

# What to Do with the Grail Now that We Have It? iPSCs, Potentiality, and Public Policy

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The ability and desire to sort out and categorize life around and within us is a central aspect of the human experience. Modern developmental biology is no exception, and three recent papers provide a new impetus for us to rethink the ways in which science and society go about drawing boundaries in and around life and its developmental potential. Three independent groups just succeeded in the generation of mice derived entirely from induced pluripotent stem cells (iPSCs) through the most stringent test of pluripotency, tetraploid embryo complementation (Boland et al., 2009; Kang et al., 2009; Zhao et al., 2009). This achievement stands as the final proof that iPSCs and embryonic stem cells (ESCs), when subjected to the same developmental challenge, can be functionally equivalent.

It is likely that these results will be read by some as yet another blow to the potentiality argument that claims that human embryos matter morally because they have the potential to become people. Positions that defend the moral status of human embryos as individuals per se are unlikely to be swayed by this latest research development, but the potentiality argument has in fact been vulnerable to the twists of research progress for some time. The birth of Dolly (Wilmut et al., 1997) and the success of mouse ESCs in tetraploid complementation were taken up in the bioethical discourse to refute the attribution of moral worth on the basis of developmental competence (Harris, 1997). With the demonstration that the reprogramming process can confer to any single cell the potential to give rise, under the correct circumstances, to an entire living being, some may argue that the potentiality argument has finally been put to rest.

In contrast, I would like to propose that rather than impacting the potentiality argument, the new results prompt a critical

reevaluation of the relationship between scientific knowledge and public deliberation. This scientific achievement underscores the intellectual thrust of today's biology and its underlying epistemology that ties the understanding of living processes to the task of redesigning and harnessing them for applied purposes. Yamanaka's pioneering efforts, in contrast to the almost alchemic features of nuclear transfer, have turned epigenetic reprogramming into a relatively straightforward process accessible to laboratories worldwide (Takahashi and Yamanaka, 2006) and, in doing so, have reinforced our understanding of developmental fates as grid-like maps of molecular switches. As noted by Paul Rabinow, the essence of modern science is that "the object to be known [...] will be known in such a way that it can be changed. [...] knowledge and power, understanding and reform, are built in, from the start, as simultaneous goals and means" (Rabinow, 1996). He was referring to the human genome, read through the same technological framework that would enable its rewriting. But this conflation between knowledge and intervention appears all the more true for molecular developmental biology. We study developmental trajectories by changing them, by interfering with them in model systems, and in so doing we acquire the power to redesign them. By illustrating this theme so dramatically, the recent iPSC experiments invite us to reconsider the relationship between science's understandings of life and our societal views of how to regard them. Thus, the point is not that one can no longer use the potentiality argument because fibroblasts might now be considered as potential persons in a more concrete way than ever before. Rather, the point is that once science exposes so clearly that developmental potential is a question of molecular context amenable

to our intervention, speaking of "potential" and "boundaries of potential," though still possible, becomes an exercise of political freedom and accountability. That is, there is no longer, if there ever was, any ready-made grid of boundaries that biology can let us see as if they were simply out there and that can serve as neutral justification for political choices. Rather, there is a whole range of developmental possibilities, a collection of fates that are at once subjects for the pursuit of knowledge and candidates for intervention.

So now that we have achieved the grail of turning a fibroblast into a mouse, what will we do with it? It will be no longer possible, if it ever was, to build a sound bioethical argument, on either side, by simply appealing to a biological given: "we ought to behave like this, because this cell is able to ..." When any cell can become an animal by applying a known and established experimental protocol, science may offer invaluable expertise, but it is ultimately the polity that is called in to deliberate on what to do with our reprogramming powers.

But how to go about this task, and what role should scientists play? Endorsing and implementing the shift from a public understanding of science to a public engagement with science is a clear priority. Although the dissemination of knowledge remains a crucial aim, it is clear that, precisely because guidance needs to be found and negotiated among the values of our societies, even a hypothetical "complete" biological knowledge on the side of the public would still not solve the question of what to do with it. As progress in research, exemplified by the iPSC watershed, invests us with new options over our bodies' regenerative and generative capabilities, engaging in a discussion as to its ends and means will be challenged by the wide-ranging value systems that exist in

a diverse society. Several attempts have been made, often under the heading of deliberative democracy, to foster new institutions and processes in which citizens can truly participate in shaping science governance. These are no easy exercises, but scientists should take them seriously and contribute to their further development, entering the public sphere as citizens who participate in the formulation of society's moral commitments and

the political task of drawing boundaries around life and our options on it.

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