



The Potential of the Human Embryo

Mark T. Brown

To cite this article: Mark T. Brown (2007) The Potential of the Human Embryo, Journal of Medicine and Philosophy, 32:6, 585-618

To link to this article: <http://dx.doi.org/10.1080/03605310701680973>



Published online: 14 Nov 2007.



Submit your article to this journal [↗](#)



Article views: 648



View related articles [↗](#)



Citing articles: 3 View citing articles [↗](#)

The Potential of the Human Embryo

MARK T. BROWN

University of Wisconsin Colleges, Wausau, Wisconsin, USA

A higher order potential analysis of moral status clarifies the issues that divide Human Being Theorists who oppose embryo research from Person Theorists who favor embryo research. Higher order potential personhood is transitive if it is active, identity preserving and morally relevant. If the transition from the Second Order Potential of the embryo to the First Order Potential of an infant is transitive, opponents of embryo research make a powerful case for the moral status of the embryo. If it is intransitive, then the Person Theorist can draw lines between levels of moral status that permit embryo research to proceed.

Keywords: *embryos, moral status, potential, stem cell research*

I. INTRODUCTION

The stakes in the human embryo research debates are very high. Proponents call attention to its potential medical, scientific, and social benefits. Most prominently, research on embryonic stem cells could lead to an indefinite supply of transplantable tissue that could provide effective treatment for a host of debilitating conditions, including heart disease, juvenile diabetes, Parkinson's Disease, spinal cord injury, retinal blindness and third degree burns (National Research Council, 2002).

Embryonic stem cell derived tissue also could be used to create and test a new generation of drugs more precisely targeted upon specific pathologies. Perhaps most important, embryo research provides an unparalleled opportunity to conduct basic science into the fundamental principles of human development. A deeper understanding of developmental disorders

Address correspondence to Mark T. Brown, Ph.D., Department of Philosophy, University of Wisconsin Colleges, 518 South 7th Avenue, Wausau, WI, 54401, USA. E-mail: mbrown@uwec.edu

could lead to clinical applications that improve the quality of life for millions of children and adults.

Any research program, especially one as ambitious and well funded as embryonic stem cell research, entails significant opportunity costs. Promising research in other areas of medicine may be foregone, the potential of alternative stem cell sources may not be fully explored, and technical obstacles could, in the end, block clinical applications. One must be careful not to overstate the immediate therapeutic implications, but on balance the argument from beneficence for human embryo research is cogent.

In general, reference to the embryo designates the eight-week developmental stage from fertilization through organogenesis, but the central focus of the contemporary argument from beneficence is upon the pre-gastrulation stage, when embryonic stem cells can be extracted and sustained in culture (Hurlburt, 2005). At gastrulation, embryonic stem cells differentiate into the tissue types from which the organs and organ systems of the fetus will form.

Research into the mechanisms of organogenesis in late embryological development holds great promise, but in this article unless otherwise indicated the expression "human embryo" will refer to the pre-gastrulation stage, extending from day one until week two and encompassing ova activation, blastomere cleavage and blastocyst formation.

Opponents of embryo research call attention to its moral hazards. Almost all human embryo research is non-therapeutic and much of it is impossible to conduct without causing serious harm or death to human embryos. If human embryos are human beings then such research constitutes an egregious infringement upon protections for human research subjects enshrined in the Nuremberg Code, the Helsinki Declaration on Human Rights, and the Belmont Report on Protection of Human Subjects. An understandable desire to protect the vulnerable members of the human community has led theologians such as Courtney Campbell and Gilbert Meilaender to insist upon, and to some degree exercise, a "meaningful ethical veto" over research that "dishonors the weakest of human beings - the embryo" (Campbell, 2001, p. 47; Meilaender, 2001, p. 143).

At the center of this aspect of the human embryo debates is the question of moral status. If human embryos have the same moral status as children and adults then they have the same basic rights, including the right not to be killed in medical experiments. If, on the other hand, human embryos do not have moral status that entitles them to human subject protections, then an argument from beneficence could provide a compelling justification for human embryo research.

The concept of moral status brings order to competing moral claims by specifying those entities toward which responsible people have moral obligations. In Section II of this article, I sketch a theory of moral status that sets minimum standards of acceptable behavior on the basis of the intrinsic

moral value that can be derived from the intrinsic properties of individuals of the kind. Moral status in this view is not conferred upon an entity on pragmatic, consequentialist, or contractual grounds, nor is moral status the consequence of social consensus or investments in the entity by third parties.

This article will explore the implications of intrinsic property theories of moral status in which critical thresholds that the entity itself crosses determine its moral status. Section III examines two widely held theories of the threshold condition for full moral status, the Person Theory and the Human Being Theory. Both theories are subject to objections that can be avoided if they incorporate a form of potential personhood into their account of moral status.

In Section IV, I offer an analysis of higher order potential personhood that provides a basis for determining the moral status of gametes, embryos and infants. In Section V, I apply this analysis to the case of the human embryo. In Section VI, I present an argument in the form of a constructive dilemma for the conclusion that embryos are human predecessors with intermediate moral status.

And in Section VII, I argue that for both Human Being and Person Theorists, the potential personhood of the embryo does not warrant moral status at a level that would entitle embryos to human subject protections. There may be other reasons to forgo the potential benefits of human embryo research, but if the argument of this essay is correct, then neither the humanity nor the future personhood of the embryo are among them.

The implications of this analysis for post-gastrulation embryo research are not explored in this article, nor do I apply the analysis to the moral status of the fetus and the morality of abortion, although the framework developed here may clarify those issues. Nor do I discuss alternative threshold theories of moral status such as Substance Dualism or Thomistic Hylo-morphism. Clearly, a full defense of this paper's central thesis would require an analysis of these views as well as conferred moral status theories and an analysis of arguments for restricting embryo research that do not depend upon questions of moral status.

II. THE CONCEPT OF MORAL STATUS

To ascribe moral status to a class of entities is to rank them on an interval scale of moral value that determines how the obligations owed to these entities can be reconciled with those owed to entities located at other points on the scale.

One widely accepted scale recognizes persons as entities with a moral status that entitles them to a complete set of basic rights, while sentient animals have a less stringent form of moral status that requires only that due

weight be given to their species-specific needs. Some philosophers and members of religious communities also recognize a form of moral status that implies a set of obligations owed to all living things; other environmental philosophies hold that ecological wholes such as species or ecosystems are morally considerable entities with an integrity and intrinsic value that entitles them to a degree of moral protection.

In each case, the intrinsic properties of the entity itself justify the ascription of moral status. This is why obligations are owed to the entity that has moral status, rather than to third parties, and why violations of moral status are wrongs perpetrated against those with moral status. A hierarchy of moral status merely reflects a commitment to a background hierarchy of intrinsic moral value.

Ascriptions of moral status thus represent very general claims about how moral agents ought to conduct themselves toward entities that have certain kinds of intrinsic properties. In this view, to claim moral status for the human embryo, or for anything else, is to make an epistemic commitment to identify the intrinsic properties that justify the sacrifices its moral status may require.

With the possible exception of God, whose moral status as the omniscient and morally perfect creator of the cosmos is *sui generis*, an interval scale of moral status assigns individuals to moral categories within which all members have the same set of rights and protections.

In monistic moral theories, levels of moral status are arranged along a single moral metric, which corresponds to the intrinsic value recognized by the theory. Kantian ethical theory is a limiting case of a monistic theory of moral status in which a single intrinsic value, moral autonomy, divides the moral universe into exclusive and exhaustive categories: persons whose rationality entitles them to full and equal moral status and non-persons who may be used as a means to further the ends of persons.

Other monistic moral theories recognize multiple levels of moral status corresponding to perceived natural divisions in a single intrinsic value. Certain forms of utilitarianism, for example, assign full moral status to human persons and intermediate moral status to certain non-human animals on the basis of the level of consciousness attained by typical members of their kind: a Great Chain of Moral Status.

Pluralistic moral theories may recognize different forms of moral status corresponding to different kinds of intrinsic value — life, sentience, self-consciousness, ecological wholes — but what all theories of moral status have in common is a set of categories within which membership confers equal standing. All living things are equally teleological centers of value; all sentient beings are equally capable of suffering; all autonomous agents are equally capable of deliberative choice; all human beings are equally human; all embodied souls are equally children of God. Equality is the hallmark of moral status.

Levels of moral status can be demarcated on the basis of what John Rawls called a range property, that is, a property which applies equally to

all individuals within its range even though members differ in the degree to which they satisfy the property (Rawls, 1972, p. 308).¹

The illustration Rawls gives is being within the interior of a circle. Different points within a circle vary in their distance from the circumference, but all are equally points within the circle. Range properties are common in hierarchical social institutions. A minimum level of skill at basketball is the threshold condition for making the varsity basketball squad, although some members of the varsity squad may be much better players than others. Once the final cut is made, everyone on the varsity squad is equally on the varsity squad.

Certain forms of moral status can be conferred in this way. For example, a minor child may acquire certain rights and responsibilities when he or she reaches a certain age. Qualification for membership in the range property comes in degrees and is acquired, but once the standard has been met, all within the range possess the property equally. Range properties reflect critical thresholds, either established by convention, or as an expression of phase transitions that alter intrinsic properties in a systematic way. When water freezes, for example, it undergoes a phase transition in which it loses the properties of liquidity and solubility and gains the properties of rigidity and solidity. Temperature functions as the threshold condition for the range property of being frozen because different blocks of ice may have different temperatures, but water which crosses the freezing point is equally ice.

Moral status that holds independently of the actions of third parties can be ascribed only on the basis of the intrinsic properties of the individual. Extrinsic properties entitle an entity only to the respect due the external source of its value. Furthermore, the intrinsic properties that constitute a threshold condition for equal moral status must be plausibly construed as constituting a phase transition of some kind in the individual's intrinsically valuable properties.

Two leading theories of moral status appear to lead to diametrically opposed positions on this issue in the case of the human embryo. If the threshold condition for full moral status is the range property of being a person, then assuming that the embryo is neither rational nor self-aware, it would seem that the embryo would fall well below the threshold of moral protection.

On the other hand, if the threshold condition for full moral status is being human, then assuming that the embryo is a human being; it would seem to be entitled to the same basic rights as any other human being. In the next section, I examine the rationale for these two theories of moral status as they apply to the human embryo.

III. THE PERSON THEORY AND THE HUMAN BEING THEORY

Kantian and utilitarian traditions converge upon a cognitive capacity standard for full moral status as a person. Personhood for Kant denotes a form

of value beyond all estimation; it is absolute, priceless, does not admit of degrees and is possessed equally by all rational beings and only by rational beings.

Autonomy functions as the threshold condition for moral status beyond which variations in cognitive competence are irrelevant. The capacities through which autonomy is exercised may come in degrees, but once someone acquires the ability to consider alternative futures and make rational judgments about the best course of action, he or she is capable of autonomous choice in a form beyond the reach of non-rational animals. This ability to make choices guided by normative reasons is what enables persons to act as moral agents and to take moral responsibility for their conduct as free and equal members of a Kantian kingdom of ends. The intrinsic property of rational agency, the "Good Will" in Kant's terms, is the intrinsic value that entitles persons to the highest form of moral status.

Those working in the utilitarian tradition emphasize self-consciousness as an alternative threshold condition for the range property of personhood. Its emergence in early childhood heralds a lifelong transformation in the content and quality of experience, opening up to the child new worlds of symbolic meaning. Sensations, perceptions and other merely conscious states become the intentional objects of a mind that can decompose and recombine their contents in accordance with conceptual, linguistic and cultural categories far removed from the immediate environment in which they arose. What for an infant was a series of mutually irrelevant episodes becomes, in a self-aware adult, incidents in an unfolding personal narrative.

Self-consciousness in the form of autobiographical memory creates a context in which events fit together as a meaningful whole. The importance of narrative unity comes to the forefront in times of crisis, when the events of a lifetime demand wholesale reinterpretation. A woman discovers the habitual philandering of her husband and what was once remembered as innocent banter between her mate and a female friend now is recalled as infidelity and betrayal; an adolescent learns of his parents' long-planned divorce and comes to remember family holidays, vacations, and birthdays as forced exercises in pretended civility; a father struggling to come to terms with the tragic death of a child remembers their last conversation quite differently before and after he hears the news. In each case a self-aware person constructs an autobiographical narrative that invests events with a form of value of which merely conscious creatures have no inkling.

Personhood meets the standard for a range property for moral status: the ability to engage in self-aware autonomous choice is an intrinsic property of persons; it makes possible forms of intrinsic value that are inaccessible to non-persons; and self-conscious rational agency is plausibly construed as an extended phase transition in psychological development beyond which individual worth no longer varies. Persons who have achieved a high level of self-mastery, for example, or those who have

exceptional intellectual abilities, are not higher life forms nor do they have new forms of consciousness. Gandhi and Einstein were extraordinary individuals, but each rightly would insist that he is a person and nothing more. Being a person does seem to be a sufficient condition for full moral status.

The Person Theory is open to a devastating objection: it fails to extend moral status to human infants and young children. Human infants are born without the psychological capacities that, according to the Person Theory, would entitle them to full moral status. Most babies do not cross the threshold to self-awareness until well into the first year; many cannot construct long term autobiographical memories until age four or five; and rational self-direction comes even later in childhood. Other mammals—certainly other primates—attain higher levels of cognitive competence than human infants, yet virtually everyone agrees that babies matter more than household pets. Infanticide, high risk non-therapeutic research on infants and failure to protect and nurture infants are morally wrong because babies are valuable for their own sakes, not merely as honorary persons, or as individuals who should be treated as if they are persons because their parents or other people love them, or because a failure to treat them as persons would pose a risk to just institutions, but because they are human beings with human rights that cannot be violated for any but the most weighty reasons.

The Human Being Theory of full moral status makes room for babies as individuals who clearly meet the threshold condition of membership in the species *homo sapiens*. Although no one concept of biological species applies in every explanatory context or to all taxonomic categories, the leading theories of species identity in the philosophy of biology converge upon a set of criteria in mammalian species that correspond quite closely to commonsense recognitional practices (Hull, 1984, pp. 603–622). Borderline cases are extremely rare, and could in principle be resolved through ancestry, genetic scan, clusters of homeostatic properties, or some combination of operational tests. In virtually every case, being a human being is an entirely determinate, either/or, all-or-nothing matter. With the possible exception of human-to-animal chimeras created in the laboratory, membership in the species *homo sapiens* is a range property that applies equally to everything to which it applies at all. If it is not obvious that an infant is human, DNA tests can remove all doubt.

Embryological development does seem to mark the emergence of new human life that cannot be unambiguously identified with either sperm or ovum. Nor is the embryo part of a woman who conceives (or of an In Vitro Fertilization apparatus!), yet it is indisputably alive and genetically human. If all goes well, the zygote can be tracked forward in time to childbirth, infancy and adulthood. Alfonso Gomez-Lobo recently put it this way:

I have developed continuously, without gaps, from the embryo that was conceived by my parents. If I trace my life back through space and time,

I arrive at that embryo – not at the embryo that developed into my older sister. I am the same human organism that started to live in April of 1939. (Gomez-Lobo, 2004, pp. 77–78)

This kind of spatio-temporal continuity is not sufficient to demonstrate numerical identity, for the simple reason that an object could be destroyed and another object composed of the same matter could continue the space-time trajectory. A desk fed through a wood chipper may be spatio-temporally continuous with a pile of sawdust, but the desk is not the sawdust. What is needed is a *sortal*, a term that tells us under what conditions an object of a certain kind continues to exist along a spatio-temporal path and when a different object has taken its place.

Sortal concepts are classificatory devices that help define the metaphysical options. Substance sortals indicate the kind of thing an individual essentially is by means of a consistent set of persistence conditions that apply throughout its history. When a substance sortal no longer applies, the individual necessarily ceases to exist. A phase sortal marks out a stage in the history of the individual, often cross-classifying entities individuated by different substance sortals. Being a chess player, for example, is a stage in the career of the Russian Grand Master Gary Kasparov and the IBM computer Deep Blue. A phase sortal approach to embryological development might treat zygote, embryo and fetus as stages in the life of a single human being, as Gomez-Lobo suggests.

Constitutive sortals are a third option in which the sortal denotes the objects that constitute the proper parts of a larger whole. A statue may be constituted by a lump of bronze for example, but the statue is not identical to the lump of bronze, because the statue and the lump of bronze have different persistence conditions. If melted down, the statue would be destroyed but the lump of bronze would persist.

In general, an object is constituted by, but not identical to, its constituents if it has different properties than its parts. Constitutive sortals apply when there are structural or organizational properties that distinguish the individual from its constituting matter, e.g., the representational properties of the statue. Cells constitute a body, because the body is no mere heap of cells; the pile of sawdust is the aftermath of the desk because the pile of sawdust is nothing over and above the sawdust pile.

The development of a central nervous system capable of consciousness in an existing human being strongly suggests that being a person is best understood as a phase sortal modifying the substance sortal “human being.” On this view, “person,” like “chess player,” cross-classifies entities of different kinds. Neanderthals and other now extinct members of the genus *Homo* probably satisfied the traditional definition of a person as someone capable of self-consciousness. Gods, demons, extraterrestrial intelligences and thinking machines, were such entities to exist, also would be persons, with quite

different essential properties and persistence conditions. Nor is personhood a constitutive sortal that tracks the matter of which persons are composed.

Since the threshold condition for moral status need not be among the essential properties of an individual, this result does not directly undermine the Person Theory, but it does provide the foundation for an argument from the essential humanity of the embryo to its moral status. Gomez-Lobo joined Council Member Robert George in his Personal Statement appended to the 2002 President's Council on Bioethics report on Human Cloning and Human Dignity:

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 being. Even in the embryonic stage of our lives, each of us was a human being and, as such, worthy of concern and protection. (George, 2002, p. 262)

This argument can be challenged either on the grounds that the properties that constitute species identity are not relevant to moral status, or on the grounds that being an embryo is not a phase sortal modifying human being. The claim that embryos are not human beings will be addressed in Section V; here I examine two attempts to bridge the explanatory gap between the genetic and ancestral properties by which species membership is determined and the intrinsic value required for full moral status.

The explanatory gap between biological properties and moral value confronts anyone attempting to justify an anthropocentric moral stance, but in the case of the human embryo the gap opens wide. The moral value of the human embryo cannot be due to its psychological capacities because it has none; nor could the intrinsically valuable properties be physical, if for no other reason than that an embryo has considerably less physical complexity and functional unity than a honey bee. It must be that the embryo is intrinsically valuable because it is thought to be a member of the species *homo sapiens*, but this merely brings the argument back full circle with the explanatory gap unfilled.

British philosopher Jan Deckers argues that a similar explanatory gap afflicts standard forms of the Person Theory. For Deckers the decision to value consciousness, or moral agency, or self-awareness more than the activities of the embryo is a social choice no less subjective, arbitrary and discriminatory than Egalitarian Speciesism, "an ethic that regards all humans as equals and as having more value than members of any other species" (Deckers, 2005, p. 262). Who is to say, Deckers asks, which "contingent human qualities" are morally significant and which are not?

The answer surely is that the history of moral philosophy testifies to the moral significance of the mental. For Kant, intrinsic moral value resides in the good will; for John Stuart Mill, higher mental pleasures have greater

moral significance than lower physical pleasures; for Aristotle the moral and intellectual virtues were habits of mind expressed in practical wisdom, and for Christian thinkers from Saint Paul to Paul Tillich, the highest goods in this world and the next are faith, hope and love. Other moral philosophers, whether they are Utilitarians, Kantians, Virtue or Christian Ethicists or work within other traditions, disagree about the relative importance of various kinds of consciousness but moral philosophy itself converges upon the centrality of the mental.

Deckers appeals to evolutionary theory to close the explanatory gap between moral value and species membership, arguing that “it makes good evolutionary sense... to favor members of our own species” since “those groups of ancestral humans that cared more about their fellow humans than other species had a competitive advantage” (Deckers, p. 267). This may be true but natural inclinations do not justify moral principles; certainly not the natural inclination to favor those who look like us, a lamentable human failing that has been the source of much of the racism and ethnocentrism that stains human history. Deckers suggests that “the natural inclination [of the embryo] toward growth into more developed humans” justifies its protected moral status, but it is difficult to understand how this “striving” differs from the phototropism of a daisy bending toward the sun unless it is “the contingent human qualities” of self-consciousness and moral autonomy that invest the striving with moral value (Deckers, p. 269).

Robert George argues that only Human Being theory can bridge a parallel explanatory gap between intrinsically valuable psychological properties and the societal commitment to moral equality that lies at the foundation of just institutions. George writes that “a mere quantitative difference in the degree of self-consciousness cannot be a justificatory basis... for why basic rights are not possessed by human beings in varying degrees” or explain why “the proposition that all human beings are created equal should [not] be relegated to the status of a superstition” (George, p. 262). From this perspective, embryo research appears to be only the most recent chapter in the history of moral horrors perpetrated upon those whose common humanity was denied or deemed irrelevant. Have we learned nothing, it may be asked, from the Middle Passage, Wounded Knee and Dachau?

While rhetorically powerful, George’s argument fails to bridge the explanatory gap in Human Being Theory for two reasons. First, the argument assumes that being human is the only range property that could extend moral protection to people of color, religious minorities and other victims of powerful social groups. But each of these historically marginalized groups also falls within the scope of moral personhood, with the sole exception of embryonic and fetal life. It would be question begging to argue that being human is the justificatory basis for the moral status of the embryo because only in this way can the moral status of embryos be justified.

Second, and more fundamentally, the argument simply advises on pragmatic grounds that one ought to act as if human equality justifies a commitment to equal moral rights. It may be true that in some cases wide acceptance of human rights is an effective political safeguard against abuse of power, but this does nothing to demonstrate that in the case of the embryo being human justifies full moral status. Membership in the species *homo sapiens* could be a marker for moral status merely because it is correlated with self-consciousness, rational autonomy and moral personality. If so, then when the normal correlation fails to hold, as it does in the case of the embryo, moral status could not be read off from human status.

IV. POTENTIAL PERSONHOOD AS THE BASIS FOR MORAL STATUS

Both the Person Theory and the Human Being Theory of moral status are open to objections that seriously undermine their credibility. The threshold property identified by the Person Theory locates human infants outside the scope of moral protection. Anyone who has held a smiling baby will find this unacceptable. The Human Being Theory elevates morally irrelevant genetic and ancestral properties to the highest moral significance. Anyone wishing theoretical justification for their moral intuitions will find this unacceptable.

Proponents of both views may reply at this point that critics have overlooked the crucial role potentiality plays in their theory of moral status. Human infants have much higher moral status than household pets, the Person Theorist might reply, because the brains of infants, unlike those of dogs and cats, have the causal power to generate self-consciousness. For this reason, they may say that babies are potential persons in a sense that meets their threshold condition for full moral status.

This response invites the reply from the Human Being theorist that embryos also are potential persons in the sense that their normal development results in adult human beings who are persons. If potential personhood elevates the moral status of human babies far above that of domestic animals, one would think that potential personhood would enhance the moral status of anyone with the potential for self-awareness. Moreover, if potential personhood distinguishes human infants and human embryos from non-human infants and embryos, then potential personhood would seem to be a component of the kind essence of human beings. Thus, to recognize the humanity of embryos also is to recognize their potential for self-consciousness. Since the intrinsic value of self-consciousness is admitted on all sides, potential personhood promises to close the explanatory gap in Human Being Theory between biological properties and intrinsic value.

Neither side makes the logical mistake of attempting to deduce actual rights from merely potential qualification for those rights. Everyone agrees

that acorns are not oak trees, lumber yards are not houses and presidential candidates cannot veto Acts of Congress. Both sides claim that potential personhood itself is a threshold condition for full moral status, but from this they derive quite different conclusions regarding the moral status of the human embryo. Obviously, clarity regarding the concept of potentiality is needed.

Potential properties are dynamic properties that encompass the sequential unfolding of events along an established causal pathway, either imposed from the outside, or sustained from within, or more commonly, through some combination of external and internal causal factors. The substantial phenotypic differences between chimpanzees and human beings, for example, are due in large part to the precise timing of gene activation in embryological development (Gould, 1977, pp. 352–405). The trigger that initiates this kind of potentiality typically is external, with the subsequent causal sequence under tight internal control.

It is important to distinguish between potentiality and capability. Both are dispositional properties that require in every case some underlying causal basis that is not itself merely dispositional. To say that A is capable of B-ing means that no change in A's intrinsic properties is required in order for A to do or become B. To say that A has the potential to become B is to say that with a change in intrinsic properties A would be capable of B-ing.

Consider a pianist at the Van Cliburn Competition awaiting her turn to perform. She has the capacity to play the piano because her musical skills are realized in the organizational properties of her mind and body. In contrast, someone who awaits his first piano lesson is a potential pianist in the sense that he could acquire the capacity to play the piano. People, unlike cats and dogs, are potential musicians because they can learn to play an instrument, read music and appreciate harmony; accomplished pianists, unlike novices, are capable of performing a Beethoven Sonata because they have the knowledge and skills to do so.

If the dynamic character of potentiality results in morally significant changes, potentiality will have consequential moral value. In general, actualized properties matter more, for good or ill, than the same properties when merely potential. This is why people act to realize potential and are disappointed when potential for good is frustrated. Indeed, if potentiality properties were morally equivalent to those same properties as actualized there would be no reason to act to promote or prevent the realization of potential and no reason to hope or fear that events unfold in one way rather than another. Potential has consequential moral value, not because of what it is, but because of what it can become.

Since only embryos can become persons, their potential personhood has great moral value independently of other considerations. The life of the embryo may be precious to many people for this reason, but this kind of extrinsic or instrumental moral value does not entitle the embryo to the

moral status of a human subject if moral status in general is derived from intrinsic properties. If, on the other hand, moral status were conferred for consequential, contractual or pragmatic reasons, then the moral status of embryos as sources of embryonic stem cells with the potential to cure diseases and advance biological knowledge would have to be balanced against the moral status of embryos as entities with the potential to bring more children into the world.

For intrinsic-value moral theorists such as Robert George and Alfonso Gomez-Lobo, the moral value of potentiality depends upon the intrinsic properties of the individual as it is rather than upon future goods. Potential personhood may be a marker for something else, for the miracle of ensoulment, or for the origin of a human being; or potential personhood may be understood as an essential property of a human being or an embodied soul, but in each case the intrinsic properties of the individual itself are the justificatory basis for ascriptions of moral status. To say that an embryo now is a potential person in this sense is not to suggest that it already is a person in some occult or preformationist way. One is simply indicating that the embryo occupies a link in a causal chain that is canalized toward the emergence of a healthy adult human being, rather than toward a chicken or a block of wood.²

George and Gomez-Lobo argue that since the embryo is a member of a biological species the normal members of which can and will in due course be self-conscious, the embryo already is a person in a sense that entitles it to the same rights as any other person. They distinguish immediately exercisable capacities from natural potential. Germans, for example, have the immediately exercisable capacity to speak their native tongue, but the ability to speak German must be understood as the consequence of a more basic potential to learn language that is part of being human. The capacity for reflective rational autonomy that endows adult human beings with moral status is said to be merely the activation of a more basic potential that is possessed by human beings as such. One's first struggles with moral choice, for example, draw upon capacities for reflective self-awareness already present in the child. In the same way, embryos are thought to be persons in virtue of a basic natural capacity for personhood present from the beginning.

Gomez-Lobo and George rightly distinguish between immediately exercisable capacities and the potential to acquire such capacities, but they do not distinguish between grades of remote potentiality. In a recent discussion of how John Rawls might respond to the human embryo debates, Russell DiSilvestro introduced the useful device of a hierarchy of higher order potential (DiSilvestro, 2005, pp. 285–304).³ Let us define First Order Potential as the capacity to acquire a capacity; Second Order Potential as the capacity to acquire First Order Potential; and Third Order Potential as the capacity to acquire Second Order Potential.

Mood, memory, intelligence, and many other important mental states are immediately exercisable capacities that enable people to respond appropriately even when they are thinking about other things. People who are asleep or under anesthesia are still persons even though temporarily unconscious because their brains are capable of generating consciousness.

Persons also have the First Order Potential for self-consciousness because they can learn to speak new languages, acquire new skills, break old habits and in general cultivate new dispositional mental states based upon underlying neural states that almost certainly are the causal correlates of consciousness. Infants may not have the immediately exercisable capacity for self-awareness but they do have the First Order Potential for self-awareness if their brains have the same kind of neurological properties that enable adults to acquire new dispositional mental states.

Embryos have the Second Order Potential to acquire First Order Potential Personhood; that is, embryos have the capacity to become infants, which in turn have the capacity to acquire dispositional mental states. Second Order Potential, like all dispositional traits, can be attributed only on the basis of an identifiable causal substrate, a physical structure of some kind, which channels changes in the individual's internal state in the direction of an expanded capacity to respond to events. Possession of a human genotype is the embryonic property most commonly cited as the causal antecedent of the neurological state that in an infant will sponsor consciousness.

Nothing else in the embryo persists into infancy; nothing else in the embryo contributes to the onset of integrated neurological function late in the second trimester. But the disposition to develop a property is not equivalent to the realized capacity to exhibit the property. Embryos have Second Order Potential Personhood rather than First Order Potential Personhood because their essential properties are one step removed from the neural properties that make consciousness possible.

Sperm and ova have the Third Order Potential to acquire Second Order Potential Personhood; that is, gametes together have the capacity to produce something, an embryo, which has the capacity to produce an infant that is capable of acquiring self-consciousness. Gametes have the intrinsic property of embryogenesis: they have the causal power to initiate in specifiable and repeatable conditions a sequence of events that begins with fertilization of a viable ovum which then may implant in the uterine wall and gestate to the point where it becomes an organism capable of being socialized as a human child. Gametes have Third Order Potential Personhood rather than Second Order Potential Personhood because neither the intrinsic properties of sperm nor the intrinsic properties of ova have the power to produce something that is capable of acquiring dispositional mental states. They are two steps removed from a baby.

When George and Gomez-Lobo claim that embryos are entitled to full moral status on the grounds that they have “the remote potential for self-consciousness” or the “basic natural capacity” to be a person, they seem committed to a principle first enunciated by Michael Lockwood (Gomez-Lobo, 2005, p. 105; George, 2002, p. 262):

The Transitivity of Potentiality:

If X has an active potentiality for giving rise to Y, and Y has an active potentiality for giving rise to Z, then it must follow that X itself has an active potential for giving rise to Z. (Lockwood, 1988, p. 197)

Gomez-Lobo writes that if an infant deserves respect as a potential human person, then by the transitivity of potential, an embryo also deserves respect as a potential human person (Gomez-Lobo, 2004b, p. 204). The Transitivity of Potential also seems to imply that gametes merit respect as potential persons, a result widely taken to be a *reductio ad absurdum* of transitivity of potential argument. Gomez-Lobo replies that potentiality is intransitive in this case because “gametes are so different from embryos that respect for embryos in no way requires respect for gametes” (Gomez-Lobo, 2004b, p. 203). And so they are, but this reply invites the response from the Person Theorist that embryos are so different from babies that transitivity fails in this case as well. A principled resolution of the issue will require criteria for the Transitivity of Potential.

Three conditions appear necessary. First, as Lockwood notes, transitive potential is active potential at each stage; second, transitive potential must be identity preserving in the sense that the individual does not lose any of its essential properties in the course of realizing its potential; and finally, these active, identity preserving properties must be sufficiently intrinsically valuable to function as threshold conditions for the range property of full moral status.

Potential is active if the intrinsic properties of an individual are the primary causal factor in the realization of its potential; potential is passive if the primary causal determinate of change comes from the outside, in causal factors that are properly extrinsic to the individual. Put another way, active potential drives change from within; passive potential is the consequence of outside forces. Potential is intransitive if external factors exert a decisive influence on the outcome, either through an intervention that breaks the causal chain or as a cumulative effect of contributing causes over time.

If the potential of X to become Y is identity preserving, then Y is a phase sortal modifying the substance sortal that defines the essential properties of X. Prince Charles has the identity preserving potential to become the King of England because no change in his essential properties are required to ascend to the throne. He was a human being before; he will be a human being after. If X loses essential properties in the process of becoming

Y, then the transition is intransitive because the realization of potential is identity destroying. A sapling, for example, has the identity preserving potential to become an oak tree, but its potential to become a table is identity destroying because carpentry kills the tree. Higher order potential must be identity preserving if it is to function as the threshold condition for moral status. Clearly, the transitivity of potential can entitle the embryo to moral status only if it survives the process.

Higher order potential must have sufficient intrinsic value to meet the threshold condition for moral status, either through being the very same properties that meet the threshold at a later stage or through intrinsic value that can be independently attributed to them. Otherwise it will not have been shown that the entity with higher order potential has the same intrinsic moral value as the entity with lower order potential. Specifically, Human Being Theorists who rely upon the transitivity of potentiality need to show that the neural properties that have intrinsic value as the causal basis for the immediately exercisable capacity for self-consciousness can be identified with the genetic properties that are the causal basis for the potential personhood of the embryo.

This analysis clarifies the key issues that divide the Human Being Theorists who oppose embryo research from the Person Theorists who favor embryo research. If the relation between First Order Potential Personhood and the capacity to acquire dispositional mental states is transitive, then Person Theorists can justify extending full moral status to infants; if the relation between the Third Order potential of gametes and the Second Order Potential of embryos is intransitive, then Human Being Theorists can plausibly exclude sperm and ova from moral protection. Seen in this light, the pivotal question becomes: Is the transition from the Second Order Potential of the embryo to the First Order Potential of an infant transitive? If it is, then opponents of embryo research have made a powerful case for extending moral protection to the embryo. Destructive embryo research would require the same level of moral justification as would be required to substitute infants for animals in other areas of medical research.

If, on the other hand, the transition from the Second Order Potential of the human embryo to the First Order Potential of human infants is intransitive, then the Person Theorist can draw lines between levels of moral status just where he wants, with infants on one side and embryos on the other.

The following two charts graphically represent this analysis. Chart 1 represents the implications of the transitivity of potential; Chart 2 the implications of the intransitivity of potential. Both Charts should be read in descending order.

In each case, the question of transitivity is an open question that can be resolved only by substantive empirical and philosophical argument. Before turning my attention to the critical issue of the transitivity of Second Order Potential Personhood in Section V of this paper, I apply this analysis to the

CHART 1 The Transitivity of Potential

Higher Order Potential	Transitivity of Potential	Full Moral Status
Persons		Competent Adults
First Order Potential Personhood	Yes	Competent Adults & Healthy Infants
Second Order Potential Personhood	Yes	Competent Adults, Healthy Infants & Viable Embryos
Third Order Potential Personhood	Yes	Competent Adults, Healthy Infants, Viable Embryos & Gametes

CHART 2 The Intransitivity of Potential

Higher Order Potential	Transitivity of Potential	Full Moral Status
Third Order Potential Personhood	No	Competent Adults, Healthy Infants, Viable Embryos
Second Order Potential Personhood	No	Competent Adults & Healthy Infants
First Order Potential Personhood	No	Competent Adults
Persons		Competent Adults

question of the transitivity of First Order Potential Personhood and to the question of the transitivity of Third Order Potential Personhood.

First Order Potential Personhood, the capacity to acquire self-awareness, makes possible forms of value that are accessible only to persons. Rational self-direction consists in large measure in the ability to convert First Order Potential into realized dispositional mental states, either through reflective self-examination—what Harry Frankfurt called Second Order Desires—or through cognitive and neurological processes occurring below the threshold of consciousness (Frankfurt, 1971). A second language may be acquired by total immersion in a linguistic community; new skills are acquired by consciously practicing them until they are unconsciously mastered; character traits arise through patterns of imitation that typically operate below the level of critical reflection.

Infants may be not be self-conscious, but if they have the neurological capacity to acquire language, construct memories and reflect upon their own experiences then they have the First Order Potential for self-awareness that in adults satisfies the threshold condition for moral status. Abundant empirical data indicates that the brain of the human infant has an inborn receptivity to the deep grammatical structure and phonetic cadences of natural language (Stern, 1985). Immersion in a linguistic culture prompts healthy human infants to speak spontaneously and to make rapid progress toward mastery of language. In contrast, even with enormous effort on the part of trainers, non-human infant and adult animals either never respond in

syntactically appropriate ways or display only the most rudimentary linguistic competence (Trefil, 1997, pp. 45–60).

Potential is active in this case because the properties that are the primary causal determinate of First Order Potential Personhood are properties of the infant brain which cause self-consciousness in later life. The conversion of First Order Potential Personhood into the immediately exercisable capacity for self-consciousness also is identity-preserving. No one believes that learning a first or second language threatens one's continued existence, or that breaking bad habits and cultivating good ones literally makes anyone into a different person. A baby is the same baby before and after she speaks her first words. We may conclude that First Order Potential Personhood is transitive.

Potential Personhood thus closes the explanatory gap between the biological properties sufficient for being human and the psychological properties sufficient for full moral status. The underlying capacity for the potential to acquire such morally valuable mental states as rational autonomy and autobiographical memory resides in the proper functioning of a human brain. Adult human beings as well as children and infants have full moral status because the biological properties of the human central nervous system are the causal explanatory basis for the psychological properties constitutive of personhood.

Gametes have the active potential for embryogenesis in the sense that the intrinsic properties of sperm and ova sharply channel the process of fertilization toward generation of an embryo. All that is required to initiate fertilization is the commingling of sperm and ovum through sexual intercourse, or laboratory conditions that mimic the conditions under which fertilization occurs *in utero*. Sperm penetration of the zona pellucida, the outer membrane of the ovum, triggers an intricate sequence of events under tight internal control, beginning with a cascade of chemical events known as the acrosome reaction and culminating in the alignment of paternal and maternal pronuclei at syngamy later in the same day.

Although active, the Third Order Potential of gametes is intransitive because fertilization is not identity preserving. Any moral standing gametes may have had in virtue of being germ line cells is lost when a complete human genotype emerges after the first cell division. The transitivity and symmetry of identity is a formal constraint upon all identity judgments: it is necessarily true that if $A=C$ and $B=C$, then $A=B$. But sperm and ova are spatio-temporally distinct entities prior to fertilization. It follows that either the sperm is not identical to the embryo or the ovum is not identical to the embryo, or that neither is. The fertilizing sperm is engulfed within the zona pellucida, sheds its head and tail during the acrosome reaction and loses its nuclear membrane at syngamy. It is an exceptionally poor candidate for identity with the embryo. The ovum might seem more promising. It is 4,000 times larger than the sperm, and in an important sense an activated egg is a

kind of egg, but embryological development causes such a dramatic shift in the internal properties of the activated ovum that the process is best understood as a substantial change that results in the demise of both sperm and ovum and the emergence of a new entity, the post-gastrulation embryo (Kiessling and Anderson, 2003, pp. 95–104).

The upshot is that gametes have the potential to produce persons, but they are not potential persons; infants on the other hand are not self-aware, but they are human beings with the potential for self-awareness. An embryo is a potential person in some sense, but is this potentiality more like that of an infant or more like that of sperm and ova?

V. HUMAN EMBRYOS AS HUMAN PREDECESSORS

Activated human genotype plays a dual role in the transitivity arguments of Human Being Theorists. On the one hand, some form of genetic essentialism seems inevitable if the active potential of the human embryo is identified with the activation of a human genotype. Different sperm, different ovum, or a different meiotic recombination of genetic material would result in a different person.⁴ On the other hand, the unfolding of a genetic program can be understood as a form of causal continuity between embryos and a future child. The genetic essentialist interpretation of the active potential of the embryo leads some Human Being theorists to argue that human embryos are essentially human persons. In his reappraisal of potentiality arguments for example, Massimo Reichlin claims that “An entity dies if it cannot actualize its potential for full personhood” (Reichlin, 1997, p. 23). Surely this is too strong. Obstetric disasters can radically diminish cognitive function without killing the infant.

The causal continuity interpretation of the active potential of the embryo provides a more plausible basis for the transitivity of Second Order Potential Personhood. Genotype is the underlying ontological foundation for inductive generalizations regarding normal human development, notably the development of a central nervous system capable of self-consciousness.⁵ The primary causal factor that determines whether an embryo will become a human being or a chimp or a pig is embryonic DNA. The same external conditions—a human, or at least mammalian, uterine environment—could lead to individuals of very different types depending upon the kind of DNA. A chimp embryo transplanted to a human uterus would result in the birth of a chimp, while a human embryo transplanted to a human uterine environment would grow into a human infant. For obvious ethical reasons, this experiment has not been done, but if it is true that the same uterine environment can lead to the birth of individuals of different species, then uterine environment cannot be the primary causal factor explaining the birth of an infant that is human. Plainly, genotype matters plenty.

Interpreted in this way, activated human genotype appears to satisfy the active potentiality condition upon the transitivity of Second Order Potential Personhood, but the moral relevance and identity preserving conditions are more problematic. Consider first the claim that an activated human genotype has sufficient intrinsic value to meet the threshold condition for moral status. The argument for moral relevance seems to depend upon an implausibly strong form of genetic determinism. Gomez-Lobo, for example, writes, "If we respect B, then we should respect A because it has the same properties that lead us to respect B, only at an earlier stage of development" (Gomez-Lobo, 2004b, pp. 205–206). But even if activated genotype is the primary causal determinate of fetal and embryological development, it does not follow that genotypic properties determine intrinsically valuable states of consciousness.

Some may suggest that psychological dispositions such as sexual orientation or aggressiveness or a propensity for substance abuse are determined at conception or shortly thereafter, others may argue on sociobiological grounds that certain gender specific patterns of behavior are genetically determined, but given the enormous role of external factors, attempts to derive psychological dispositions from genetic properties are far from established (Sober, 1993, pp. 185–194).

One might object that moral relevance requires only that genetic properties systematically bias development in the direction of acquiring the capacity for self-consciousness, not that a particular future is prefigured in the embryo (Stone, 1994, pp. 281–294). Predispositions to genetic disease are parallel in certain respects. BRCA1 or BRCA2 mutations, for example, are identifiable in the embryo and produce an 80% genetic predisposition to breast cancer. Since the expression of breast cancer is morally relevant, the genetic predisposition is morally relevant. Certainty is not possible in medicine, but empirical knowledge is, including knowledge of likely outcomes based upon genetic properties. One can very well make moral and medical judgments on this basis. In the same way, moral and medical judgments can be based upon the likelihood of personhood given a human genotype.

Nonetheless it is not literally true that a girl with unexpressed BRCA already has breast cancer. Unexpressed genetic properties do not have the same medical or moral significance as expressed genetic properties, nor are genetic properties the very same properties as their phenotypic expression, as Gomez-Lobo suggests. If one cannot say of a particular embryo that it has a genetic disease for which it has a genetic predisposition, then one cannot say of that same embryo that it is a person because it has the genetic predisposition to be a person.

It might be replied that the analogy breaks down at this point because a genetic predisposition for a disease is associated with a particular set of genes while the predisposition to become a person is the systemic effect of the entire genome on central nervous system development.

Consider then a pre-implantation genetic diagnosis that revealed that the embryo was genetically female. The XX sex chromosome will have a systemic epigenetic effect upon the development of her reproductive system with wide-ranging consequences for her physical and psychological development in later life. The potential of the female embryo to become a mother is no less essential to her identity than her potential to become an adult. Indeed, for a sexually reproducing organism, adulthood is constituted in part by potential parenthood. We grow up when we become potential parents, even if for medical or social reasons that potential is never realized. One could thus say that a genetically female embryo was potentially a mother in the sense that if she follows a normal and healthy developmental path she will become a sexually mature woman with the immediately exercisable capacity to be a mother. But no one would say a genetically female embryo already is a mother in the morally relevant sense. Her potential motherhood certainly does not entitle her to the moral or legal status of being a mother. Nor, it would seem, does the genetic potential of the embryo to become a person entitle it to the moral status of being a person.

VI. A CONSTRUCTIVE DILEMMA

The identity-preserving condition upon the transitivity of Second Order Potential Personhood also must be satisfied if potentiality is to justify human subject protection for human embryos. Recall that the transitivity argument pressed by Robert George and Alfonso Gomez-Lobo rested upon the claim that “even in the embryonic stage of our lives, each of us was a human being” and that “if I trace my life back through space and time, I arrive at that embryo — not at the embryo that developed into my older sister” (George, 2002, p. 262; Gomez-Lobo, 2004a, pp. 77–78).

Being an embryo is interpreted here as a phase sortal that restricts the substance sortal, human being. Embryological development is thought to be identity-preserving because embryos are understood as biologically human individuals in their earliest stage of development.

Recent critics of the Human Being Theory reject the claim that the human embryo is a stage in the life of a human being on the basis of embryological data that suggests that the embryo lacks the organizational integrity and functional unity that characterizes a genuine organism (Presson, 2003, pp. 505–509; Smith and Brogaard, 2003, p. 59–62). Embryological development cannot be identity-preserving if there is no individual to preserve. Human Being Theorists contest this interpretation of the embryological data, insisting that the evidence indicates that the embryo is an integrated biological individual that exercises substantial internal control over its own development.

The embryological evidence must be carefully considered, but it is possible to mount a Constructive Dilemma that implies that human embryo research is permissible on either interpretation. Everyone can agree as a matter of logic that either the embryo is a biological individual or the embryo is not a biological individual. Assume that the embryo is not a biological individual. In this case the embryo is not a stage in the life of a human being because the human being it will become does not yet exist. The potential personhood of the embryo would not entitle it to the moral status of human subject because embryological development would not be identity preserving.

Assume that the embryo is a biological individual. If the properties that constitute the identity of the embryonic individual are incompatible with the essential properties of human beings then the embryo cannot be a stage in the life of human being. It could be an individual, just not the same individual as a human infant with full moral status. Among the essential properties of biological individuals are their persistence conditions, but there is reason to believe that the pre-gastrulation embryo persists under different conditions than adults and infants. In this case, the Second Order Potential Personhood of the embryo would be intransitive because embryological development destroys the biological individual the embryo once was, producing in its place a new organism which goes on to become a human infant. Either way, human embryos are predecessors of human beings; either way, potential personhood does not entitle human embryos to human subject protection.

Consider first the claim that human embryos are not biological individuals. Proponents of biological individuality hold that from the moment of conception the embryo contains within it all that is essential to the human being it will be become. No one today thinks that adult structures are physically present as tiny organs and body parts, but leading biologists hold what may be described as a sophisticated form of Preformationism in which information encoded in the genome is the primary causal factor in the development and regulation of the physiological processes essential to life (Robert, 2004, pp. 34–56).

Ernest Mayr, for example, writes that “the genetic program is the underlying factor of everything organisms do. It plays a decisive role in laying down the structure of an organism, its development, its functions, and its activities”(Mayr, 1997 p. 123). Since the human genome requires only an appropriately permissive and supportive environment in order to be expressed as a human body, the pre-gastrulation embryo is seen as a human being at its earliest developmental stage.

But much of what is known about early embryological development suggests that a complete and fully functional human genotype is not operative at this stage. Early embryological development falls into three principal stages: ova activation, blastomere cleavage and formation of the blastocyst.

Primary ova are in a state of cell cycle arrest. Penetration of the zona pellucida by one or more spermatozoa reinitiates meiosis in the ovum, the process by which haploid germ cells are generated, and mitosis in the ovum, the process of cell division resulting in two diploid cells. The precise deployment of stockpiles of messenger RNA and proteins stored within the ovular cytoplasm leads to the extrusion of the second polar body, thereby completing ovular meiosis. The ovum remodels the sperm head in advance of syngamy, the point at which the pronuclei of sperm and ovum come into alignment, duplicate themselves separately and initiate the process of mitotic cell division (Kiessling & Anderson, 2003, pp. 41–50).

At no point do the pronuclei of the single cell zygote fuse. Molecular biologist Lee Silver describes the process this way:

Copies from each [pro-nuclei] come together inside the actual nuclei formed *after* the first cell division. It is within each of the two nuclei present in the two-cell embryo that a complete set of human chromosomes commingle for the first time. (Silver, 1997, p. 45)

The primary causal factor in this sequence of events cannot be the embryonic genome because no embryonic genome exists at this stage. The components needed for ova activation are stored in the primary oocyte and the process itself seems to be under the control of maternal signal molecules. Spontaneous ova activation confirms the view that ovular cytoplasm is the primary causal factor in ova activation. Failure of an ovarian follicle to rupture can lead to a form of parthenogenesis in which ova are activated independently of a fertilization event.

The embryonic genome is formed when blastomeres begin to cleave, but the newly compiled genotype does not yet appear to control embryological development. At least until the eight-cell stage, the developmental process seems to be regulated by ovular cytoplasm and maternal genes. The twenty-three paternal chromosomes apparently are completely inert, making no contribution at all to embryological development. This may be why parthenotes are capable of a form of cell division similar in relevant respects to that observed in the two-cell and four-cell embryo.

The embryo at the cleaving blastomere stage is a poor candidate for a biological individual for a second reason. The undifferentiated cells thought to constitute the two-, four-, and eight- cell embryo are totipotent in the sense that if detached they could develop in the same way as a single-celled zygote.

Consider a totipotent cell, TC, that is part of an early human embryo, HE. If TC were detached from HE, TC would be capable of developing into a human infant in the same way that HE is capable of developing into a human infant (Massey, 1994, pp. 50—59). TC would be a human embryo. But if the detached TC is a human embryo then the undetached TC also is a human embryo, because the relation between them seems to be identity.⁶

Recall that on the metaphysics of identity under consideration, the criterion of numerical identity is spatio-temporal continuity under a substance sortal. One can track TC through space and time as a cell with a complete human genotype with the active potential to become a person. Since detached TC is spatio-temporally continuous with undetached TC, and since detachment does not change the intrinsic properties of TC, detachment does not result in a change in the identity of TC.

But if TC is a human embryo when located outside the zona pellucida then TC is a human embryo when located inside the zona pellucida. TC would be numerically identical to an embryo that constitutes another embryo. But if TC is part of HE, then TC is not a distinct human embryo. The same argument can be iterated for each of the totipotent cells thought to constitute HE.

Something has gone seriously wrong in the phase sortal account of the metaphysics of the human embryo. A consistent application of the view that human beings come into existence at conception results in a proliferation of ephemeral human beings, each identical to a totipotent cell within the early embryo, each destined to pass out of existence within days, and each with the same intrinsic properties and moral status as the zygote that came into existence at fertilization.

The definite article misleads. "The embryo" sometimes functions as a count noun in reproductive medicine, rather as one might refer to a bag of marbles in a toy store, but the embryo is plural at least from day two until the first differentiation events make blastomere removal no longer possible. This is why the kind of first-person formulation that Gomez-Lobo provides is misleading. I can no longer ask whether I am a two-cell, four-cell or eight-cell embryo than I could ask if I am my second grade class in elementary school. I could be a member of that class but it is logically impossible that I be identical to a collection that has me as a proper part.

Blastomere separation is just one aspect of the extraordinary ontological indeterminacy of the human embryo. Human embryos also are capable of a form of fusion strikingly similar to fertilization. If brought into close proximity embryos at the cleaving blastomere stage may fuse and go on to develop into an adult human being.⁷ The result is a human chimera, a single human being whose tissues bear the marks of distinct genotypes.

An indeterminate number of people are human chimeras; some with expressed genetic disorders, others who appear completely healthy and may not even know their genetic history (Kopinski, 2004, pp. 624–626). You, dear reader, could be a chimera. But nothing can survive fusion with another substance of the same kind. The two original embryos must go out of existence in order to give rise to a new, chimeric, embryo.

The blastocyst is a stronger candidate for the status of biological individual. By the fourth day, one or more blastomeres are completely enclosed within the dividing sphere of totipotent cells. The cells on the outside

flatten, form tight junctions with each other and pump water and nutrients to the interior, giving rise to the blastocoel, a cavity that becomes the site for increasingly rapid cell division.

Elements of the paternal genome trigger the first differentiation event, leading to the formation of an exterior sheet of cells called the trophoblast from which the placenta and other extraembryonic membranes originate, and to the formation of the inner cell mass from which the structures of the embryo proper arise (Kiessling & Anderson, 2003, pp. 95–104). The blastocyst thus has significant structural, functional and genetic properties. Cytoplasmic stores continue to guide embryological development but the onset of embryonic genome function heralds a phase transition to a biological individual in the sense Ernest Mayr delineates.

The phenomenon of identical twinning indicates that the blastocyst has not yet achieved biological individuality. Identical twinning can occur at any time prior to implantation either through a breach in the zona pellucida or a gradual thinning of a region of the trophoblast. This event is incompatible with the continued existence of a biological individual. Recall that identity judgments are transitive and symmetrical in the sense that if $a=b$ and $a=c$ then $b=c$. For example, if Elizabeth changes her name to Kathy, and Elizabeth later changes her name to Mary, then Kathy and Mary are just names for Elizabeth at different stages in her life.

But consider Isaac, an embryo that undergoes identical twinning, dividing into two independently developing embryos, both of whom implant, gestate and are born, one named Esau, the other Jacob. Since it is not possible for both to be Isaac, either Isaac is not Esau or Isaac is not Jacob, or neither is. Isaac could not be identical to one but not the other because Isaac is qualitatively and causally continuous with both. To identify Isaac with both identical twins would be to lapse into contradiction; to identify him with one twin but not the other would be arbitrary. Nor could one reply that Isaac nonetheless survived as one brother, say Jacob, while budding off his brother Esau. In this case, the identity of blastocyst Isaac would be indeterminate, a result which itself calls into question Isaac's individual identity.⁸

A second form of chimeric fusion raises questions about the genetic identity of the embryo at the blastocyst stage. Experiments in mice show that it is possible to remove blastomeres from one embryo and inject them into the blastocoel cavity of a second embryo (Kiessling & Anderson, 2003, pp. 104–107). Viable offspring with cells derived from both sources may result. These chimeras are sometimes called Knockout Mice, since they present an opportunity to study the function of specific genes, but they also provide additional evidence of indeterminacy in the human embryo. A completely determinate and fully functional genome may be constitutive of biological individuality as Mayr suggests, but, if so, the plasticity of the blastocyst genome suggests that early embryos are not biological individuals.

Now assume the truth of the other limb of the Constructive Dilemma: the pre-gastrulation embryo is a biological individual. Robert George and Alfonso Gomez-Lobo rightly insist that earlier and later developmental stages are implicitly contained within the identity conditions of an organism. To identify a chrysalis is also to pick out a specific caterpillar and a particular butterfly; to identify a little girl is to identify the baby she was and the woman she will be.

Biological individuals cannot be understood in terms of a prototype represented by their adult stage, or by any other time slice of their life cycle. Most organisms undergo a precise species-specific developmental sequence. This is certainly true of human beings, with their nearly complete helplessness at birth, their enormously extended juvenile period and limited stage of female fertility, but it does not follow that the embryo should be identified with the infant to which it gives rise.

Embryos could be biological individuals without being the same biological individuals as those whom their matter has come to constitute. Just as a desk is not the tree from which it was built and the embryo is not the sperm and ovum which constituted its material cause, the fetus need not be identical to the embryonic constituents from which it originated. Individuals identified at different times cannot be numerically identical if they have different essential properties. Persistence conditions are among those essential properties. Recall the melted-down bronze statue. The statue cannot be identical to the lump of bronze because they have different persistence conditions: the statue is gone; the hunk of bronze is still there.

Even if the early embryo has sufficient organic unity to count as a biological individual, the features of early embryological development that cast doubt upon its biological individuality also call into question its identity to an infant. Embryos cannot be stages in the life of human beings if they come into existence and go out of existence in ways that are incompatible with being human. Human beings are multi-cellular, sexually reproducing animal life forms whose growth and development is controlled by a diploid genotype; the zygote is a unicellular individual whose haploid genotype contributes little to the cytoplasmic processes that result in qualitatively identical offshoots.

Cleaving blastomeres may be viewed as biological individuals for certain purposes, but blastomere separation, chimeric fusion and identical twinning imply that its identity conditions are incompatible with the identity conditions of human beings. Even the blastocyst, with its greater functional integration and genomic control, cannot be considered the same biological individual as the infant it becomes. Infants do not divide; blastocysts do; therefore blastocysts are not infants.

Gomez-Lobo rejects this objection to the phase sortal interpretation of the identity of human embryos on the grounds that monozygotic twinning, chimeric fusion and blastomere separation are unrealized possibilities for

almost all human embryos (Gomez-Lobo, 2004a, p. 79). Even if in rare cases the potential personhood of early embryos takes an identity-destroying form, over 98% of human embryos do not twin and chimeric fusion almost certainly is rarer still (O'Rahilly and Muller, 1996, pp. 46—50). It would seem that embryos that do not divide or fuse might well be stages in the life of a single human being. Many undergo continuous embryological and fetal development until the pregnancy is terminated or brought to term. Gomez-Lobo writes that a stick held in one's hand could be broken in two, but it nonetheless is one stick if no one breaks it. Similarly, an embryo that does not twin would seem to be one continuously existing human being.

This reply misses the metaphysical point. Since persistence conditions are essential properties that determine identity in all possible situations, any clear cut counterexample is sufficient to falsify a phase sortal thesis. The mere possibility of brain transplants, for example, is enough to discredit bodily continuity theories of personal identity. The modal properties of embryos are much more empirically robust. The process by which millions of identical twins have been born is understood well enough to erase any doubt that embryos are divisible even if most embryos do not as a matter of fact divide. The less well understood but nonetheless undeniably real phenomenon of human chimeric fusion demonstrates that human embryos can fuse to form a single embryo. And the experimental possibility of blastomere separation shows that embryos are separable in a sense incompatible with being separate and distinct human beings.

In sum, the Constructive Dilemma Argument recognizes the legitimate controversy over the biological individuality of the embryo in its first two weeks. Plainly, reasonable people can disagree, but both proponents and opponents of embryo research can agree that either the embryo has sufficient organic unity for biological individuality, or the relative independence of its parts falls short of that required for being a human being.

If the embryo is a biological individual then embryological development is not identity preserving because monozygotic twinning and related phenomena imply that embryos do not fall under the same substance sortal as human infants; if the embryo is not a biological individual then embryological development is not identity preserving because there is no entity to preserve. Thus, the Second Order Potential Personhood of the human embryo is intransitive.

One may object that the Constructive Dilemma merely shows what we already knew: early embryological development is a continuous process within which no non-arbitrary lines can be drawn. The biological facts, insofar as they demonstrate anything, imply that the human embryo is an intermediate life form bridging the ontological gap between gametes and infants. But this is precisely the conclusion of the Constructive Dilemma: human embryos are human predecessors. Attempts to go between the horns of the dilemma just lead to the same result.

Chart 3 represents schematically the outcome of the Higher Order Potential analysis:

All of this suggests that early human embryos are human predecessors: intermediate forms of human life that precede and pre-decease the human beings to whom they give rise, midway between the sperm and ova which are their cause and the fetus to which they give rise. If Human Being Theory provides the threshold condition for full moral status then potential personhood does not locate human embryos within the scope of Belmont, Helsinki or Nuremberg human subject protections.

Nor do human embryos merit protection as human subjects if Person Theory defines the threshold for full moral status in terms of potential personhood. Moral status might be conferred upon human embryos on extrinsic grounds, but neither of the two leading theories of intrinsic moral status justifies a meaningful ethical veto on embryonic stem cell research and other potentially beneficial research programs.

The Human Being and Person theories considered in this essay provide alternative routes to the same moral conclusion regarding embryo research, but as general theories of moral status they diverge in other borderline cases. Infants, children and adults who are severely cognitively impaired may fall permanently below a cognitive competence standard of personhood, but nonetheless be entitled to human subject protection as human beings. Nor do potential personhood theories provide firm guidance regarding the moral status of the fetus or the conditions under which a pregnancy may be terminated.

A distinction between early and late term fetuses may be necessary in order to apply the transitivity of potential personhood standard to the problem of abortion. And a moral theory that privileges membership in a particular species could be expected to have different implications for the moral status of animals than a moral theory that sets a standard for intrinsic value that cuts across species boundaries. These and other cases at the margins of

CHART 3 Conditions of the Transitivity of Potential

Higher Order Potential	Transitivity of Potential		Full Moral Status
Persons			Competent Adults
First Order Potential	Active	Yes	Competent Adults & Healthy Infants
Personhood of Infants	Morally Relevant	Yes	
	Identity Preserving	Yes	
Second Order Potential	Active	Yes	Competent Adults & Healthy Infants
Personhood of Embryos	Morally Relevant	No	
	Identity Preserving	No	
Third Order Potential	Active	Yes	Competent Adults & Healthy Infants
Personhood of Gametes	Morally Relevant	No	
	Identity Preserving	No	

moral status could provide the theoretical basis for adjudicating between the Person and Human Being Theory, but in the absence of such a systematic analysis, it is noteworthy that potential personhood theories converge upon the same result in the case of the human embryo.

VII. THE MORAL RELEVANCE OF ONTOLOGICAL INDETERMINACY

The argument for the thesis that human embryos are human predecessors that do not have either the moral status of human beings or the moral status or persons has relied heavily upon an analysis of the implications of monozygotic twinning and related phenomena. Variations on this view have been current in the literature on the moral status of embryos since the publication of Norman Ford's groundbreaking book "When Did I Begin?" in 1988. Both proponents of embryo research and opponents of embryo research have called into question the moral relevance of embryonic ontological indeterminacy. In this final section, I consider objections to this line of argument from Human Being Theorists and from Person Theorists.

David Oderberg and Robert George protest that division, fusion and separation do not show that the embryo did not exist as an identifiable individual before the breach in its identity (Oderberg, 1997 pp. 275–278; George, 2002, p. 268). The pre-twin embryo must exist in order to undergo twinning. The mere fact that it will go out of existence naturally does not justify taking action to destroy it. This fact may provide a clue to the intrinsic value of embryos generally. Entities have moral status if the intrinsic value of their intrinsic properties meets a threshold condition that imposes obligations upon moral agents to consider their interests.

Since moral status in this sense is a range property, all entities that cross the threshold are entitled to the same moral protections. Equality is the hallmark of moral status. Since pre-twin embryos have the same intrinsic properties as post-twin embryos and as non-twinning embryos, embryos destined to twin have the same intrinsic value, and the same moral status, as embryos that do not twin.

But if the moral status of a non-twinning embryo is equivalent to the moral status of a child, as Oderberg and George urge, then the event of monozygotic twinning would be as great a tragedy as the death of a child due to genetic disease. The question is not whether most people are as a matter of fact grief-stricken by the demise of embryos—they are not—but whether grief in this case is an appropriate moral emotion. Some people do mourn the destruction of embryos for research purposes and express grief for discarded "spare embryos" in assisted reproduction, but very few people would consider grief an appropriate response to the news that they are expecting identical twins. Most genetic counselors would be most reluctant to advise prospective parents to do so.

The alternative is to assimilate the case of twinning embryos to the case of non-twinning embryos. Since non-twinning embryos have the same intrinsic properties as pre-twinning embryos, and pre-twin embryos do not have intrinsic properties that meet the threshold condition for moral status, non-twinning embryos do not have moral status. Embryos are either twinning or non-twinning; thus embryos do not have moral status.

Christian Munthie argues on consequentialist grounds that divisibility and related phenomena are irrelevant to moral status. Munthie's argument relies upon two counterexamples that purport to show that "even if normal adult human beings were to be divisible, they would nevertheless have moral status." (Munthie, 2001, p. 387). Munthie first considers Derek Parfit's well-known thought experiment in which the cerebral hemispheres of a patient are surgically severed, removed from his skull and transplanted to two other patients.

Assuming that the operation is a success, the result would seem to be the division of a human person. But the pre-operative patient, Munthie protests, would nonetheless have the moral status of a person. The surgeons would have to acquire his informed consent, for example. Nor could one perform without informed consent high-risk surgery upon either of the person offshoots. If this kind of split-brain transplant is possible, then human persons are divisible, but the mere possibility of division does not affect the moral status of human persons. Similarly, Munthie suggests that embryonic divisibility ought not to affect the moral status of embryos.

As Parfit himself insists, what the thought experiment shows is that the unity of consciousness is not an essential property of human persons (Parfit, 1984, pp. 245–266). In the case of a split-brain transplant, both pre-operative and post-operative persons have their moral status as persons in virtue of the intrinsic value of their own stream of consciousness. By hypothesis, each post-fission person has the capacity for psychological states that separately are sufficient for full moral status.

In this case, moral status is determined independently of an identity judgment linking the pre-division and post-division individuals, but in the case of the transitivity arguments that we have been examining, moral status is claimed to be a consequence of the purported identity of the embryo with an adult human being. Split-brain transplant thought experiments are thus not counterexamples to the moral relevance of embryonic divisibility.

Munthie's second case is more fanciful:

In a few hundred years humanity starts to colonize outer space and eventually colonizers on different planets gradually evolve biologically in quite different directions. On one of those planets natural selection leads to humans that procreate by division, similar to amoebas. They have our type of consciousness and physical features, and may be able to procreate with us. Are we allowed to torture, kill and eat them just because they procreate by division? (Munthie, 2001, pp. 287–288)

The first point to notice is that the persistence conditions of such “humans” would be incompatible with the substance sortal that individuates terrestrial human beings. The case nonetheless illustrates the importance of embryonic divisibility. It is not just that the heart, the mouth, the anus, the genitals, the brain and other organs are not bilaterally symmetrical, or that a human body cannot unravel like a double helix, splitting off half of its organs and organ systems, while attracting free floating tissues from the ambient environment. Rather, the entire point of embryological and fetal development is to build an indivisible vertebrate body through cellular differentiation and organogenesis. Tissue formation is composed of precisely those cells that are not capable of twinning. Divisibility, fusibility and separability are indicators of the absence of the hierarchical integration of cells into tissues, tissues into organs, organs into organ systems and organ systems into organisms that is the defining feature of animal life forms. The logical possibility of amoebae persons may be of interest in discussions of personal identity, but it does not appear to be germane to the moral relevance of human divisibility.

VIII. CONCLUSION

Embryos are never created for their own sake. They exercise their identity-destroying potential to become a child, or they exercise their identity-destroying potential to become research subjects, but either way the intrinsic properties that might have entitled them to moral status as human subjects pass out existence with the embryo. As noted at the outset, embryo research has enormous potential for good. Embryonic stem cell research promises both transplantable tissue and more effective drugs for the treatment of degenerative disease; research into the mechanisms of fertilization could lead to both safer and more effective infertility treatments and safer and more effective contraceptives; and possibly most significant in the long term, embryo research is an opportunity to conduct basic science into the fundamental principles of human development.

If human embryos are human predecessors, then they do not cross the threshold for moral status that would justify restrictions upon scientific research that promises to make the lives of a great many people a great deal better. One may choose on other grounds to confer such moral status upon embryos but the argument for such a decision would need to be balanced against the argument from beneficence, a task well beyond the scope of this article.

ACKNOWLEDGMENTS

This article was written with the support of a 2005 University of Wisconsin Colleges/University of Wisconsin Madison Summer Research Grant. Special thanks are due to Professor Robert Streiffer of the

University of Wisconsin Madison Department of Philosophy and Department of Medical History and Bioethics.

This article was greatly improved by Robert Streiffer's insightful written critiques of earlier drafts of this paper and by many hours of searching conversation. Detailed commentary from anonymous reviewers for *The Journal of Medicine and Philosophy* also resulted in a much-improved article.

NOTES

1. Rawls can be interpreted as a Person Theorist of moral status for whom the threshold condition is moral personality understood as the capacity to have a conception of the good and a capacity for a sense of justice. Rawls writes: "provided the minimum for moral personality is satisfied, the person is owed all the guarantees of justice" (p. 507).

2. Biological causal chains are canalized if established biochemical pathways make a certain range of biochemical outcomes much more likely than others (Sober, 1993, pp. 185–194).

3. DiSilvestro recognizes the logical possibility of grades of higher order potential, but like George and Gomez-Lobo, does not discuss the moral relevance of differences in higher order potential.

4. This is the operative assumption for the Identity Problem in Wrongful Life cases.

5. Compare Stone, 1994, p. 284: "A fetus develops normally if she follows to the end the developmental path determined primarily by her nature (genotype) that leads to the adult stage of members of her kind."

6. It may seem Somatic Cell Nuclear Transfer technology implies that something similar is true of all somatic cells in an adult human being, but somatic cells have at most the passive potential to generate an embryo. Nuclear Transfer technology requires massive outside intervention, in the form of removal of nuclei from both ova and somatic cell, injection of the somatic cell nuclei into the enucleated ovum, and creation of the precise conditions which induce the resulting cell to transdifferentiate into a totipotent state. Moreover, even a modest form of genetic essentialism implies that the procedure is identity-destroying since the nucleus is removed from both the ovum and the somatic cell. For an opposing view, see Charo, 2001, pp. 82–92.

7. Human-to-human chimeras can be formed either by separate sperm fertilizing both the ovular nuclei and the polar body detached at the acrosome reaction, or by fusion of two independently fertilized ova, or by transfer of stem cells or precursor cells derived from one human embryo to another human embryo or fetus. Organ and tissue transplants also can be interpreted as creating human-to-human chimeras, since the body of the transplant recipient is composed of cells derived from distinct human genotypes. See Strain, Dean, Hamilton, & Bontrhon, 1998, pp. 166–169.

8. The literature on the determinacy of identity is vast, deep and beyond the scope of this essay. The thesis of the determinacy of identity to which I appeal is controversial, although it is regarded as the standard view from which an ontology of vague objects departs. A complete response to this objection to the Twinning Argument probably would require a resolution of the background metaphysical issue.

REFERENCES

- Campbell, C. (2001). 'Source or resource? Human embryo research as an ethical issue,' in P. Lauritzen (Ed.), *Cloning and the Future of Human Embryo Research* (pp. 34–49). Oxford: Oxford University Press.
- Charo, A. (2001). 'Every cell is sacred: Logical consequences of the argument from potential in the age of cloning,' in P. Lauritzen (Ed.), *Cloning and the Future of Human Embryo Research* (pp. 81–92). Oxford: Oxford University Press.
- Deckers, J. (2005). 'Why current UK legislation on embryo research is immoral' *Bioethics*, 19, 251–271.
- DiSilvestro, R. (2005). 'Human embryos in the original position?' *Journal of Medicine and Philosophy*, 30, 285–304.

- Ford, N. (1988). *When did I begin?* Cambridge: Cambridge University Press.
- Frankfurt, F. (1971). 'Freedom of the will and the concept of a person,' *Journal of Philosophy*, 68, 5–20.
- George, R. (2002). 'Statement of Professor George (Joined by Dr. Gómez-Lobo),' in *President's Council on Bioethics: Human Cloning and Human Dignity: An Ethical Inquiry* (pp. 258–266). Available at <http://www.bioethics.gov/reports/cloningreport/pcbe_cloning_report.pdf>
- Gomez-Lobo, A. (2005). 'On potentiality and respect for embryos,' *Journal of Theoretical Medicine and Bioethics*, 26, 105–110.
- Gomez-Lobo, A. (2004a). 'On the ethical evaluation of stem cell research,' *Kennedy Institute of Ethics Journal*, 14, 75–80.
- Gomez-Lobo, A. (2004b). 'Does respect for embryos entail respect for gametes?' *Journal of Theoretical Medicine and Bioethics*, 25, 199–208.
- Gould, S. J. (1977). *Ontogeny and phylogeny*. Cambridge, MA: Cambridge University Press.
- Hull, D. (1984). 'Contemporary systematic philosophies,' in E. Sober (Ed.), *Conceptual issues in evolutionary biology* (pp. 603–622). Cambridge, MA: MIT Press.
- Hurlburt, W. (2005). 'Altered nuclear transfer as a morally acceptable means for the procurement of human embryonic stem cells,' *Perspectives in Biology and Medicine*, 28, 211–228.
- Kiessling, A. & Anderson, S. (2003). *Human embryonic stem cells*. London: Jones and Bartlett Publishers.
- Kopinski, N. (2004). 'Human-nonhuman chimeras: a regulatory proposal on the blurring of species lines,' *Boston College Law Review*, 45, 619–666.
- Lockwood, M. (1988). 'Warnock versus Powell and Harradine: When does potentiality count?' *Bioethics*, 2, 188–213.
- Mayr, E. (1997). *This is biology: The science of the living world*. Cambridge, MA: Harvard University Press.
- Massey, J. B. (1994). 'Blastomere separation: Potential for human investigation,' *Assisted Reproduction Reviews*, 4, 50–59.
- Meilaender, G. (2001). 'Some Protestant reflections,' in S. Holland (Ed.), *The Human Embryonic Stem Cell Debate* (pp. 141–147). Cambridge, MA: MIT Press.
- Munthie, C. (2001). 'Divisibility and the moral status of embryos,' *Bioethics*, 15, 382–397.
- National Research Council. (2002). *Stem cells and the future of regenerative medicine*. Washington, D.C.: National Academy Press.
- Oderberg, D. (1997). 'Modal properties, moral status and identity,' *Philosophy and Public Affairs*, 26, 259–298.
- O'Rahilly, R. & Muller, F. (1996). *Human embryology and teratology*. New York: Wiley-Liss.
- Parfit, D. (1984). *Reasons and Persons*. Oxford: Clarendon Press.
- Presson, I. (2003). 'Two claims about potential human beings,' *Bioethics*, 17, 503–516.
- Rawls, J. (1972). *A theory of justice*. Oxford: Clarendon Press.
- Reichlin, M. (1997). 'The argument from potential: A reappraisal,' *Bioethics*, 11, 2–23.
- Robert, J. S. (2004). *Embryology, epigenesis, and evolution*. Cambridge, MA: Cambridge University Press.
- Silver, L. (1997). *Remaking Eden*. New York: Harper Collins.

- Smith, B. & Brogard, B. (2003). 'Sixteen days,' *Journal of Medicine and Philosophy*, 28, 45–78.
- Sober, E. (1993). *Philosophy of biology*. Boulder, CO: Westview Press.
- Strain, L., Dean, J, Hamilton, M, & Bontrhon, D. (1998). 'A true hermaphrodite chimera resulting from embryo amalgamation in vitro fertilization,' *New England Journal of Medicine*, 338, 166–169.
- Stern, D. (1985). *The impersonal world of the infant*. New York: Basic Books.
- Stone, J. (1994). 'Why potentiality still matters,' *Canadian Journal of Philosophy*, 24, 281–294.
- Trefil, J. (1997). *Are we unique?* New York: John Wiley & Sons.