic one, meaning that it should not have features that lead it to prejudge the debate over a particular issue, such as the morality of federally funding SCNT for scientific research. Rather, reasonableness may be defined in terms of generally agreed-upon principles for public deliberation, including coherence, consistency, fairness, and soundness. The inspiration for this sense of reasonableness comes from John Rawls. For Rawls,

> Persons are reasonable in one basic aspect when, among equals say, they are ready to propose principles and standards as fair terms of cooperation and to abide by them willingly, given the assurance that others will likewise do so. Those norms they view as reasonable for everyone to accept and therefore as justifiable to them; and they are ready to discuss the fair terms that others propose. […] Reasonable persons, we say, are not moved by the general good as such but desire for its own sake *a social world in which they, as free and equal, can cooperate with others on terms all can accept* (Rawls 2005, pp. 49-50; italics added).

Adopting the standard of reasonableness provides an avenue for fairly criticizing the simple argument without requiring a foray into the issue of where human life begins. Rather, all that is required is to successfully challenge the identity claim encapsulated in Premise 4, between the referent of "human embryo" and the referent of "the product of somatic cell nuclear transfer." Since the simple argument does not include assumptions about the contentious issue of when human life begins, one need not engage with this issue in order to determine whether funding experimentation upon clone embryos is morally permissible. To determine whether such funding is permissible instead requires determining (a) whether clone embryos are identical to human embryos, which are granted moral status by stipulation in this work, or (b) whether clone

embryos warrant moral status on grounds independent from, though analogous to the grounds for attributing moral status to human embryos. To determine this, it is necessary to define the meanings of the terms "human embryo," "clone embryo," and "parthenote" in a way that they are seen as "terms all can accept" when taking part in policymaking deliberations. I submit that these terms refer to biological entities best described in terms of the steps necessary for their persistent development. Once these defining features have been made explicit, it will become clear that the products of SCNT may be distinguished from both human embryos and parthenotes. Thus, the simple argument is shown to be unsound because the identity relation it posits is shown to rest on shaky ground. However, one may nevertheless hold that clone embryos deserve moral status on other grounds, principle among them being that they are capable of developing into entities that warrant moral status, such as fetuses or neonates, irrespective of whether they are identical to human embryos. Whether this view is persuasive depends on whether it seems likely that clone embryos have this capability, which I will argue they do not.

2.2 The Human Embryo as the Product of Fertilization

The first term in need of clarification is "human embryo." In order to be precise about the referent of this term it is necessary to review the cellular biology of fertilization and embryogenesis. The formation of a human embryo via natural or artificial fertilization begins with the fusion of male and female gametes, or sperm and egg, and ends with a two-celled zygote. In natural fertilization, this process occurs in the fallopian tube and takes about a day to complete. It is depicted in Figure 1.

In the first step of fertilization, the female *haploid* nucleus undergoes duplication to form the female *pronucleus*. The pronucleus has 46 chromosomes; however, in the pronucleus these 46 chromosomes stem from only one parent. As is shown in Figure 1-A, the female pronucleus forms when gametic chromosomes duplicate. After a single spermatozoon passes through the protective shell surrounding the oocyte (the *zona pellucida*), the sperm and egg membranes fuse and the male haploid nucleus is released into the cytoplasm, where it then duplicates to form the male pronucleus (Figure 1, B and C). Toward the end of fertilization, the male and female pronuclei briefly come into contact and exchange chromosomes (Figure 1-D). The pronuclei then undergo *syngamy*, a poorly understood process whereby the two haploid sets of parental chromosomes organize together, merge, and migrate (Figure 1-E) to prepare for the initial division of the fertilized egg. The steps of fertilization are also called *zygosis*, because their culmination results in the formation of a *zygote* – a two-celled entity that is the starting point of *embryogenesis*, a process including the formation and development of a human embryo (Figure 1-F).

After zygosis, the human embryo undergoes the first stage of *cleavage*. In this process, the two-celled embryo grows via a special type of cellular division; wherein the number of cells, called *blastomeres*, increases geometrically while the total volume of the embryo remains constant. Within three days after fertilization, the embryo takes on a shape resembling a mulberry, which is a tightly compacted formation of growing blastomeres termed a *morula* (Figure 1-G). By the fourth or fifth day after the initiation of fertilization, the embryo is considered a *blastocyst*, the stage at which a cavity first appears inside the morula (Alberts et al. 2002, pp. 1139-1156; Guenin 2008, pp. 4-5). The importance of the blastocyst stage cannot be overstated; the late blastocyst stage marks the moment when embryonic cells exhibit their first

differentiation into three regions, as depicted in Figure 1-H: (i) *trophoblast*, the exterior cellular membrane of the blastocyst; (ii) *inner cell mass* (ICM), the group of totipotent and pluripotent cells in the interior of the blastocyst; and (iii) *blastocystic cavity*, the internal space distinguishing the ICM from the trophoblast (O'Rahilly and Müller 2001, pp. 38-39). Between the fifth and seventh days after fertilization, the blastocyst moves through the fallopian tube towards the uterus. In order for a human embryo to develop into a fetus, the blastocyst must hatch from the zona pellucida and implant in the uterine wall. Human embryos that fail to do this will not undergo *gestation*, the process in which embryonic cells specialize and take on distinct roles.

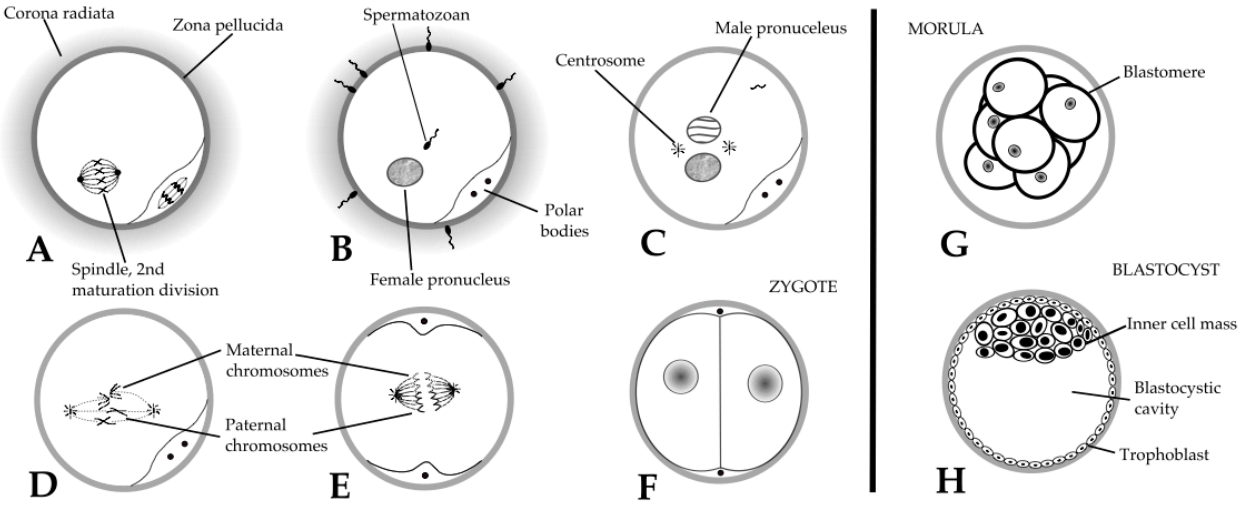

Figure 1. Human fertilization (A-F) and early embryogenesis (G-H). See text for explanation. Adapted from Sadler (2000) and O'Rahilily and Müller (2001).

Fertilization naturally occurs within a fallopian tube over a few days, after which embryogenesis takes place in a woman's uterus. In light of this, I follow Lewis Guenin in referring to embryos that originate in or enter into a uterus and a connected fallopian tube as *enabled embryos*, because they meet the minimum environmental conditions necessary for beginning the developmental cascade into later stage embryos, fetuses, and neonates. There are two ways for an embryo to be enabled: by originating in a uterus, as in natural fertilization, or by being transferred into a uterus prior to the seventh day after fertilization, such as occurs in the case of IVF. With this vocabulary, we may also distinguish another category of embryos, *unenabled embryos*—those that never exist in a uterus and connected fallopian tube (Guenin 2008, pp. 21 and 27-31). This distinction is useful because it provides language for describing a difference in types of embryos in terms of their presence in an environment that is required for their further development, rather than in terms of their origins. Whether they arise from artificial or natural fertilization, cloning, parthenogenesis, or some other process, all embryos may be separated into the classes of enabled and unenabled, its opposite.[10]

2.3 The Clone Embryo as the Product of SCNT

In 2008, a team of scientists made the first, and until very recently the only, successful attempt to produce a blastocyst-stage clone embryo (French et al. 2008).[11] In describing their work they

[10] The distinction between enabled and unenabled embryos will be elaborated upon further in § 3.2

[11] Infamously, a team of researchers led by Hwang Woo-suk first published a report claiming to have successfully performed SCNT in humans in 2005, though this report was later retracted due to scientific misconduct. For citations to the original paper and information on this controversy, see Cho, McGee, and

state that producing a blastocyst via SCNT requires four major steps, which I take to describe the origins and developmental stages of the product of SCNT.

The first two steps are to prepare the nucleus and oocyte to fuse together to become the entity from which the clone embryo is derived. In the first step, the *cumulus matrix* of the oocyte is removed, followed by the removal of the oocyte's nucleus. To remove the cumulus matrix, an enzymatic solution is gently pipetted into the viscous matrix surrounding the oocyte, breaking it down and dislodging it. After the oocyte is incubated for forty-five minutes, the nucleus is removed, either by aspiration through a pipette or by extrusion through a small slit cut in the zona pellucida. After the second step of SCNT, wherein human skin cells (*fibroblasts*) are selected according to the likelihood they are in the ideal phase of cellular development for nuclear transfer, G1 or G0, the enucleated oocyte and fibroblast are ready to be fused. In the third step, the somatic cell is inserted underneath the zona pellucida so that it comes into contact with the internal membrane of the enucleated egg cell. Introduced into a buffer solution in which they receive rapid, repeated electrical stimulation, the fibroblast and oocyte are stimulated to fuse. After fusion, the resulting entity is an enucleated egg cell containing a single somatic cell nucleus. This new product must undergo *parthenogenetic activation*, whereby the cell is chemically stimulated to undergo the symphony of genetic events which initiate duplication and division. Parthenogenetic activation occurs when cells incubating in fusion buffer are rapidly moved into a second buffer for four minutes and then incubated in a third buffer for three to four hours.

Magnus (2006) and the special online section devoted to it by the journal, *Science*, which originally published the fraudulent research (Science 2011).

If each of the four steps of SCNT has been carried out successfully, then in another six to seven hours the fused cell will have been *remodeled*, meaning that its nucleus will have been returned to a pronuclear state. This results in a single-cell entity undergoing *parthenogenesis*, the growth of an embryo without fertilization. In another day, after *initial cleavage* has occurred, the product of successful SCNT will be a clone embryo, a two-celled embryo created by the four major steps of SCNT. In theory, after a clone embryo reaches the blastocyst stage, the inner cell mass can be removed and cultivated further, creating an autologous stem cell line for use in scientific research (Vats et al. 2005). However, this has proven to be difficult to do in practice.

2.4 Clone Embryos and Human Embryos are Not Identical

I propose to distinguish among different types of embryos which have (1) different origins, (2) different developmental pathways, and consequently, (3) different *developmental potentials*. Doing so suggests clear reasons for the reevaluation and reinterpretation of existing public policies for funding stem cell research, including policies prohibiting public funding of somatic cell nuclear transfer. Additionally, distinguishing among classes of embryos will shed light on some ethical problems brought about by current and future advancements in biotechnology.

On my account, *human embryos* are entities that originate via fertilization, whether *in vivo* or *in vitro*, as described above. Although the process has not been described in full mechanistic detail here,[12] what we do know about fertilization suggests that the following are necessary moments in a human embryo's developmental path: the formation of the female pronucleus, the activation of the oocyte by the fusion of the sperm membrane with the zona

[12] For such detail, see O'Rahilly and Müller (2001).

pellucida, the formation of the male pronucleus, and zygosis, which immediately results in a *two-celled* zygote and includes syngamy and the first division. After the first division, a human embryo undergoes cleavage sequentially until it reaches the blastocyst stage. An enabled embryo may then undergo gestation, after which it has the developmental potential to become a fetus, and ultimately, a neonate.

A clone embryo is an entity that originates from somatic cell nuclear transfer.[13] There are four major steps to SCNT, suggesting that the following are necessary moments in a clone embryo's developmental path: the donor cells are altered from their native states in order to prepare them to be capable of embryological development; the somatic nucleus is introduced into the oocyte after fusion; the immediately resulting *single-celled* entity is stimulated to undergo parthenogenetic activation; and, the donated nucleus undergoes remodeling. After remodeling, a clone embryo undergoes its initial cleavage, which results in a two-clled entity that can in theory be used for research or reproductive purposes.

My proposal to distinguish between different classes of embryos is not a novel one. For example, the PCBE Report from the President's Council on Bioethics represents the different entities it discusses by distinguishing among their origins (Figure 2). The PCBE Report employs terminology that is almost identical to my own: it refers to the process from which embryos originate as "fertilization" and refers to the process whereby clone embryos originate as "cloning." In cloning, an egg cell is enucleated, a donor cell is fused to that egg cell, the

[13] Following Guenin (2008), I propose to call the product of SCNT a *clone embryo*, as in a 'mouse embryo' or 'mammalian embryo'. This locution is preferable to a similar one, cloned embryo, because it accurately implies that the embryo is the product of cloning by SCNT, rather than that the embryo is a copy of its progenitor. Saying 'cloned' embryo is inaccurate because clone embryos contain DNA from both their gametic and somatic sources.

resulting cell is activated, and the result is a "cloned embryo" (President's Council on Bioethics 2002a, p. 61).

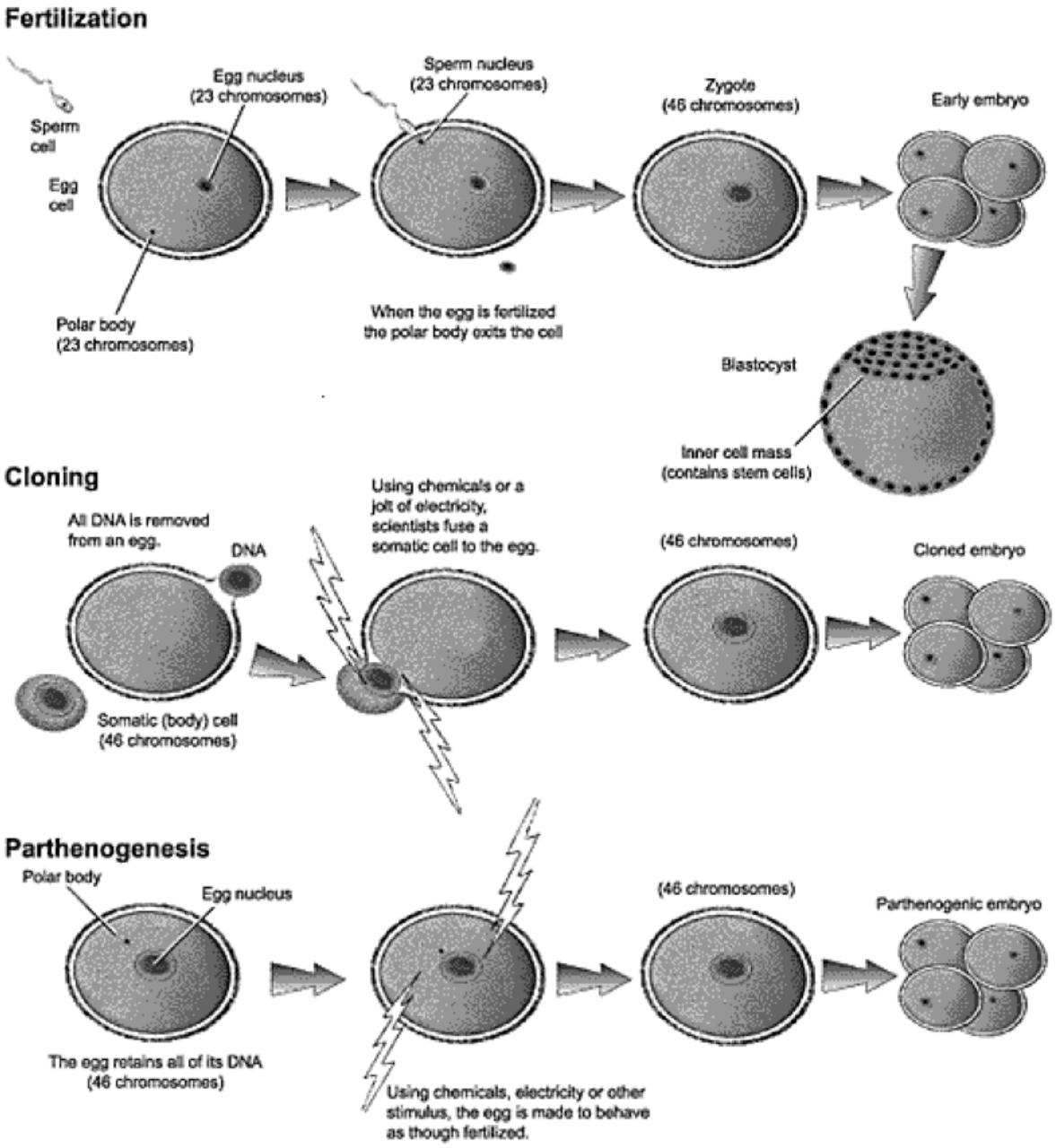

Figure 2: A depiction of different embryo types and their origins. From the President's Council on Bioethics report, *Human Cloning and Human Dignity*: "Diagram of early stages of human fertilization, cloning, and parthenogenesis" (President's Council on Bioethics 2002a, p. 61).

The PCBE is perhaps the most thoughtful governmental body to have considered the morality of federally funding cloning for therapeutic research – that is, for research rather than for reproduction. For precisely this reason, it is all the more troubling that their reasoning is flawed, as it is encapsulated in Figure 2. To see their error, recall that the earliest stage of embryological development, a zygote, is a *two-cell* stage, which, in total, contains 92 chromosomes, or two copies of the entity's 46 nuclear chromosomes. Yet, in the PCBE diagram we see that their third stage of fertilization is a *single-cell* zygote containing 46 chromosomes. Comparing this diagram to Figure 1 reveals that the PCBE Report makes a false assumption, that embryos undergo a single-cell stage of development that has the identical number of chromosomes as the resulting zygote. But, they do not.[14]

The importance of recognizing this error stems from the fact that the diagram in Figure 2 makes no other errors: it represents cloning and parthenogenesis faithfully. Each of these processes includes a single-cell stage. These cells may undergo parthenogenetic activation, and under laboratory conditions may develop further, perhaps even to the blastocyst stage. *But, the embryo does not undergo parthenogenetic activation, because it does not originate in a single-cell stage.* Rather, the embryo undergoes *zygotic activation*, which is a distinct process that results in a blastocyst with high probability.

It is reasonable to ask whether parthenogenetic activation and zygotic activation are simply two terms to refer to the same process, or perhaps two terms referring to different ways in

[14] To be fair, this error is not uncommon. Others who have made it include Helga Kuhse and Peter Singer (in Kuhse and Singer 1990, p. 66ff.) and David DeGrazia (2006, p. 50). Yet, others also appreciate the implications a distinction between the fertilized egg and the resultant two-cell zygote has for ethical and policy issues (*e.g.*, Grobstein 1985; Cohen and Tomkin 1994; Cameron and Williamson 2005).

which the same process can be instantiated. The honest answer is that we do not know. Embryogenesis and parthenogenesis are poorly understood, so a definitive answer remains unavailable. However, one very basic fact suggests they are different processes: without intervention and under natural environmental conditions, human parthenotes *never* develop past the blastocyst stage, while the majority of human embryos do develop past that stage under the same conditions. Parthenotes that continue to develop do not "develop" per se: they become cystic and enlarge like cancerous masses. Recent experiments have shed light on why this might be.

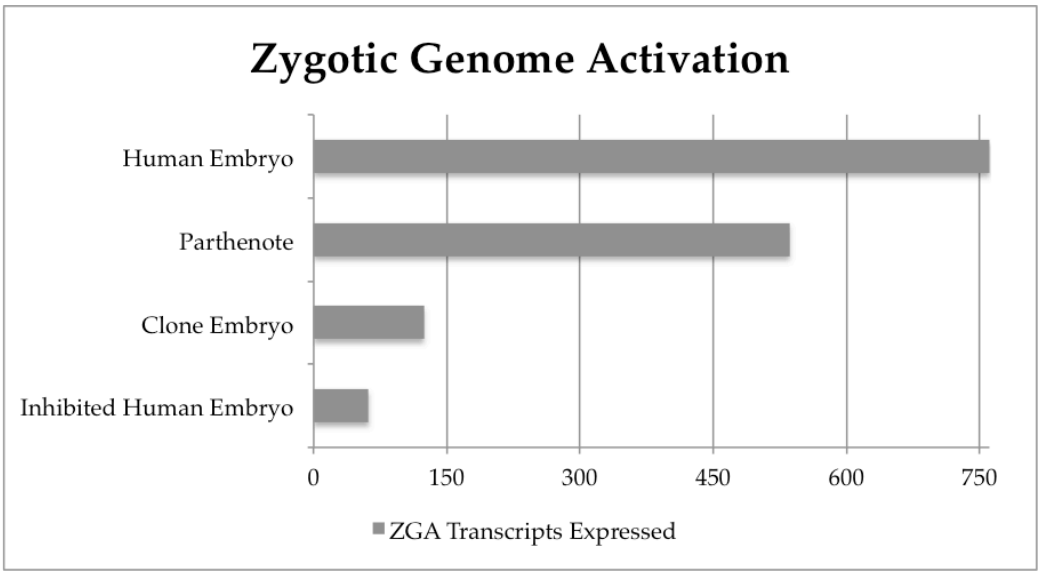

Figure 3**: Zygotic genome activation of four types of embryos:** human embryo, 761/761 transcripts; parthenote, 536/761 transcripts; clone embryo, 124/761 transcripts; inhibited human embryo, 62/761 transcripts (see Noggle et al. 2011).

To examine whether different types of embryos exhibit different patterns of gene expression, scientists mapped a set of 761 genes that are highly active during the very beginning of embryogenesis at zygotic activation. They then compared the expression rates of three different types of embryos to this level of activation, which they termed *zygotic gene activation*.

They found that parthenotes express 70% of the zygotic genome, clone embryos express 16%, and human embryos treated with alpha amanitin (which prevents DNA from being transcribed into proteins) express 8%. Using gene activity as a measure, parthenotes were shown to have significantly different expression rates than human embryos, and *clone embryos were shown to express roughly 16% – or less than one sixth – of the genes active in a human embryo* (Noggle et al. 2011, pp. 71-72).

The genetic expression profiles of clone embryos are markedly different than those of human embryos. In fact, they show far more similarity to human embryos whose development has been chemically arrested than to developing human embryos. Experiments were not done to see whether clone embryos and parthenotes exhibit similarities in a parthenogenetic activation genome. However, given that neither of these types of embryos develops past the earliest blastocyst stage, without intervention they seem far more similar to one another than either is to a human embryo originating from fertilization. Thus, clone embryos are *ontologically different* from human embryos because they have different developmental potentials, evidenced by their different origins and developmental paths, and substantiated by genetic measures of potential.

I use the term "ontologically" here to describe the differences between human and clone embryos because what I have just discussed are differences in the ways that these entities come into existence. And, these differences in their processes of coming into being causally bear on the developmental potentials the resultant entities have. I take ontology to be concerned with claims about what things exist, including how things come to be, and once they exist, how they persist or change over time, and therefore what they are capable of becoming. In the case of human and clone embryos, I have distinguished these two types of entities according to differences in the way they come into being (their origins) and the way that they persist or

change over time (their developmental pathways). Because of these differences, I contend that these entities have different developmental potentials, different capabilities to become various sorts of entities, particularly morally salient beings like human fetuses or neonates and beings like groups of stem cells or other cellular entities.

Human embryos arise from fertilization, a process that originates in the joining of two 23-chromosome cells, human egg and sperm, under conditions that occur naturally and frequently and are thus easy to replicate *in vivo* or *in vitro*. Their initial changes over time include the chromosomal material duplicating, coming together, and segregating, in order to form a 92-chromosome, 2-cell entity, or a zygote. Human embryos do not originate in, nor do they exhibit a single-cell state.

A clone embryo differs, however. In the few reported circumstances of the creation of clone embryos, they arise from SCNT, a process that originates with the manipulation and joining of a human egg cell containing no chromosomes and the nucleus of a somatic cell containing 46 chromosomes, under specific laboratory conditions that are not easy to replicate *in vitro* and that cannot be replicated *in vivo*. Their initial changes over time are not well understood, although they at least include the formation of a single 46-chromosome cell that then duplicates to form a 92-chromosome, two-cell entity.

It is unclear whether the term "zygote" is accurate for the entity that results from SCNT, because this implies that the entity will undergo zygotic activation and proximal downstream stages of development.[15] I have argued that empirical research suggests this is not the case. The

[15] Paul McHugh agrees with my intuition that the product of SCNT should not be referred to as a "zygote." Rather, he suggests that the product of SCNT for non-reproductive purposes is akin a cell

two-cell entity that results from SCNT expresses one sixth of the genes of a normally developing human embryo at this stage of cellular development. By comparison, a human parthenote, an entity that is *certain* not to undergo zygotic activation and subsequent developmental stages, expresses two thirds of the genes of a normally developing human embryo. Thus, since we know that expressing two thirds of the genes leads to a cell type with a distinct developmental pathway from the pathway of the human embryo, I maintain this gives overwhelming reasons to conclude that the same is true of a cell type that expresses one sixth of the genes. And I conclude these are differences in the way these entities come into being and develop over time. Hence, they are ontological differences.

These ontological differences matter for the simple argument, because Premise 4 (the claim that SCNT harms human embryos because the product of SCNT is identical to a human embryo) denies there are such differences. The imagery in Figure 2 captures the fourth premise better than can be expressed by words. Through it, doubt may be cast on the claim that SCNT produces a human embryo. Human embryos have the developmental potential to produce human fetuses and neonates. Like parthenotes, clone embryos do not. Human embryos originate from fertilization. Like parthenotes, clone embryos do not. Given these differences, clone embryos and parthenotes should be distinguished from human embryos on account of the patent differences between their origins, developmental pathways, and developmental potentials. As such, if one is engaging in reasonable argument using terms upon which we all can agree, then one should conclude that clone embryos are not human embryos in the sense of that term necessary for the simple argument to be sound. Hence, the simple argument fails.

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culture. Consequently, he proposes that to capture the differences between the cellular product of IVF, which is an embryo, and the product of SCNT, we refer to the latter as a "clonote" (McHugh 2004, 210).

3.0 CLONE EMBRYOS, HUMAN EMBRYOS, AND MORAL STATUS

The criticism of the simple argument given in the previous chapter will provoke various responses. One strategy could be to respond to the ontological claims made in chapter 2 by arguing clone embryos and human embryos are identical based on biological research that counters what is presented above or at least shows the evidence marshaled to be problematic, because it is based on experiments of poor quality or suffers from other limitations. Another strategy would be to accept the reasoning in chapter 2 but nevertheless to argue clone embryos deserve moral status based on grounds that are independent from their putative identity with human embryos. If so, then the simple argument could be reasonably modified irrespective of whether clone embryos are identical to human embryos. A third strategy would be to argue that in making science funding policy it may not be necessary to consider the sort of scientific models and evidence I have discussed in order to make justified policies, and thus the ontological issues I raise do not bear on the issue of what policies ought to be established for publicly funding nonreproductive cloning research.

In this chapter I focus on the second of these two possible responses to my argument.[16] I begin by considering traditional approaches to grounding attributions of moral status, in section 3.1. I distinguish between two overarching strategies for grounding such claims. One is based on the origins of the target entity, specifically whether it is of human parentage. The other is based on whether the target entity has morally relevant capacities, such as the ability to feel pain, cognitive capacities, or capacities for moral agency. I argue that clone embryos are not candidates for moral status based on these traditional approaches. However, I acknowledge that other routes are available for attributing moral status. In section 3.2, I consider whether it is possible to argue that clone embryos deserve moral status based on their potential to *become* entities that have morally relevant capacities, and I find this argument to be unsatisfying given our understanding of clone embryos' developmental potentials. Then, I turn to considering whether it might be possible to support the attribution of moral status by arguing that clone embryos have the potential to *produce* entities that have morally salient capacities if one manipulates them or their cellular derivatives using biotechnologies. This lengthy section includes a minor digression on the question of whether, given my arguments against arguments from potentiality in the case of clone embryos, I contend that arguments from potentiality are proven to be unimportant by considerations of recent advances in stem cell science (§ 3.3.2). Despite my rejection of the specific arguments from potentiality I consider in this chapter, I conclude that this is not the case. Arguments from potentiality can be useful and important. Indeed, I conclude (§ 3.4) by summarizing what we learn by considering its applications of

[16] In the next chapter I will focus on the third possible response. I will not discuss the first response further because I am not aware of scientific evidence that might counter my claims about the ontological differences between human and clone embryos. If I knew of such evidence, I would have cited it above.

arguments from potentiality to the particular case of non-reproductive cloning, which is that the prohibition on public funding for this activity cannot be justified by an argument from potentiality; and, from demonstrating this we learn important information about the assumptions of proponents of prohibition.

3.1 The Retreat to Moral Status

I will call the response that clone embryos deserve moral status irrespective of their putative identity with human embryos *the retreat to moral status*. As a response to my argument, it can be shown to be a move of considerable desperation. First, notice how much this maneuver concedes. As I maintained in the first chapter, the simple argument is not merely *an* argument that would support a prohibition on federal funding, it is in fact *the* argument that has traditionally been used to support the actual prohibition in place. So while a retreat to moral status may be an alternative means for justifying the prohibition, it is one that is employed at the cost of conceding that the previous justification was unsatisfactory. Despite this, the argument from moral status may succeed where the simple argument from identity fails. We must ask, then, what justifies an attribution of moral status to clone embryos?

The topic of moral status is a contentious one. Although there are a number of strategies for grounding attributions of moral status, it is not clear that any of them is satisfactory. And this is especially the case if the strategy is designed to justify a necessary and sufficient condition for attributing moral status, rather than only a sufficient condition. However, there appears to be consensus on what "moral status" is, even if there is evident dis-consensus regarding how to discern it. For example, Beauchamp and Childress define moral status as an entity being in such a state that it deserves the protection afforded by moral norms, "such as principles, obligations,

duties, or rights" (2009, p. 66). Thus, to have moral status is to be the sort of entity that other entities beholden to moral norms ought to recognize as a moral being, as also being properly covered by those norms, though perhaps not equally as other moral beings.

Beauchamp and Childress characterize four approaches for characterizing sufficient conditions for attributing moral status. The first they suggest "might be called the traditional account of moral status" (*ibid*., p. 67). On this view, an entity has moral status if it is conceived by human parents, or perhaps alternatively, if it has a human genome. Some authors refer to this as "speciesism," which singles out membership in *Homo sapiens* as a necessary condition for moral status. However I focus on a weaker position, which I refer to as the *anthropocentric approach* to attributing moral status (Piotrowska forthcoming) because this term draws attention to the view's emphasis on membership in *Homo sapiens* as a sufficient condition for moral status. This is the approach that lies behind the simple argument as it is given in section 1.2. On this view, embryos are afforded moral status because they are produced via conception, whether the process of conception occurs *in vivo* or *in vitro*. Therefore, if something is an embryo, then it deserves moral status. And since proponents of prohibition propose that clone embryos are identical to human embryos, they therefore conclude that clone embryos deserve moral status, just as human embryos do.[17]

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[17] Indeed, the example that Beauchamp and Childress cite to demonstrate the anthropocentric approach is from two members of the PCBE who argue for the simple argument. They quote Robert George and Alfonso Gomez-Lobo as follows. "Fertilization produces a new and complete, though immature, human organism. The same is true of successful cloning. Cloned embryos therefore ought to be treated as having the same moral status as other human embryos. A human embryo is a whole living member of the species Homo sapiens in the earliest stage…Human embryos possess the epigenetic primordial for self-directed growth into adulthood. We were then, as we are now distinct and complete…To deny that embryonic human beings deserve full respect, one must suppose that not every whole living human being is

My argument against the simple argument may be carried over *mutatis mutandis* to an anthropocentric approach to attributing moral status to clone embryos. In chapter 2, I argued that clone embryos and human embryos are ontologically different. Therefore, even granting for the sake of argument that human embryos deserve moral status on grounds of their being conceived by human parents, if my argument holds, then the same cannot be said for clone embryos. Thus, clone embryos would not warrant moral status based on the considerations of the anthropocentric approach.

The anthropocentric approach rests on claims about the origins of entities. On it, moral status is conferred to entities that arise from conception, though allowing for artificial means of performing this activity. The other approaches for attributing moral status that Beauchamp and Childress describe differ in that they do not rest on claims about entities' origins. Instead, they focus on the capacities these entities have for exhibiting certain morally relevant properties (cf. Laio 2010). Beauchamp and Childress distinguish three different properties that have been used for attributing moral status, *cognitive* properties, including awareness, perception, memory, understanding, and reflection; *moral* properties, such as a capacity to make moral judgments and to have motives that are open to judgment by others; and, *affective* properties, most notably, the ability to feel pain, or sentience (Beauchamp and Childress 2009, pp. 71-79).

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deserving of full respect. To do that, one must hold that those human beings who deserve full respect deserve it not in virtue of the kind of entity they are, but, rather, in virtue of some acquired characteristic that some human beings…have and others do not, and which some human beings have in greater degree than others…[Even embryos] are quire unlike cats and does…As humans they are members of a natural kind—the human species…Since human beings are intrinsically valuable and deserving of full moral respect in virtue of what they are, it follows that they are intrinsically valuable from the point at which they come into beings (George and Gomez-Lobo 2005; quoted in Beauchamp and Childress 2009, pp. 67-68).

There are thus two traditional types of moral classification, in terms of a type of entity's origins or its capacities to exhibit morally salient properties (Piotrowska forthcoming).[18] I have already suggested why emphasizing the origins of clone embryos is not a basis for attributing moral status to them. I believe it is even easier to see why they would not warrant moral status on a capacities approach. Clone embryos are not capable of exhibiting cognitive properties, moral properties, or affective properties. They are not aware and cannot think, perceive, and so forth. They also cannot make moral judgments. Nor can they feel pain, because they lack the necessary biological structures to feel pain.

If the retreat to moral status is understood as a retreat to one of the traditional approaches for grounding attributions of moral status, it is thus shown to be an unsuccessful move. Clone embryos lack the relevant capacities or origins upon which a successful attribution might be grounded. However, proponents of prohibiting publicly funding SCNT may respond another way. Rather than emphasizing the capacities a clone embryo *has*, they might emphasize the capacities that a clone embryo *has the capacity to have*. That is, one might respond to my discussion thus far in this chapter by claiming that it is appropriate to ground an attribution of moral status on an entity's current capacity to exhibit morally relevant capacities in the future, rather than its exhibiting morally relevant capacities in the present. The rest of this chapter explores this possibility.

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[18] My argument against the simple argument may not fit with this distinction between two types of moral classification, because I claim that to distinguish a type of entity that does not have moral status (clone embryos) from a type that does (human embryos) requires considering their origins, developmental pathways, and developmental potentials. Thus, I may be arguing for a non-reductive account of moral classification, although considering this possibility is beyond the scope of the present discussion (see Cunningham in press).

3.2 Status and the Potential to Become

Before I consider and respond to this intuition, it is first important to underscore how far away from the simple argument we have traveled. No longer are we discussing whether clone embryos are identical to human embryos, and thus deserving of moral status. Nor are we discussing whether clone embryos exhibit certain capacities or properties that warrant the attribution of moral status. Instead it is being proposed that clone embryos warrant the attribution of moral status because they have a second-order capacity to develop at some later time a first-order capacity that in turn warrants the attribution of moral status. On this view, the following assumption must be made: *Even if x at t_1 lacks a morally relevant capacity, as long as x has the capacity to develop the morally relevant capacity at t_2, x has moral status at t_1.*[19] I find this premise dubious, however, as we will see below, if it is granted then a number of objections to my conclusions follow.

There are two possible responses to my argument that appeal to second-order capacities. Because each focuses on the clone embryo's *potential* to develop into an entity that warrants the attribution of moral status, both are arguments from potentiality. Taking these arguments seriously requires distinguishing between different senses of potential, which is understood best in terms of either *producing* or *becoming* (Buckle 1988). To have potential in the sense of becoming – or being capable of developing into something – a target entity must maintain its identity through a developmental process; it must *persist* despite its change from one state to another. To have potential in the sense of producing, a target entity must be capable of being manipulated such that it results in an entity that warrants the attribution of moral status on other

[19] I thank Mark Wicclair for helping me formulate this assumption and make it explicit.

grounds. Thus, one might adopt the second-order capacities approach in two ways, by asserting that clone embryos have the potential to become entities that exhibit first-order capacities or by asserting that clone embryos have the potential to produce entities that exhibit first-order capacities. I will focus on the former line of reasoning in this section and the latter in the following section.

To begin, I will consider all of the second-order capacities approaches at once, rather than distinguish different morally relevant first-order capacities and argue against each of them separately in their second-order guises. Irrespective of one's intuitions about *which* morally relevant first-order property is the right one, an argument based on the intuition that bearing second-order capacities is sufficient to warrant the attribution of moral status will rest on the claim that the entity under consideration has the relevant second-order capacity. If we take an ideally moral human agent as a model of an entity that warrants the attribution of status, we may say that such an entity normally develops each of these capacities over time, beginning with sentience, then to cognition, and finally to moral reflection. Yet, other entities may warrant moral status that develop differently: they may never realize the capacity of moral reflection or they may never realize the capacity of cognition. However, it is reasonable to assume that if an entity warrants the attribution of moral status, then it will at least have the capacity to develop sentience, which, under normal circumstances, arises earlier in development than capacities for cognition or moral agency.[20] It is also reasonable to think that under normal circumstances the

[20] Given that some human beings may develop capacities for cognition and moral reflection without developing the ability to feel pain (Cox et al. 2006), it is possible to dissociate sentience from other moral developmental capacities. However, this neuropathy is very rare and clearly pathological, so it does not disturb the intuition that under normal conditions sentience arises before other morally relevant capacities.

development of the capacity to feel pain is biologically less complex than the other capacities that are traditionally appealed to as warranting attribution of moral status. Thus, as I endeavor to show that a clone embryo lacks the second-order capacity to develop *any* of these morally relevant first-order capacities, I will focus only on the presumably most proximal and least complex of these morally relevant developmental milestones, sentience, or the first-order capacity to feel pain.

In order to develop pain, an entity must have certain biological properties. It must have developed certain neural pathways and structures, and chemical systems associated with the transmission of pain through the sensory and nervous systems (Steinbock 2006, n. 14). Recent estimates suggest that for a human embryo this might occur as early as 17 gestational weeks (Glover and Fisk 1996) or as late as 29 gestational weeks (Lee et al. 2005). Either way, it is clear that in order for a human embryo to develop the capacity for sentience the embryo must be implanted in a uterus; furthermore, it must be sufficiently viable to persist in the intrauterine environment for a number of weeks. The question is thus whether clone embryos have both of these relevant second-order capacities of (i) a capacity to be implanted in a uterus and (ii) a capacity to persist in the intrauterine environment for a number of weeks subsequent to implantation.

There are two reasons to think that clone embryos used for stem cell research will not have either of these relevant second-order capacities. First, following Guenin's proposal discussed in chapter 2, I contend that clone embryos should only be developed if cell donors (of oocytes and fibroblasts) have autonomously expressed preferences precluding the enablement of

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Yet it does show that in very rare cases sentience need not arise before them. This pathology further confirms the intuition that sentience is at most a sufficient condition for moral status.

any resulting clone embryos. Thus, clone embryos would, as a class, remain unenabled; hence, they cannot be inserted into a uterus without violating a legal and moral prohibition. Thus, even granting for the sake of argument that they have the other relevant second-order moral capacity, they will, nevertheless, not develop past the blastocyst stage due to an explicit prohibition.[21]

Distinguishing between enabled and unenabled embryos draws attention to an important precondition for becoming an enabled embryo. Embryos do not just arise *de novo*. In order for an embryo to come into being, human beings must perform activities that cause them to develop. That is, until very recently, the only source of human embryos in all of human history was from sexual intercourse and conception. Both sperm and egg were required to produce human embryos, thus both women and men were required. And embryos routinely arose in a context such that they once they were unenabled they could not later be reenabled. Embryos could not exit the intrauterine environment and then return.

Yet, now, this is no longer the case. The introduction of artificial means for fertilization *in vitro* now make it possible to produce an embryo outside of a woman's body. Yet it is still the case that sperm and egg are required. Since sperm and egg must be donated by individuals in

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[21] This point may also be raised as regards its application to human embryos produced via IVF. One might wonder, does this mean that left over IVF human embryos also do not have moral status, presuming they are prohibited from enablement, and hence, do not have the chance to develop further to gain the capacity necessary to be attributed moral status? It is important to recognize that by accepting Premise 2 of the simple argument these issues are thereby muted. It is accepted that all human embryos, including those produced by IVF, have moral status based on their origins. Thus, whether they are unenabled or not, they still have that status, merely by stipulation. Now, important controversies might result from accepting this stipulation, *e.g.*, regarding the morality of freezing or destroying leftover IVF embryos. And, these are no doubt important issues. However, they are not the issues that concern the current argument, which is not about all of the many ethical issues that would follow from accepting for the sake of argument that human embryos have moral status.

order to be available for conception *ex vivo*, this activity still requires women and men. Distinguishing between enabled and unenabled embryos draws attention to the fact that in order to create embryos *ex vivo* a donor must consent to the harvesting of his or her material. As this is the case, they have the moral authority to constrain what is done with their biologic material after harvesting. That is, they, and they alone, have the moral authority to consent to research practices with their biologic material under traditional accounts of ethical human subjects research (Luna and Macklin 2009). Thus, in cases of *ex vivo* conception, only if those who donate their biologic material authorize it is it morally permissible to enable embryos.

Some may argue that sperm and egg donors lack the moral authority to justify donating their cells under the explicit assumption that embryos will be created out of them, nor do they have the moral authority to justify donating human embryos for research. However, no one can plausibly claim that *someone else* has that moral authority. Thus, if *anyone* has the moral authority to autonomously authorize that their own biologic material is used for the purposes of creating human embryos, then it is the persons from whom that biologic material has been harvested (Warren 1990, p. 126). Therefore, if there is anyone with the moral authority to prohibit some class of embryos from ever being enabled, then that moral authority rests at some point with the persons who choose to donate their biologic material, including oocytes. Thus, with this distinction we may recognize that in the case of artificially produced embryos – whether by artificial fertilization, *in vitro* parthenogenesis, or SCNT – if anyone has the moral authority to authorize that cellular material be used to produce human embryos, then those who donate the cellular material for manipulation and experimentation are the only persons with the moral authority to authorize enablement. And moreover, we may follow Geunin's analysis and

recognize that a prohibition on enablement should be required for any biologic material that is donated for the purpose of research on cloning (Geunin 2008, pp. 27ff.).

Of course prohibitions fail when people choose to flout them. And they are only as good as our enforcement of them. So, this reason will not be compelling to the skeptic. A second, stronger reason clone embryos used for research purposes cannot develop the capacity to feel pain is that the process of isolating stem cells from a clone embryo alters it such that the remaining tissue is incapable of further development, even if it were transferred into a uterus, and even – granting again for the sake of argument – if we presuppose that the clone embryo had the second-order capacity necessary to develop further in the uterus. To isolate stem cells, the trophoblast of an embryo is destroyed and the inner cell mass is selected for using a specific nutritional medium (Lanzendorf, Boyd, and Wright 2004). Since the trophoblast is necessary for implantation, using a clone embryo to produce a stem cell line excludes the possibility of also using it for reproductive purposes: nothing remains that is capable of developing into an embryo, and hence, nothing remains that could undergo embryogenesis.

Thus, when a clone embryo is used for research purposes it is incapable of developing the capacity to feel pain, both because it is unenabled and incapable of developing past the blastocyst stage. Therefore, the claim that clone embryos produced for research deserve moral status cannot be supported on the basis of a second-order capacity to develop a morally relevant first-order capacity, whether that capacity is to feel pain, to be cognitive, or to morally reflect.

3.3 Status and the Potential to Produce

Proponents of prohibiting publicly funding nonreproductive cloning might still argue that although it may not be possible for clone embryos to become entities that develop morally

relevant second-order capacities, it is possible to *use* clone embryos to produce stem cells and then use *those cells* to produce such entities. That is, it might be claims that it is possible to take a clone embryo and then manipulate it to produce an entity deserving of moral status. If so, then it can be maintained that the clone embryo does have the second-order capacity to develop into an appropriate entity to warrant attribution of moral status, just as long as we interpret "develop" here to include significant manipulation using advanced biotechnologies. Just as human oocyte and sperm may be manipulated to produce early-stage embryos via IVF, and those embryos may be manipulated to produce late-stage embryos and eventually neonates, it might be possible to manipulate clone embryos and produce entities with the relevant second-order capacities via a different technology.

This response may initially appear to bring us into the realm of science fiction, as opposed to science fact. However, it actually does not. Currently, it is possible to conceive of two different ways to produce an entity with morally relevant second-order capacities using clone embryos. First, it is conceivable that one could derive stem cells from clone embryos and then manipulate those stem cells to form analogues to the cellular structures found in developing embryos. If such an entity were produced, then implanted, and then nurtured in just the right way, then it is possible that an entity with morally relevant second-order capacities could result. Second, it is conceivable that one could produce a clone embryo but not manipulate it to procure stem cells; then one could directly introduce that clone embryo into a uterus, just as would be done with a human embryo in IVF; finally, one could facilitate the development of the clone embryo until an entity with first-order morally relevant capacities results. In the following sub-sections, I take up each of these possibilities in turn, as well as a digression discussing whether arguments like mine are unimportant because the issue of potentiality is not worth considering

(as some have argued). In the next section, I conclude by summarizing the argument in this chapter and considering assumptions about the nature of possibility underlying the positions I have considered in this chapter.

3.3.1 *Potentiality and stem cell research*

Stem cells are often described as being pluripotent, meaning that they can develop into any cell type, in theory. Moreover, recent research shows that human embryonic stem cells (hESCs) can be engineered to produce trophoblast cells *in vitro* (Ezashi et al. 2012). This further suggests that with the right intervention, hESCs may become totipotent, meaning they could have the potential to form embryonic and extraembryonic tissues, and thus be capable of producing all tissues – including, perhaps, a healthy, functioning, whole embryo (see Denker 2006). Given this, one might wonder whether stem cells isolated from a single clone embryo could be manipulated into an embryonic form that could then regenerate *both* the trophoblast and early blastocystic structures, suitably organized such that a healthy, functioning, whole embryo results. If so, this would suggest that isolating stem cells from a clone embryo – that is, producing clone embryonic stem cells (cESCs) – does not preclude using it for reproductive purposes. Because, the cESCs could be used to produce a "competent" clone embryo that could be implanted and would result in an entity deserving of moral status.

Although the logic of this reasoning is clear, all that we know suggests this it is simply not possible to develop analogues to human embryonic structures in the case of clone embryos, as distinguished from human embryos. Consider that embryos must develop within the zona pellucida, which they then hatch from before implantation. Developing cESCs would not have this structure. They would be developed in controlled laboratory conditions, without the

presence of materials that might, in theory, produce a clone embryo with developmental potential. Moreover, even in theory, in order to engineer clone embryonic stem cells to have such properties would require manipulating them by introducing other cellular tissue that itself has some sort of developmental potential.

This distinction is important, as it draws attention to the fact that without specific manipulation involving additional cellular and genomic material, hESCs have been shown to develop into various types of specialized *cells*, but not into teleologically organized *entities*. When isolated, murine stem cells naturally become cystic (Evans and Kaufman 1981), as do human embryonic stem cells. Evidence also indicates that the latter become *embryoid bodies*, disorganized spherical balls containing heterogeneous tissues (Desbaillets et al. 2000), which may predominantly contain neuronal cells if not exposed to extrinsic influences (Smukler et al. 2006). Yet, how to interpret this evidence is unclear, because human embryos also form embryoid bodies under similar experimental conditions. So, this behavior of embryonic stem cells derived from human embryos may not carry moral weight if intended to distinguish between human embryos and hESCs.

Nevertheless, such issues are only relevant *if* we first conflate human and clone embryos, without appreciating the differences between them described in chapter 2. Once we recognize clone embryos arise from distinct origins and developmental pathways and have different developmental potentials, then whether one believes hESCs are capable of being used to produce entities that warrant moral status does not bear on whether clone embryos are so capable, regardless of the strength of the evidence for that belief. Indeed, as the genetic expression profiles of clone embryos are significantly more similar to human embryos whose development has been chemically suppressed, and thus which have no developmental potential (Figure 3), we

should assume the same of their derivatives. Recognizing this may make clone embryos poor candidates for producing (clone) embryonic stem cells or other therapeutic cell tissues, but that is something that is unknowable without the appropriate experimentation, and hence additional federal funding.[22] Nevertheless, although it is *conceivable* that clone embryos might be used to produce an entity with second-order capacities that could be used for the attribution of moral status, the extent to which this is conceivable rests on an analogy between cESCs and hESCs that is untenable unless the proponent of the view finds independent reasons to challenge the claim that clone embryos and human embryos are not identical.

However, we my push this argument a bit further. If we grant for the sake of argument that clone embryonic stem cells could be used to produce an entity with the relevant second-order capacities, then it follows that *all* cells in the body would have moral status once clone embryos are granted moral status on the grounds considered in this section. That is, assuming that SCNT could be used to produce an entity deserving of moral status, we would be compelled to say that all of our skin cells (fibroblasts) would have the potential to produce such an entity via the process of SCNT; hence they would also deserve moral status (Charo 2001; cf. Disilvestro 2007). This worry is exactly why distinguishing between producing and becoming is philosophically useful, because it aids in describing conditions where an entity does not itself have sufficient capacities to become a morally salient entity (or perhaps under typical environmental conditions that do not require significant technological intervention). If such an

[22] One such experiment might be to repeat the experiments done by Noggle et al. (2011) to see whether the zygotic gene activation of hESCs was at all similar to zygotes, parthenotes, or clone embryos, and likewise, to compare these expression patterns to those of cESCs. But of course, first the latter would have to be isolated and reliably cultured, which has only been reported once (Tachibana et al. 2013) and has yet to be replicated.

entity could be engineered to develop into a being deserving of moral status, then it is not the properties of that entity that are morally salient, but the properties of the technological interventions and *those who are responsible for them* that are morally salient.

3.3.2 *Potentiality de-potentialized?*

It may thus seem that proponents of the simple argument have been put in a position to jettison appeals to potentiality, because if the product of SCNT has the requisite sense of potentiality to warrant moral status, then all human skin cells warrant moral status too. If this is true, then it may be the case that the ethical dilemmas like those on which this thesis focuses have become moot or of considerably less importance, because arguments from potentiality are themselves impotent and thus need not be taken seriously (cf., Gottweis and Minger 2008; Holm 2008; Chan and Harris 2008; Watt and Kobayashi 2010).

This argument has been given in considerable detail recently in the *American Journal of Bioethics*, where Stier and Schoene-Siefert argue that certain technologies that fall under stem cell research undermine the entire notion of potentiality as it applies to ethical justifications of stem cell research. Although their conclusion might appear consistent with the arguments given in this chapter, I disagree. And I believe that considering their argument further reinforces the view that the arguments advanced in this thesis against the prohibition of public funding for SCNT are worth making.

In their paper, Stier and Schoene-Siefert purport to 'depotentialize' the argument from potentiality as it applies to stem cell research, because recent biotechnological advancements suggest *all* human cells have the potential to develop into morally significant entities. Hence, under the assumptions of the potentiality argument, all cells warrant protection; and, the evident

absurdity of this conclusion results in a reductio. Their view rests on the contention that through a three-step process, cells lacking moral status may be "converted" into morally significant entities. Those steps are (1) "conversion" into induced pluripotent stem cells (iPSCs); (2) subsequent "conversion" into embryos via tetraploid complementation; and (3) introduction into uteruses and development into neonates (Stier and Schoene-Siefert 2013).

Stier and Schoene-Siefert acknowledge that no human cells have ever been engineered in this three-step conversion process. However, recent work we have already discussed above does show that Steps 1 and 2 are possible using human cells (Ezashi et al. 2012). Considering these two "conversion steps" allows us to understand how cells are purportedly *innocuously* converted from one phase to another, concluding with their realizing putatively "latent" causal powers to become embryos.

Takahashi and coauthers (2007) describe the first conversion step: human cells isolated by biotechnology companies from knee joints, facial skin, neonatal foreskin, or carcinomas are infected with specially engineered viral vectors containing high copies of codes for four proteins. When these proteins are produced by cells' native machinery, they undergo changes in gene expression patterns, often referred to as "reprogramming." Thereafter, the resultant cellular proteins cause cells to undergo morphological changes and behave like hESCs.

Although a variety of biochemical and morphological tests show that resultant iPSCs behave like hESCs, much remains unknown about *how* Conversion Step 1 induces cells to undergo these changes. As Takahashi et al. note, the mechanisms by which the four proteins induce pluripotency remain "elusive" (2007, p. 868). Yet, they do know that resulting cells exhibit more than 20 genomic retroviral integration sites, suggesting a significant increase in tumorigenesis in these cells and their derivatives; indeed, they report roughly 20% of mice

derived from iPSCs develop tumors. Moreover, for our purposes, they report important limitations to their research. One is that Conversion Step 1 is *extremely* inefficient. Each time they manipulated 500,000 somatic cells they were able to generate 10 iPSCs on average. Also, iPSCs express many genes differently than hESCs, 1,267 to be exact. So, although the expression profiles of iPSCs and hESCs are much more similar to each other than either is to unconverted somatic cells, they clearly are not identical.

Acknowledging these aspects of how iPSCs are produced provides one reason for skepticism about Stier and Schoene-Siefert's analysis, because they claim, much like one customizes the options of a software program, "nothing substantial is added to the [initial] cell, nothing taken away" (2013). However, our epistemic stances toward a software program differ considerably from a developing iPSC or human embryo. Regardless of whether one personally knows how software works, many do know. However, no one knows how human embryos' "programs" work. Nor do we know for sure whether the 10 iPSCs Takahashi et al. generated out of the initial 500,000 cells were ones they both engineered *and* selected for or ones they merely selected for. Additionally, their microarray data suggests something substantial is indeed added, or at east different in converted iPSCs: they contain genetic codes for proteins that change cells' genetic expression profiles, which results in their having unique expression profiles from either their progenitor cells or hESCs. Thus, Stier and Schoene-Siefert's claims of mere "triggering" overreach.

Despite their cogent analysis of the importance of identity claims for the argument from potentiality, these facts threaten Stier and Schoene-Siefert's conclusion, that in light of stem cell science the argument from potentiality is impotent. We simply do not know what it would mean to be identical to an iPSC, because we do not know enough about how iPSCs are created.

Assuming a reductionistic line of reasoning and solely using a measure of genetic similarity, it appears iPSCs are a unique type of cell, being neither identical to their precursors nor hESCs. Hence, I agree with Stier and Schoene-Siefert's claim, that to understand the moral status of iPSCs, we will have to make claims about the morality of their production, rather than about their identity relations. However, I disagree that these cells are derived by innocuous means, and thus that "convertibility" is an acceptable premise in a reductio against the argument from potentiality.

This point relates to a second reason for skepticism about the convertibility of iPSCs. In Conversion Step 2, it is important to focus on the method of tetraploid complementation. Therein, two two-celled embryos are suspended between electrodes and electrically pulsed, causing them to join, which results in the four-celled "tetraploid." After a day of culturing, 10-15 ESCs or iPSCs may be placed between two tetraploids in a well on a culture plate. In mice, after another day of culturing, the resulting "aggregates" may be transferred to pseudo-pregnant females, who will later bear live pups at extremely low rates of efficiency (Nagy et al. 1993; Kang et al. 2009). This experimental procedure justifies the claim that any cell has the potential to be "converted" into a morally significant entity.

Briefly describing Conversion Step 2 suffices for motivating skepticism about its innocuousness because it shows that to convert iPSCs to embryos requires one first begins with embryos. *One must destroy two embryos in order to generate one embryo from iPSCs.* It is not as though innocuous cells are manipulated in morally irrelevant ways in order to produce embryos by "cell conversion." No, one destroys two embryos in the process. Thus the moral algebra seems quite clear. One begins with two entities that have potential in any meaningful sense of

the term. Then one manipulates those entities in ways that *purportedly* destroys that potential and uses them to generate potential in a group of cells that, prior to that moment, lacked it.

Much remains unknown about early embryogenesis, and hence the development of embryo-like cells, including clone embryos, iPSCs, and hESCs. And, our ignorance is important because it must be acknowledged when evaluating the cogency of arguments like Stier and Schoene-Siefert's. We know that embryos under natural conditions reliably lead to fetuses and neonates. We know that iPSCs do not. We know that unless they are experimentally manipulated to form denuded tetraploids, human embryos are the paradigmatic cells by which the notion of potentiality gains its meaning. But, we do not know how they do it. We do not know what confers this potential. Thus, although I agree with Stier and Schoene-Siefert's ultimate aim of countering arguments from potentiality, I believe their argument overreaches, further muddying debates over the ethics of hESC-related research.

Thus, I concede that the argument from potentiality is useful. I believe that if an entity has the potential to develop into an entity with the first-order capacity to exhibit morally relevant properties, then this provides a compelling reason to attribute moral status to it. I am not sure this provides a sufficient reason, but I believe that arguing in this fashion, by appeal to potentiality, is a useful exercise for exploring our agreements and disagreements about which entities deserve moral status. It reveals, for example, that one can endorse the view that human embryos have moral status because of second-order characteristics, and yet one can also consistently reject the view that clone embryos do.

3.3.3 *Potentiality and reproductive cloning*

Acknowledging the usefulness of the potentiality argument does not entail that clone embryos deserve moral status. Indeed, I have given reasons to think that under traditional accounts of moral status, they should not. However, I believe one route remains open to the proponents of prohibiting using public funds for nonreproductive cloning, although it is one that can be dispensed with rather quickly. A reasonable response to my claims might be to ask whether, if they were not used for research and were enabled, clone embryos could develop into an entity of moral significance such as a later stage embryo, a fetus, or a neonate. To make this claim is to introduce a variant of Premise 2 of the simple argument and reasons that support it. That is, it is to claim that clone embryos warrant moral respect precisely because of their ability to produce certain entities if suitably manipulated and introduced into an intrauterine environment. If it were possible to use clone embryos to produce an entity that has morally relevant first order capacities, then that would imply that there is a route from the SCNT technique to an entity that warrants moral status. If this were the case, then the claim that clone embryos have the second-order capacity to produce an entity with morally relevant first-order capacities under certain conditions would be true. Thus, nonreproductive cloning would be morally wrong because it would prevent an entity that has sufficient second-order capacities to develop morally relevant first-order capacities to warrant moral status. What makes nonreproductive cloning morally wrong on this view is thus the capacity of the clone embryo under certain circumstances, not the extent to which clone embryos are or are not identical to human embryos.

Before considering the plausibility of these claims, it should first be made clear that they constitute an important shift in the discussion: we are now considering whether performing SCNT for *reproductive* purposes might create an entity of moral worth, and therefore, whether

the potential of creating such an entity would delegitimize cloning for the purposes of researching cell therapies. We are not focusing on the simple argument that has been central to policy discussions regarding publicly funding nonreproductive cloning research, as I demonstrated in chapter 1, which merely held that human embryos and clone embryos are identical. Instead, we are discussing a different argument, that clone embryos warrant moral respect because of their capacity to become certain sorts of entities under certain experimental circumstances.[23] Again, even if this were the case, it must be recognized that the proposal defended here – that SCNT is a tool for producing immunocompatible stem cells that should be federally funded – is independent from the proposal that we should fund research into SCNT for reproductive purposes. Nevertheless, this line of argument must be taken seriously.

There is absolutely no evidence that reproductive cloning is possible in human beings. This may of course be because experiments designed to show it is possible are almost universally forbidden, and thus would not be reported. Nevertheless, proof of concept experiments in other species are telling. Reproductive cloning – the production of live offspring via SCNT combined with other artificial reproductive technologies – has been successfully attempted in six mammalian species. Yet despite considerable attempts by teams who have cloned other species, it has never been achieved in primates (De Sousa et al. 2004; Lee et al. 2005; Sparman, Tachibana, and Mitalipov 2010). Across mammalian species, the success rate of reproductive

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[23] Note that this argument is also cited in policy discussions of the permissibility of publicly funding nonreproductive cloning. For example, Leon Kass makes this point during the deliberations of the PCBE over the issue of funding SCNT (see § 4.3 below). However, as this is not the argument that has been given to justify the current policy prohibiting federal funding of SCNT, it is not the direct target of my analysis. But as it an argument the proponent of prohibition may be expected to give, it is one must preoccupy us at moments in this discussion.

cloning is 1-4%, and once born, "despite apparent physical well-being," these offspring "still have genetic or epigenetic abnormalities" (De Sousa 2004, p. 353). Early embryonic development varies widely across species, including fundamental differences between humans and all of the mammals cloned thus far (cf. Stern 2004), and these differences are hypothesized to explain why human clone embryos develop poorly when compared with human embryos (as shown in Figure 3).

Lacking evidence that reproductive cloning is possible in human beings, one might nevertheless appeal to the fact that it has occurred in mammals to argue by analogy that it is possible in humans. It must be admitted that this response simply cannot be decisively defeated: it is true that reproductive cloning has successfully been performed in mammals. But there are good reasons to think that this argument from analogy is unpersuasive. Consider that our best estimates suggest in healthy women natural conception has about a 68% success rate for producing a live offspring (Wilcox et al. 1999). Once a woman has conceived, the chance that zygote will develop and she will bring it to term are quite good. Even if a woman conceives using artificial reproductive technologies, the chance she will bring a child to term are quite good. In 2009, the last year for which there is data, 41% of IVF cycles resulted in a live birth (CDC 2011). These statistics suggest that even if, for the sake of argument, we suppose that cloning was possible in human beings, and that the rate of success was similar to that seen in other mammals, it would still remain unclear that such successes are good evidence for the claim that clone embryos could be used to produce entities with morally relevant first-order capacities.

Thus, evidence suggests that enabled human embryos have a good chance of developing into neonates. By contrast, even granting a number of contentious assumptions and *absent any evidence*, it seems that, in theory, enabled clone embryos would have an *extremely* poor chance

of developing into neonates. Indeed, without granting those assumptions, they should be said to have *no chance at all*. Therefore, I conclude that this approach to grounding the attribution of moral status upon the clone embryo's capacity to *produce* an entity with second-order morally relevant capacities is unsatisfying, just as the previous attempts considered above are.

3.4 How Simple is the Argument?

In this chapter, I have considered how a proponent of the simple argument might respond to my claims by appealing to the notion of moral status. I have argued that traditional accounts of moral status are not up to the task, because clone embryos are not of human origins in the way required by the anthropocentric approach and they do not have the capacity to exhibit first-order moral properties as is required on characteristics approaches. Yet, I recognized that another route was open to those who are swayed by the simple argument: they could argue that if an entity has a second-order capacity to develop such that they will at some later time exhibit a first-order capacity, then this warrants the attribution of moral status. And I have argued against this view by providing reasons against accepting the two ways it might be unpacked, in terms of a clone embryo having the capacity to be used to make a morally relevant entity via manipulation and combination with human embryonic stem cells or via reproductive cloning.

By drawing out the implications of the retreat to moral status in this way, I believe what has become clear is that the simple argument may not be so simple after all. It may rest on an extremely contentious assumption of how to attribute moral status, which I identified in the beginning of section 3.2. I have shown that in the case of clone embryos, however, even on this contentious account of moral status attribution, clone embryos do not deserve moral status. Yet in one sense, my conclusion is limited because it rests on empirical claims about the

developmental potentials of clone embryos, and these claims may of course be overturned or become problematic in the future. The proponent of prohibiting public funding for SCNT may think that this is at last a moment of victory. And so it is, in a way. I cannot conclusively refute the claim that it is conceivable, it is possible, that clone embryos could develop into a being that warrants attribution of moral status.

Yet I believe that appealing to this concession to support prohibiting using public funds for nonreproductive cloning would be a significant mistake by my interlocutor, because it would reveal a troubling assumption about the sense of conceivability or possibility that is sufficient for making moral judgments. On this view, clone embryos produced for reproductive purposes may be said to be capable of developing into an entity with moral status, such as a neonate or 17-week embryo. But notice that the sense of possibility is of the weakest possible sense, which we might call *logical possibility*. That is, hypothetically, and granting many contentious and evidentially unsupported assumptions, it is logically possible that clone embryos *might* be capable of producing human offspring. And even then, they could do so only if enabled, and in violation of strong social and legal prohibitions against such activities.

We may distinguish among logical and *nomological possibility*,[24] where the latter is actual possibility, grounded in empirical observation or perhaps by reference to scientific laws if such laws were available. No evidence exists to support the claim that it is nomologically possible for enabled clone embryos to develop into neonates, or any other stage of development past the blastocyst. Thus, as this is necessary for establishing the claim that clone embryos have

[24] See Singer and Dawson (1988) for an expression of this distinction and application of it to embryo experimentation.

a second-order capacity such that they deserve moral status, the claim that they do have such a capacity is unsupported by the available evidence.

Given that my thesis is that the simple argument fails as a justification of prohibiting funding for non-reproductive cloning, the remote logical possibility that a clone embryo could, in theory, develop into a neonate is a pyrrhic victory for the proponent of prohibition.[25] It underscores how different human embryos and clone embryos are, and hence, that the moral status of the former hangs on different assumptions than the latter. Clone embryos and human embryos are ontologically distinct, and this distinction carries moral weight. Even if one holds that human embryos have a moral status that precludes federally funding research upon them, accepting this position does not entail the same view of clone embryos. To defend a prohibition of federal funding for SCNT for research purposes requires additional assumptions, ones that should be doubted in light of the argument given here.

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[25] Stated thusly, this argument suggests the questions, what threshold for potentiality (possibility) is sufficient to warrant moral status or protection; and likewise, how should we respond to the fact that there is some, albeit only logical, possibility that a clone embryo could develop into a neonate? By distinguishing between logical and nomological possibility, we can appreciate just how low, yet uncertain, these possibilities are, which is an important advance in our accounts of what justifies science-funding policies. Nevertheless, even this minimal possibility suggests that the correct stance regarding funding is one that is cautious, such as using strict, adaptive funding policies that respond to science quickly as we learn more about the entities under discussion (see Mitchell 2009).

4.0 POLITICAL REALITIES AND POLICYMAKING

Having considered the high-road retreat to moral status and found it indefensible, it is important to consider a lower route to justifying the ban on federally funding cloning for biomedical research instead, namely via an appeal to the bearing of political realities on policymaking. On such an account, what justifies the ban would not be the claim that SCNT produces human embryos, nor would it be that clone embryos have moral status. Rather it would be justified by claims about the political nature of making science policy, which, when added to the simple argument, make it sound. Three such attempts are considered in this chapter. First, I consider whether simply explaining the current ban on federal funding for SCNT would suffice to justify it, which I dismiss as an inappropriate distortion of the notion "justification" (§ 4.1). In section 4.2, I consider whether it is possible to justify the current ban based on the claim that it is necessary to simplify scientific claims during policymaking, which requires policies that may not be consistent with the sorts of scientific evidence I have marshaled above. I argue that this has the unsatisfying implication that we should encourage our policymakers to make policy based on falsehoods, and thus, is unacceptable. In the last section, I consider whether a procedural approach to justification might suffice for justifying the policies that result from it, including those that currently prohibit public funding for SCNT. I find this line of argument promising but I argue that the detailed analysis required to develop this line of argument prevents me from

exploring it here. Whether a procedural account of policy justification would support the proponent of prohibition, I conclude, is an empirical question.

4.1 To Explain the Ban is to Justify the Ban

One might say that what justifies policy is not a logically sound argument, but political will and capital. Thus, to explain the ban on cloning requires an analysis of the political forces leading to the passage of the Dickey-Wicker Amendment and subsequent political events. The ban on cloning would be *explicable* by reference to historical political events, which would justify the ban by explicating the means by which it occurred. On this account, the Rawlsian standard of reasonableness bears little weight. The ban is justified by the sheer fact that it happened via some confluence of political events, irrespective of whether these events hold up to philosophical scrutiny.

The force of this alternative approach to justifying the existing ban on cloning rests on one's intuitions about philosophy and criticism in policy formation. One might believe that no amount of deliberation can alter the entrenched moral foundations of individuals' dispositions to support one or another policy. Under this purview, the analytic work performed here is solely (and presumably pejoratively) academic. Analyzing the logic underlying policy is not only quixotic, but also beside the point, because what justifies new political actions like creating and enacting policy are prior political acts.

Although a lesson worth learning is expressed by this response – that philosophical argument alone is insufficient to evaluate policy change – as an objection to the argument given here, the response fails because it overreaches in redefining justification. To justify something is to show that it is right or reasonable in accordance with some accepted standard or norm, rather

than simply to show how it happened. To treat justifying the prohibition synonymously with explaining its political history is to replace the standards of justification with those of description. This is unacceptable because of its significant consequences. On such an account, how would political decisions be open to criticism? How could one ever question the credibility of governmental policy? One could not. Rather, faced with incredible policies, one would be reduced to accepting them as the product of some explicable political process, and hence justified. This will not do. Policymaking should be accountable to standards over and above political expediency. Justification by appeal to commonly accepted norms is one of these, and on the account of justification as reasonableness, the ban on funding SCNT remains unjustified.

4.2 Simplification and Falsehoods in Policymaking

Recognizing the political realities of policymaking may justify the ban on funding nonreproductive cloning in another way: one might reply to my argument by claiming that appealing to a simple fact about policymaking rehabilitates the simple argument. That is, one could say the consideration of numerous scientific details, as is done above, is inimical to the activity of policymaking. Rather, since making policy requires agreement between individuals of varying intellectual backgrounds and political loyalties, *policymakers must simplify scientific information when creating policy*. Moreover, in some cases, such simplification entails that the depiction of scientific information used for forming policy will prove false if compared with a richer depiction from unsimplified scientific information.

What justifies the ban under this account is not the simple argument per se, but the simple argument with the additional premise that simplification is necessary in policymaking, even to

the point of falsehood. The current ban is then justified not despite its reliance on an identity claim between clone embryos and human embryos, but *because* of it: because a simplified and false representation of science is necessary for policymaking in today's political climate, arguments based on it are justified.

This is an interesting response to the arguments given here, and simply articulating it is to advance our understanding of the logic of science policy formation and the role that philosophy can play in that process. Notably, the response has gained some support from well-respected bioethicists involved in policymaking activities. For example, while discussing his time with the President's Commission for the Study of Ethical Problems in Medicine and Biomedical and Behavioral Research, Alan Weisbard writes that even when philosophical analyses of policy options were given during deliberations, they were not helpful. Rather, at the level of macro-policy, "philosophical analysis tended to invoke standards for justification that few real world policy initiatives (including those likely to command widespread political support in a 'mixed' society like our own) could meet" (1987, p. 781). Dan Brock agrees that there is a deep tension between academic philosophy and policymaking, which he believes arises out of the philosopher's commitment to truth on the one hand and the policymaker's commitment to enacting policy on the other. By his lights, the virtues of philosophy simply do not translate well to policymaking (Brock 1987, pp. 786-787; cf. Wickler 1991).

If the political realities of policymaking are inimical to philosophical criticism, and hence, to fruitful contributions by scholars whose policy work is consistent with the professional standards of philosophy, I believe it is a problem for policymaking, not for philosophy. Thus, though we may recognize that the political realities of policymaking may likely require a participant to alter his or her standards in order to effectively contribute to the process,

acknowledging this need not equate to a call for *lowering* those standards, which is, in effect, what the justification of the simplification of scientific information comes down to. That tactic would entail that we not only accept, but also in fact encourage, our leaders and policymakers to make policy decisions on the basis of far less knowledge than is available. This would amount to encouraging policymaking from ignorance, a perverse endeavor for the philosopher committed to characterizing and articulating justified knowledge. While we must accept that our leaders and policymakers are at times ignorant of the subtleties of the science their regulations target, philosophers should not enshrine this ignorance by using its inevitability as a premise for the justification of policies based on falsehoods.

4.3 Proceduralism and Policymaking

A proponent of the simple argument may respond to my claims about policymaking by pointing to a procedural account of policy justification. Policies and regulations, it could be claim, are justified just so long as they are produced via a certain sort of procedure. In the case of stem cell research, Benjamin Capps has argued exactly this. According to him, the argument for authoritative regulation of stem cell research is as follows. First, if we recognize both that our society is a pluralistic democratic society and that reasonable persons will disagree on the permissibility of possible courses of action in controversial cases like stem cell research, then it follows that significant disputes will arise for us. Now, Capps suggests that it might be possible that in such cases the views are not so extreme as to preclude peaceful orderly co-existence. However, he suggests that in the case of stem cell research the rhetoric of the two sides to the debate is so strong that this is not such a case. One side believes that scientific research harms human embryos, whereas the other side believes that not performing research harms suffering

human beings with debilitating diseases. Hence, Capps concludes that some action is required to resolve the reasonable disagreement about the public good. He proposes that a Rawlsian procedural approach to justification is particularly well suited to such a circumstance because it emphasizes thorough, unbiased deliberation and the protection of those who might be harmed by permitting actions or prohibiting them (Capps 2008).

I have a strong affinity for Capps' approach. I have cited Rawls' account of reasonableness above, and I believe that a Rawlsian account of ethical justification is preferable to other accounts because of its anti-essentialism and anti-foundationalism (see Walden 2013). However I do not believe that such an approach will be useful to those who would prohibit funding because of the type of justification that would have to be given for the prohibition. Capps says that a procedure that would justify authoritative regulation in stem cell research and cases like it would include a number of procedural stages. These would include an "egalitarian election process" by which policies are evaluated by the public, and mechanisms for "reactive policies," whereby existing policies may be modified in light of unanticipated developments (for instance, in scientific knowledge), which would be determined in a fair way by the sitting government. In addition, procedures would require that government policy is enacted according to fair deliberation among policymakers, which Capps characterizes as follows:

> In the political setting, optimum procedures allow free discussion, critical debate, and (peaceful) dissent. If these procedures are consented to – which is assumed on an individual level by simply participating in the process – they are committed (up to a point) to supporting its binding outcomes. Coherent policies cannot be reasonably rejected if they are soundly built upon procedures that: (1) acknowledge reasonable disagreement on the matter; (2) incorporate important elements of any personal moral

position; and (3) respect as many different reasonable positions as any workable alternative. (Capps 2008, p. 49)

Capps' description of a procedural approach to justifying federal funding policies for stem cell research describes a much higher bar for justification than were considered in the previous two sections of this chapter. And this is a bar that I am skeptical the proponent of the ban will be able to meet. To justify the prohibition by appeal to such a procedural account will require showing that policies were enacted through an egalitarian electoral process. Certainly, no elections have been held on the matter of stem cell research policies in particular in the United States. However, elected officials have played roles in deliberating stem cell research policies, as I discussed in chapter 1. Granting for the sake of argument that these processes meet the threshold Capps describes, I believe it is an open question whether existing policies have been modified in light of developments in our scientific understanding of the ontological differences between human and clone embryos. The bulk of my argument suggests they have not, and I believe they should be.

However, I cannot conclude that policies have not been adequately updated in light of the knowledge I have discussed in this thesis. Yet, neither can the proponent of prohibition conclude that policies *have* been so updated. Because, to do this would require showing that the sorts of deliberation that undergird our current policies were "soundly built" on the procedures quoted above: recognition of reasonable disagreement, incorporation of personal moral positions, and respect of as many different reasonable positions as possible. Such an analysis would require identifying how information about different moral positions becomes recognized at the level of policymaking and then becomes considered by actual policymakers during the instantiation of the ideal procedure described by Capps. Considering such procedures would result in a lengthy

analysis that cannot be taken up here. It would require, for example, considering the many instances of disagreement, persuasion, acceptance, agreement, endorsement, and other such attitudes and activities during the deliberations between policymakers, such as the members of the PCBE. If so, it then becomes an empirical question whether the policy of prohibition could be justified on procedural grounds.

Again, this is not an empirical question that can be answered in this analysis, because it simply lies beyond the scope of our discussion. However, I close this chapter by offering the following passage by members of the PCBE, as they deliberate about the appropriate terminology to use when referring to the product of SCNT. Many such passages can be found in their deliberations, and this one was chosen merely for convenience and because it was relatively short, compared to the convolutedness of ordinary speech found in the PCBE member's open discussions. I believe this passage shows that the deliberation did consider the recognition of reasonable disagreement, but I also believe it shows a reluctance to incorporate the personal moral positions of some deliberators on the council. Thus, I believe it remains an open question whether a procedural approach might rescue the current prohibition on public funding for SCNT. Yet, it is clear to me that given the discussion above, this is the only justification that remains available for that view.

> **DR. GAZZANIGA:** In the spirit of reducing linguistic sloppiness, speech as fact, if you look at the two definitions there, which basically are what are at stake here in terms of us trying to determine what we mean by those, the reproductive cloning, as stated there, is creating a living cloned human embryo. We stopped there because that is how each definition is launched. **I think the case could be made that using the word "creating" is loaded; "living" is redundant; and "embryo" is flat out wrong.** […]
>
> **CHAIRMAN KASS:** Now, why isn't a cell, which is -- will on its own proceed to divide and develop to the blastocyst stage -- I think there is a certain place earlier in the discussion where it describes this product. It is a cell but it is not an

ordinary cell. **It is a cell that resembles and can be made to act like a fertilized egg. It not only has the full complement of chromosomes but, unlike a somatic cell, it is capable of developing into a new organism. In other words, it is a zygote or a zygote-like being**. Is that –

DR. GAZZANIGA: It is not a zygote.

CHAIRMAN KASS: It is a zygote or a zygote-like being. Do you think that is wrong?

DR. GAZZANIGA: Well, it is a totipotent cell that is being reprogrammed is what it is. A zygote means two gametes have come together to form. […]

PROF. DRESSER: This is somewhat related. On page 5, the first two paragraphs or second two paragraphs, there is a lot of discussion about this as a cell that could become, I mean, implicitly a baby and, I guess, this is somewhat related. **It struck me that we do not really know that. I mean, it is -- we do not know whether it is a potential human life.** […]

DR. GAZZANIGA: I do not see the problem. Synthesizing a totipotent cell for the purposes of developing a blastocyst is an accurate description of what is going on.

CHAIRMAN KASS: Yes, but look --

DR. GAZZANIGA: And **it is not an embryo in the sense of how embryo is defined in the medical and scientific literature.** […]

CHAIRMAN KASS: And I think that whether -- that the -- **the textbook biological definition of embryo as from fertilization to -- I have forgotten**, is it two months or eight weeks when they start calling it a fetus? There is something arbitrary about that and it seems to me that what you mean humanly speaking when you are synthesizing this is do you or do you not have that which can turn into an adult? Does it have the potency if it works? Now Rebecca's point is still here but, **if it works, *is not the product of somatic cell nuclear transfer identical to the product of fertilization*** in this respect, mainly both of them, if things go well are capable of producing an adult of that species? And, **therefore, to call one a totipotent cell and to call the other one an embryo or a zygote might be technically correct but it would be to substitute a certain technical meaning for the human import. The human import is if they are totipotent they are**

both the same.

DR. GAZZANIGA: Well, I hear you but **creating a living cloned human embryo is loaded connotatively and everything else,** and to say synthesizing a totipotent cell is the accurate way of describing it -- now ***the interpretations and ethics of that event are all subsequent to getting the initial definition correct*** (PCBE 2002b; italics and bold added for emphasis and the sake of clarity).

5.0 CONCLUSION

This thesis argues that when performed for research purposes somatic cell nuclear transfer does not require the destruction of human embryos; it requires the creation and destruction of clone embryos to produce cell lines. Therefore, it claims that the longstanding bipartisan ban prohibiting federal funding of SCNT is unjustified because it rests on an unsound argument that assumes SCNT does destroy human embryos. Two types of responses to this position have been anticipated. First, that it fails because it sidesteps the ethical question of whether clone embryos deserve moral status, and second, that it fails because alternative sources of justifying the ban may be given by appealing to the political realities of policymaking. It is hoped that the argument given here will persuade others that federal science policy is a topic worthy of philosophical analysis, and exposing the reasoning that grounds our policies is a useful application of philosophical criticism. More attention to the particular topic of somatic cell nuclear transfer may reveal additional reasons to doubt the conclusions argued for here; however, the effort of analyzing science policy is one that I believe will continue to have substantial payoffs for both the scholar and the broader community, which must pay the costs for regulations of the means for pursuing the quintessentially humane end of relieving suffering.

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