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› The Argument from Potentiality in the Embryo Protection Debate: Finally 'Depotentialized'?

Marco Stier and Bettina Schoene-Seifert*

Abstract: Debates on the moral status of human embryos have been highly and continuously controversial. For many, these controversies have turned into a fruitless scholastical endeavor. However, recent developments and insights in cellular biology have cast further doubt on one of the core points of dissent: the argument from potentiality. In this paper, we want to show in a non-scholastical way why this argument cannot possibly survive. Getting once more into the intricacies of status debates is a must in our eyes. Not merely intellectual coherence but the standing and self-understanding of current stem cell research might profit from finally taking leave of the argument from potentiality.

Keywords: argument from potentiality, (induced) pluripotent stem cells, identity, tetraploid complementation, cell convertibility, right to life.

Gaining and using stem cells from human embryos is still highly controversial on normative grounds. The central question of the moral status of early human embryos (i. e. of the fertilized egg and its subsequent developmental stages)[1] has not only been an intellectual challenge to many and an existential challenge in certain areas of reproduction. It also lies at the heart of current stem cell ethics. Contrary to the hopes of many, the availability of alternative stem cell sources—notably adult stem cells or induced pluripotent stem cells (iPSCs)—has not rendered the status controversy practically irrelevant for current stem cell research. Rather, stem cells

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1 To keep matters simple and straightforward we do not differentiate terminologically between pre-embryos and embryos. Rather, we use the broad notion of 'embryo' for the phase between the completed fertilization cascade of the oocyte and the completion of organogenesis at about three months later—as well as for all of its functional equivalents that might be produced along other pathways. This *inclusive* embryo concept is, of course, welcome to protectionists, but does neither presuppose nor imply their position. In the following 'embryo' stands for *human* embryo.

from embryonic sources are still considered indispensable by the field's leading experts.[2] Hence, moral status questions are still of tremendous and direct relevance for stem cell 'bench' work.

Embryo-protective positions, if not stated merely apodictically or canonically, are very often based on the so-called argument from potentiality (PA). PA can be phrased in various versions. This might be a highly suggestive one: *Babies have a full right to life. Embryos are potential babies. Therefore, embryos have a full right to life.* Other versions replace the term 'babies' by 'persons' or 'living human beings'. Whatever the exact substitution, PA's kernel is ascribing rights to a class of entities that in the eyes of many only have a potential to *develop into* bearers of rights. The developmental potential in question—let's call it the P-quality—is allegedly a status-bestowing quality.

Moreover, none of the other classical pro-embryo-protection arguments seem to work without at least some implicit reference to the P-quality. Thus, unless presupposing the P-quality, the 'species argument' (the embryo already belongs to the human family) would either exclude the embryo or extend to any human tissue. Likewise, the 'argument from continuity' (in the development of fertilized eggs there is no morally relevant cut-off point) refers to the specific development towards birth. And finally, the 'argument from identity' (the embryo is relevantly identical to the later child) does again refer to the specific *developmental* relation between the alleged identity relata. To say the least, the embryo's P-quality is taken to be a necessary aspect in all the standard pro-protection arguments and as sufficient grounds for the proponents of PA. Most importantly, however, PA as such is still very much en vogue. Just to mention two prominent examples, Pontifical Declarations (e. g. Congregation for the Doctrine of the Faith 2008) as well as a recent decision of the European Court of Justice (ECJ: *Bruestle vs. Greenpeace* 2011) make use of this notion.

The objective of this paper is to argue against the ethical relevance of the P-quality and thus against the plausibility of PA. In our eyes, recent developments in cellular biology, i. e. insights into the principally ubiquitous *convertibility* of human cells from one type into another, have dealt PA its finishing blow. As a consequence, PA is either to be given up or to be augmented by auxiliary arguments, which themselves seem too hard to swallow. Certainly, we are not the first to point to the implications that modern cellular and epigenetic findings have for PA.[3] But we do claim merits in critically discussing the issue within a broader context. If we prove right, insisting on the plausibility of PA comes down to a seemingly rational secular disguise of a purely dogmatic embryo-protection-position.

PA's recent history: versions, refinements, and refutations

In secular philosophical debates since the 1970s, the argument from potentiality has been bedrock for embryo protectionism. Likewise, it has been the target of sharp criticism. In this section we will roughly and briefly outline what we take to be the most important aspects of this discussion.

2 For example see the recent statement of the *International Society for Stem cell Research* (ISSCR): "The ISSCR strongly supports all forms of stem cell research, including human embryonic stem cell research, and feels the issues of responsible stem cell therapies crosses all fields and all religions. Adult and embryonic stem cell research avenues are not only complementary but also vital for the development of therapies for a range of human diseases." (ISSCR 2012).

3 See i. e. Baertschi/Mauron 2010; Denker 2006; Devolder/Harris 2007; Testa et al. 2007.

To be more precise: PA is not one distinct argument, but rather the all-encompassing title for several closely related arguments. These versions differ in two aspects. One of the differentiating aspects is the relevant *final* descriptor ('baby', 'human subject', 'person') by reference to which the relevant potential is determined ('potential baby' etc.). The other aspect, partly linked to the first, is whether the potential in question is taken to bestow the embryo with a status that is (only) equivalent to beings falling under the descriptor (embryos *as potential persons* with a person-equivalent status) or rather subsume the embryo already under the descriptor (embryos *as persons* with developmental potential).

Hence we get two PA standard versions:

> **PA-as-if-versions**: embryos are potential persons/human subjects and therefore to be treated ***as if*** they were such (e. g. Manninen 2007).
> **PA-identity-versions**: embryos ***are*** persons/human subjects and therefore to be treated ***as*** such (e. g. Congregation for the Doctrine of Faith 2008).

Complicated as these subtleties (to which we will return in the identity section below) look at first glance, they all converge in taking the embryonic developmental potential as sufficient for bestowing a full moral status on the embryo.[4] Therefore, despite their variation, they invite quite similar objections. Roughly, these objections can be classified as either (a) why-should-P-matter-arguments or (b) absurd-extension-arguments. Let us take a systematic look at them.

Why-should-P-matter-arguments are probably the best-known objections. Mostly, they are directed against as-if-variants of PA. It is unconvincing, according to their core point, to base an embryo's right to life on its potential to acquire—sometime in the future—the features on which this right is (primarily) grounded. One cannot have a certain right just because of what one might become later but is not yet at present. Joel Feinberg has called the target of this objection "the logical point about potentiality" (Feinberg 1994, 49). Quite a number of authors have tried to illustrate this message by providing examples from other contexts where we do *keep* the distinction between potential and actual right-bearers, among them the prince/king example (a prince as potential king does not have the rights of a king) or the owner-of-the-driver's-licence example (the aspirant isn't allowed to drive a car). Stanley Benn has put this very rationale in his now classic remark, "A potential president of the United States is not on that account Commander-in-Chief [of the U. S. Army and Navy]" (Benn 1973: 143). Of course, proponents of the as-if-PA are free to insist on embryos being disanalogous to princes and other potential right bearers. And surely, this is what many of them do. However, in the eyes of their critics, this unparalleled evaluative stance has a sincere aura of ad hoc absurdity.

The other (historical) line of attack against PA—this time both as-if- and identity-variants of PA—can be classified as what we have called absurd-extension arguments. Its first token has been put forward by Leonard Sumner (Sumner 1981) and similarly by Helga Kuhse and Peter Singer (Kuhse and Singer 1982): If the embryo has a right to life because it will be a person some day, then ovum and sperm, put together in a petri dish, have this right as well. Since we would not even dream of ascribing rights to sperm and ovum, let alone a right to life, we should not do so in the case of embryos, either. A standard answer to this attack is to deny the gametes' alleged potential for non-identity reasons. For an entity x to have the potential to become y, it is said, x and y have to be relevantly identical. Since the embryo cannot simultaneously be

4 Interested in PA's principle plausibily, we are setting aside positions that assume PA to bestow a somewhat *weaker* moral status on embryos.

identical to both sperm and ovum, the gametes' case is said to be nonequivalent to the case of the embryo (Stone 1987; Brown 2007).

Some years later, other tokens of the extension-argument shed new light on non-identity objections. Some authors have pointed to PA's logical extension to pronuclei oocytes, i. e. egg cells during the ongoing fertilization process of nuclei fusion (even Gomez-Lobo 2004). According to (probably) all international policies, however, these 'fertilizing' oocytes are not being regarded as worthy of any protection. Others have argued, what we find even more exciting, that taking PA seriously would now imply extending protection even to somatic cells—given that their nuclei had proven to have the potential to develop into viable organisms (e. g. Charo 2001). Obviously, this perspective was linked to the successful cloning of mammals (like Dolly the sheep in 1996). Whereas cell nuclei can arguably be considered *non-identical* to the re-nucleated cell resulting from SNT (somatic nuclear transfer) (Gómez-Lobo 2004), identity questions are more sophisticated in the afore-mentioned case of egg cells *during versus after* completed fertilization. Hence, various authors have argued with the notion of an entity's 'intrinsic nature' (Oderberg 1997). After all, "everything is potentially everything else" (Feinberg 1994, 48). A house, for example, is a 'potential' pile of ashes, but obviously not identical to them (Stone 1987). What is needed, according to Stone, is a strong reading of the potentiality claim, one presupposing some due notion of identity. We will take this up again in the section after next.

Cells and their convertibility

One of the most exciting insights of recent cell biology refers to the phenomenon of (more or less) ubiquitous cell convertibility. It seems as if, in principle, human cells of any type can be triggered to turn into cells of any other type: skin cells into stem cells into neuro cells into egg cells etc. etc. This mutability, hence, is not confined to 'reprogramming' cells sensu strictu from a more to a less differentiated status and from there to differentiating into yet another direction.[5] Rather, it includes the possibility of direct conversion of cells of one specialized type (e. g. fibroblasts) to yet another cell specialty (e. g. dopa-producing neuroblasts) (Caiazzo et al. 2011)[6].

Deriving iPS cells: The first conversion of a differentiated (unipotent) adult cell into an ESC-like (pluripotent) stage was achieved in 2006 at the University of Kyoto (Takahashi and Yamanaka 2006). Kazutoshi Takahashi and Shinya Yamanaka introduced four genes into differentiated skin cells of mice, using retroviral vectors as 'gene ferries'. Hereby, these cells—which prior to this manipulation could generate nothing but skin cells—were now able to

5 The term 'reprogramming' is regularly used to refer to techniques of deriving iPSCs from other cell types and quite often as a synonym for all kinds of induced cell conversion. At first glance this may seem an appropriate shorthand description of what is done. On a closer scrutiny, however, it is misleading. Thus, 'reprogramming' can be read as reversing the natural process of cell differentiation, which would be a wrong understanding of part of what scientists do in cell conversion. Moreover, reprogramming can be interpreted as giving something a *new* program and, thus, changing its *nature* (whatever that may be). Actually, in 'reprogramming' cells it is not the programme *itself* that is 'changed' in the sense of replacing it with a different one. Rather, some of its options are activated. Take a text processor as an analogy: When you check some option boxes and uncheck others you don't change the programme—you just use some of the software's already available but temporarily disabled functions. Things are quite similar when a cell is put in the position to actualize its latent but already existing potential of bringing forth cells with alternative features. It is in this sense that we use and understand 'conversion'.

6 On the current state of the art in of producing neuroblasts as potential therapeutic tools, see Ming et al. 2011.

develop into numerous different cell types, if appropriately triggered. Much like stem cells derived from early embryos, they were pluripotent and not totipotent, i. e. unable to develop into a whole organism. This new type of cells has been named "induced pluripotent stem cell" (iPSC). Shortly afterwards, the derivation of iPSCs could also be reproduced with *human* skin cells (Takahashi 2007; Yu 2007). The 'inducing' procedure has since been refined and improved step by step, e. g. using adeno- instead of retroviruses as vectors to avoid the integration of gene particles into the genome of the cell. Currently, iPSCs are produced by means of proteins or microRNA (Zhou 2009; Li 2011). It should be emphasized that by these procedures the original skin cells are not substantially altered. As is well known, the genome of every cell contains the genetic information of the whole organism. During the described conversion nothing substantial is added to the cell, nothing taken away.

Tetraploid complementation: Since it was discovered that normal somatic cells could be triggered to gain pluripotency, these iPSCs have been celebrated as a solution to the ethical problems associated with the embryo-destroying production of human embryonic stem cells (hESCs).[7] What researchers needed in addition to the induction technique was a sound proof of pluripotency. Currently, this is achieved by one of two methods, either by means of so-called "tetraploid embryo aggregation" or via "tetraploid embryo complementation" (Nagy 1993; Kang 2009). Unexpectedly though, these pluripotency-tests *undermined* the moral 'innocence' of pluripotency that hitherto had been taken for granted by everyone—much in contrast to the totipotency of embryos and of single embryonic cells until the 8-cell stage. As we shall explain in a moment, pluripotency turned out to be what others and we would as well call a special variant of totipotency. It has thus been an "ironic twist of fate", as Giuseppe Testa and colleagues state, "that the research efforts aimed at reprogramming adult cells in order to bypass the perceived ethical problems of ES cells end up dismantling the very argument most of those ethical problems are based on" (Testa et al. 2007, 155).

This is, in rough outlines, what happens when pluripotent cells of any source are tested by the aggregation method: First, some pairs of normal diploid embryos at the 2- or 4-cell stage are fused to generate so-called tetraploid embryos, containing four sets of chromosomes instead of the usual two. These tetraploid embryos are no longer totipotent, i. e. they are unable to develop into a whole organism. Next, ten to fifteen iPSCs (or ECSs) are aggregated with those tetraploid cells and subsequently implanted into a uterus. Finally, normal fertile mouse pups are born. This has been reproduced in mice by many researchers and there is consensus among scientists that this is principally also possible with human cells - even if not done as yet since it is a form of reproductive cloning. To see the moral implication of these phenomena, two more aspects are of utmost importance. First, the newborn resulting from these procedures is not a conglomerate of cells of different origin, but stems from one single pluripotent cell (iPSC or ESC). Second, and even more important, as can be shown by DNA analysis the newborn does doubtlessly not develop from the iPSC *plus* the tetraploid 'sandwich', but from one of the iPSCs with the *assistance* of the tetraploid cells (Boland et al. 2009; Zhao et al. 2010).

So far, we have discussed only those relevant conversions that have indeed been performed successfully. Thus, our focus has been on the actual possibility of converting somatic cells, with

7 Another great advantage of iPSCs over ESCs is seen in their derivability from those individuals who in a hoped-for future might receive stem cell therapies for as yet untreatable degenerative conditions. Individualized production of the required cells is favourable in terms of immunology. On the other hand, iPSCs seem to have specific and major disadvantages such as a heightened tumorigenicity—a problem that researchers are currently trying to understand and overcome.

much technical effort, into pubs via iPSCs. The more straightforward conversion of somatic cells into pubs (or even babies) would, however, proceed directly via blastocysts. As yet, this conversion of somatic cells into earliest embryos has not been performed sucessfully in any mammals. Experts assume that the main problem for cells to regain totipotency by appropriate triggering is their insufficient cytoplasmic volume (Mitalipov, Wolf 2009). The success of the SNT-method in producing totipotent cells supports this view. Hence, the direct conversion of differentiated cells into totipotent ones does not seem out of reach.

Regardless of this last point, the convertibility of unipotent or pluripotent cells into entities that give rise to whole organisms undermines current *terminology*. Although 'totipotency', 'pluripotency', and 'unipotency' do refer to different states of the cell genom, *all* of them can be triggered to change. Thus totipotency, as the 'super potential' to develop into a newborn, is lurking behind both pluripotenty and unipotency. As a result, we are confronted with two terminological options: (1) we can keep standard terminology for the sake of descriptive differences, but disconnect it from traditional meanings. Or (2) we can give up current terminology for the sake of correct meanings, thereby loosing descriptive differentiations. We have made a decision in favor of the first option, urging our readers to keep in mind its price.

This is the puzzling synopsis of recent progress in cell biology: By converting a skin cell into an iPSC, and by subsequently assisting *this* cell via tetraploid cells it is ultimately possible to develop a newborn from a normal skin cell. Certainly, at present this procedure is very inefficient, but so is, to a much lesser degree, natural reproduction. Low birth rates have commonly not been accepted as a refutation of PA. Thus, for all we can see these insights are giving rise to yet another variant of the absurd-extension objection to PA, this time a deadly variant. Before we can develop this line of argument we have to come back to the question of identity. What, if any, identity relation must be presupposed to make the argument from potentiality work?

PA and identity?

As already mentioned in section 2, PA is often supplemented by the claim that the potentiality-possessing entity in question is in some appropriate sense identical to the human subject or person that could develop from this origin. This identity presupposition is required for what we have called PA-identity-versions. In contrast, it is not necessarily required by proponents of all PA-*as-if*-versions. Let's take a closer look.

Conceivably, a proponent of PA might assume the early embryo to be non-identical to the later child, but still worthy of protection. Although we know of nobody who does *explicitly* do this, she would thereby escape identity problems. However, it then becomes very tricky to explain why the potentiality-possessing entity should be protected. A coherent but absurd answer would refer to the goal of creating as many babies as possible. Likewise, people might want to protect mahogany trees with an eye to potential mahogany tables. In the case of embryos, however, this would definitively imply a ban on contraception and a moral imperative to convert skin cells into babies. Thus, this does not appear as a serious version of PA. All other PA variants seem to be in need of some identity presupposition.

Technically speaking, fertilized egg cells (earliest embryos), iPSCs and skin cells are all potential 'baby-precursors', in part due to modern cell biology. Defenders of PA-identity-versions have to claim that only embryos are relevantly identical to babies. The weakest candidate at hand for the needed notion of identity is 'numerical identity'. Roughly, x is numerically identical to y, if x and y are one and the same entity. Doubts about numerical identity can occur *synchronically* (is the evening star the same entity as the morning star?) or, as in our contexts,

diachronically, i. e. over time. Friends of PA-identity-versions have to claim that of all potential baby-precursors *only* embryos are numerically identical to the later child. Just like the house is not numerically identical to the ashes into which it can turn, they have to argue, skin cells and iPSCs cannot be numerically identical to a child developed from them. A burned down house and a highly manipulated skin cell simply stop being what they were before. According to this view *that's* why non-embryonic baby-precursors (if the reader will permit this rude description) do not qualify for PA.

Is this a convincing view? We certainly do not think so. Without getting too deep into the complex issues of identity theory (compare the enlightening papers of Olson 2010 and Shoemaker 2012), we simply want to emphasize that (1) the numerical identity of early embryos and babies is deadly threatened by the 'fission problem' and that (2) non-embryonic baby precursors certainly do not fare worse in matters of numerical baby-identity than early embryos do. Fission problems for identity relations have long been discussed outside embryo protection debates. If an entity E gets split and gives way to two follow-up entities F and G, what can be said of the resulting identity relations? According to common identity logic, E cannot be identical to both F and G, because that would imply F and G to be also identical to each other. However, E cannot be said to be identical only to F *or* G alternatively since this would be arbitrary. The problem seems to require either a branching condition for identity or a complex re-interpretation of this relation. Undeniably, the fact that early embryos might split into monocygotic twins within the first two weeks of their development is a fission case at hand. Undeniably, numerical identity between pre-14-day embryos and babies is therefore highly questionable, to say the least.[8]

In terms of identity relations with later babies, non-embryo baby-precursors certainly do no better—but neither worse. As described above, converting a differentiated somatic cell into an iPSC does not require more than a suitable cell environment. The cell itself is not substantially altered. So far, even numerical identity between the cells in question is preserved. For subsequent tetraploid treatment, the iPS-cell becomes multiplied. Ten to fifteen of the iPSCs thus produced get layered like hamburger patties into the tetraploid embryonic cells. Thereafter the sandwich layers 'simply' trigger some processes in the cell. Nothing substantial is taken away from the iPCSs or added to them, apart from inducing certain biochemical that make use of already available cell potentials. Now, the crucial point is that similar triggering (think of the option boxes mentioned in FN 4) is also necessary for normal embryonic development from about the 14th day onwards—innumerable triggers are needed again and again to keep the embryonic machinery running (we will come back to this issue in the next section). If one regards external triggers as identity-compromising in the first case, one should be prepared to do the same in the second. And likewise: if one regards identity as preserved in the second case, one can hardly deny it in the first one. This is all that needs to be demonstrated—the status

8 Apart from twinning, the blastomeres of the 8-cell stage are each totipotent and can each develop into a whole organism. Therefore, numerical identity is once more excluded because of the one-eight-one relation. A third reason to contest numerical identity at this stage is the fact that the newborn does not develop from the zygote, but from 'a part of a part of a part' of it. In the course of blastulation—the formation of the blastocyst (which consists of trophoblast and embryoblast)—and the further development several fissions happen: The trophoblast will develop into extraembryonic tissue. The embryoblast, in turn, further divides into hypoblast (contributing to extraembryonic tissue) and epiblast. Only a part of the latter will ultimately develop into the embryo itself. It should be clear on these grounds that numerical identity between zygotes and babies is extremely contested and no solid ground for PA.

of the iPSCs and the status of the blastomeres are equivalent in their identity relation to the developing organism.

Friends of PA-identity-versions might interpose at this point that the version of the argument just attacked is nothing but a straw man argument. Since what they have in mind is something quite different, the 'arguments' understood by proponents and opponents are, they might claim, like "ships that pass in the night" (Burgess 2010, 140). According to a different and stronger identity version of PA, embryos are not just entities that might, due to their specific potential, later acquire the properties of persons. Rather, embryos *are already persons*. According to this view, the potential of the fertilized human ovum does not indicate what it can become but what it already is. Thus an embryo is not taken to be a potential person but a "person with potential" (Eberl/Brown 2011, 44). Clearly, there is an important difference in the notion of 'person' underlying these two options. In the first case being a person is understood as a phase in human life, much like being a baby, a teenager, or even being a president. In contrast to this 'phase sortal' understanding of 'person', the second reading takes person not as a temporary property but as the essence of a way of existing (as a 'substance sortal').[9] Hence, no entity can *become* a person. Either it is a person throughout its existence or it is not a person at all.

What does this mean for identity? It is no longer (numerical) identity that serves as a 'binding principle' for potentiality. Rather, the very notion of a 'person' is said to do this job. If only we understand 'person' adequately, we see that being as person just means having certain potentials. In taking this stance the defender of PA hopes to bypass the difficulties of identity logic (the fission problem) as well as "the logical point about potentiality" (see above).

Has the critic of PA now lost the game? Certainly not: she can give five answers to this refined account. Firstly, regarding fertilized oocytes as persons is highly counterintuitive. Secondly, allowing the person to begin with the fusion of sperm and ovum is arbitrary. Since there is a continual active developmental path from the somatic to the adult cell, we can start at this point as well. Things would be different if the somatic cell changes its intrinsic nature, but that remains to be shown. Thirdly, it is not the potential that is in the focus of the argument here. We have an 'argument from personhood', not one 'from potential'. Fourthly, the proponent has turned PA into an argument congruent to the species argument. There it is species membership that is believed to ground certain moral rights, here it is membership to the class of persons. 'Species' has merely been replaced by 'person'. Fifthly, as potentiality is still part of the game, personhood and potential are explained mutually. Does the embryo have a specifically valuable potential? Yes, because it is a person. Why is the embryo a person? Because it has the potential in question. In other words: Is the embryo a person because it has a specific potential or has it a specific potential because it is a person? In the first case we can doubt the potential and its relevance, in the second we can discount personhood until the proponent of PA can prove it.

The only solution to these problems lies in a plausible explanation of the specificity of the embryonic potential and its normative significance. If both could be shown one might swallow the person status of human embryos as well as the duty to protect them. If the first is not plausible, the rest can be disregarded, too. This is the final question now: Is the potentiality of embryos significantly different from that of other baby-precursors? Following our previous thoughts, we can now ignore matters of identity.

9 Going deeper into the issues of sortal versus substance identity and of 'person essentialism' is beyond the scope of this paper (see Burke 1996; Olsen 2010).

PA in light of cell convertibility

PA stands and falls with an adequate notion of the specific embryo potential and why it should be protected. Obviously, even the earliest embryo (fertilized egg) has a potential to develop into a viable human subject. What is apparently not that obvious and has to be brought into mind is that even under standard reproductive conditions embryo development needs innumerable external biochemical triggers. From all that is currently (and incompletely) known, these triggers (a) include nutrition, (b) work at least to a large extent by turning inbuilt genetic 'switches' on and off, and (c) adhere to strict time patterns. Hence, in normal reproduction a viable human being will develop in the usual way if and only if the embryonic potential (P1) meets its corresponding external biochemical triggers (E1).

Looking at the newly discovered alternative 'baby-precursors', we find that pluripotent cells *also* have a specific potential (P2) to develop into a viable human being. P2, however, needs quite unusual triggers in the form of tetraploid 'sandwiches' (E2). In addition, common embryo triggers (E1) would be needed as soon as the common line of embryogenesis has been taken. The crucial question will be whether there is any normatively relevant difference between the two potentials P1 and P2.

Going backward in development to more unusual 'baby-precursors' such as skin cells or other differentiated, i. e. 'unipotent' cells, we can now ascribe a potential (P3) to develop into a full human being to them, too. For P3 to get actualized, we first need the cocktail of transcription factors (E3) to turn on—or 'awake'—a specific part of the cells' (latent) potential, thereby making them 'pluripotent'. Secondly, the resulting iPSCs need the above mentioned triggers of the tetraploid sandwich (E2). Thirdly, the usual external reproductive triggers (E1) have to be present. Again, the question is whether the normative relevance of P3 is any different from that of P1 or P2.

For illustration see the following table:

Required environmental conditions	**Existing potentials** **P1** (of totipotent cells)	**P2** (of pluripotent cells)	**P3** (of differentiated cells)
E3 (transcription factors)			●
E2 (sandwich trigger)		●	●
E1 (standard reproductive environment)	●	●*	●

* this might even become dispensable in the future – see above

Obviously, all three potentials (P1, P2, and P3) can be described as a potential of "developing into an individual human being if the necessary conditions prevail" (Germany's Embryo Protection Act 1991), while those necessary conditions are, however, becoming more and more complex and unusual. Taking PA literally, we would thus have to regard and protect skin cells and most probably any intact differentiated human cell as potential human subjects. Clearly,

this is the full-blown absurd-extension argument.[10] It is the *absurdest*-extension argument. To block it, a specification of PA would be needed that includes P1 and excludes P2 and P3. But as we will try to show in the next section such a specification via auxiliary arguments cannot coherently and plausibly be given.

The argument from differences in the respective identity relations between babies and their various baby-precursors is already blocked since there are none (see above). Another strategy for avoiding the absurdest-extension argument would be to give different normative weight to the various external triggers E1 versus E2 and E3. But this doesn't work either. Descriptively, any of those signals triggering and controlling the internal processes of the cells works via biochemical molecular reactions. How could one type of signal, one set of molecules be of greater normative weight than any other? Furthermore, regarding E1 as being an *internal* part of the fertilized ovum or embryo in contrast to external influences E2 and E3 is plainly wrong. To our best knowledge, the specific triggers needed to develop a blastocyst are located *within* the cell-fluid, thus making the early embryo temporarily independent. But starting with implantation, this period of independence is over.

Looking for other reasons for the normative superiority of P1 over P2 and P3 we now have to turn to some more traditional auxiliary arguments. Ultimately though, we do not find any of them at all convincing. If our line of argument proves sound, the only choice left is between accepting the *absurdest* extension of PA or else accepting PA to be finally 'depotentialized' in the light of modern science.

Auxiliary Arguments

The task at issue for PA defenders is to provide sound arguments for the normative superiority of P1 over P2 and P3. If successful, this might at least prove that new scientific findings about cell convertibility are of no significance for the standard conservative PA based view. In defenses and invocations of PA we can trace three such supplementing or *auxiliary* arguments.

The Argument from Natural Fit

Some proponents of PA might want to emphasize the fact that only the specific potential of embryos (P1) can be actualized under natural conditions. Doubtlessly, they are right. The naturally occurring interplay between the totipotency (P1) of blastocysts and later-stage embryos is the factual, sufficient, and hitherto necessary condition for human reproduction. Only P1 fits the natural givens of maternal triggers during human pregnancy (E1). Once moved into a 'prepared' uterus, the fertilized human ovum will thanks to its totipotency (P1) quite naturally and with substantial probability develop into a viable human being. Without P1 humanity would not exist. P2 and P3, on the other hand, can only be actualized by highly artificial and complicated science borne tricks (E2 and E3, respectively). Without these highly sophisticated interventions, unknown in nature, differentiated or pluripotent cells would never ever result in babies. And even then, these procedures are extremely inefficient.

If all these descriptions are true without question, how can these differences be taken to ground a *normative* gap between P1 and P2/ P3? The 'naturalness' and 'normality' of P1 do not make up for sound arguments. For one thing, inferring normative superiority of P1 over

10 Likewise: Devolder/Harris 2007; Testa et al 2007.

P2 and P3 from its fit to the 'naturalness' or 'normality' of usual human reproduction and embryo development is but a naturalistic fallacy. The fact that something can be found in nature doesn't as such tell anything about its moral significance. Even if we were willing to admit such normative superiority of natural processes as such, we would be forced to welcome every kind of cancer, diabetes, or tooth decay, as these are natural processes as well.

But this is only the first half of the refutation of the natural-fit argument. In the second half we can again beat the defender of PA at her own game. Let us for argument's sake accept the claim that only P1 is a rights-granting potential because it can be actualized *without* the application of artificial means. From this perspective neither somatic cells nor iPSCs are to be protected, but neither are embryos in vitro or embryos in vivo that could only survive by some therapeutic intervention earlier or later in their development. This reductio in the other direction is certainly not what the defender of PA has in mind.

Teleology

One further aspect of the argument from naturalness has to be re-emphasized. In a way it is a self-destructive aspect: If the rights-granting property of embryos is the ability to develop under non-artificial circumstances, then it is no longer the potential as such that counts in this argument, but the potential's context.[11] One such contextual aspect could be the assumption that embryos, but not skin cells or artifacts like iPSCs, are *meant* to become babies and therefore should not be disturbed in their pre-determined way. Certainly, in any secular worldview, such assumptions seem strangely unfounded and ad hoc. However, within religious belief systems this might be a thorough option for believers who can and want to accept it as such, even though it might not meet requirements of consistency. Quite a number of official Catholic statements on the dignity and person-status of embryos suggest an underlying understanding along such lines.[12] If God is believed to have his hands and plans on naturally fertilized and naturally developing embryos and on their functional equivalents (i. e. artificially produced totipotent entities), but *not* on somatic cells or iPSCs, this cannot be questioned on rational grounds. How this belief can be compatibilized with other judgments and evaluative positions, is not the business of those who do not believe in these doctrines. Only, they should not be defended by rational arguments and their standards of consistency.

Active versus Passive Potentials

One seemingly weighty argument of PA defenders that we finally want to analyze refers to the distinction between active and passive potentials in Book Z of Aristotle's *Metaphysics*. Aristotle explains that a potential (dynamis) is passive if the principle of actualization comes from outside the transformed or transformable entity. In this sense a tree is a potential table, but only in as far as it can be turned into one by the carpenter. The principle or source of change is nowhere

11 We owe this point to FitzPatrick 2004.

12 E. g.: Pope John Paul II: "Human life is sacred and inviolable at every moment of existence, including the initial phase which precedes birth. All human beings, from their mothers' womb, belong to God who searches them and knows them, who forms them and knits them together with his own hands, who gazes on them when they are tiny shapeless embryos and already sees in them the adults of tomorrow whose days are numbered and whose vocation is even now written in the "book of life" (cf. *Ps* 139: 1, 13–16)." (Encyclica Vitae 1995; number 6)

'in' the tree but coming from outside. This kind of potentiality means "simply the disposition to receive modifications" in a certain direction (Reichlin 1997, 13). Active potentiality, in contrast, is present for Aristotle if the principle of actualization is part of the 'intrinsic nature' of the thing, which is transformed—or rather, which transforms itself. Nothing in the intrinsic nature of a tree indicates that it can (let alone will) be a table, everything in the intrinsic nature of an acorn, however, indicates that it can and quite likely will turn into an oak tree.

Applying this Aristotelian distinction with or without reverence to its inventor seems somewhat self-understanding for many friends of PA. Talking of the blastocyst's 'active' or 'own' potential (to develop into a human subject with capacities like self-consciousness, rationality and so on) is indeed part of standard PA formulations.[13] Does it make sense, then, to ascribe an active potential to embryos and only a 'passive' one to other baby-precursors like iPSCs? Surely, many friends of PA would greatly welcome this and seem to presume that this distinction can and should be made sensibly. How can the difference between active and passive potentialities be spelled out more precisely, in particular within our context? Or to put it differently: what are the necessary conditions for a potential to be 'active'?

Standard interpretations require that an active potential belongs to the 'intrinsic nature' of the entity in question and that its actualization does not change its bearer's identity (Reichlin 1997). As we have seen above, numerical identity preservation seems rather questionable for early embryos *as well as* for other baby-precursors. But in any case, all of them are on a par in this regard. How then are we to understand the intrinsic nature allusion? Does the potential P1 of an embryo belong to its nature in a more intimate way than e. g. P3 relates to somatic cells? What exactly happens if transcription factors convert these cells into iPCSs? Can they be said to change the nature of the cell? Yes and no—but in any case, there is no difference with regard to maternal triggers (E1) that help to develop an embryo. In *all* these cases, the only thing being transferred are biochemical triggers that change the functional profiles of their target cells by 'switching on and off' gene expressions. Do you change the nature of your cell phone by turning the Wi-Fi connection on? Hence, the 'principle' in question comes from inside the cell; the ability to actualize certain of its latent active potentials in certain environments is due to the cell's intrinsic nature.

Let's return to Aristotle's own examples. Is the conversion of a somatic cell into an iPSC analogous to the tree-table story? It would be so, if counterfactually the carpenter could just pour some cocktail into the wood thereby starting the tree's own intrinsic program of developing itself into a table. Human cells, however, really function in such a magic way. Hence in Aristotelian terms, the 'principle' of the table lies in the carpenter—the 'principle' of the human subject to develop lies in any somatic cell.[14]

13 "… As a matter of biological fact, this new living organism has the full complement of human genes and is *actively* expressing those genes to live and develop in a way that is unique to human beings, setting the essential foundation for further development." (United States Conference of Catholic Bishops 2008, 3; emphasis added)

14 Relying on Aristotle's ideas and concepts might, moreover, be somewhat dangerous for the defender of PA herself. According to Aristotle's embryology the 'form', or soul, of a new animal comes from the sperm. "[M]ale semen has an active power/capacity to make something an animal (of a definite sort)" (Code 1987). Moreover, if we follow Code, the active principle now being in the embryo is the very same principle that was in the sperm before. Even if the female ovum (the "menstrual fluid" as Aristotle believed) is only passive, shouldn't we acknowledge a right to life at least of the sperm? Of course, that seems silly. So, let's forget the sperm and concentrate on the real active ability to form a whole human being.

To our best diagnosis, the Aristotelian *activity*-label, so welcome among PA friends, does not deliver any additional insight or explanation. Rather, it serves as a shortcut for the mere claim that there is something very special and normatively grounding in embryonic potentials.

Conclusion: Honesty about the Argument from Potentiality

From all we can see, PA talk *outside* religious belief systems should definitively be regarded as outmoded—if only for its indefensibility against the absurdest-extension objection. In sharp contrast to common claims, recent results in cell biology and genetics do not support PA. Rather, scientific insights in the (probably ubiquitous) convertibility of human cells render the notion of intrinsic potentials as the basis of moral status simply obsolete. How this should be brought into account inside confessional dogmas is none of our business. Obviously, for those inside and outside research coming to realize the logical implications of cell convertibility, PA must become too hard to swallow. In any case, secularized versions of PA have to be seen as 'depotentialized'—finally.

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