Embryos, stem cells and moral status: a response to George and Lee

In an earlier essay, we argued that those who grant a special moral status to human embryos cannot consistently refuse to grant a similar moral status to other entities, such as stem cells, that also have the potential to develop into adult humans (Sagan & Singer, 2007). To do so, however, would have absurd implications. In a recent issue of *EMBO reports*, Robert George and Patrick Lee defended their attribution of special moral status to the human embryo against our argument (George & Lee, 2009). But their defence fails.

In making the case that a stem cell is an entity with the potential to become an adult human, we suggested that when a cell is transferred to an enucleated egg, we should regard the cytoplasm of the egg as the environment in which the cell develops. In rejecting our contention that the stem cell is such an entity, George and Lee deny that the cytoplasm is merely the environment in which the cell develops. They wrote: "something that qualifies as 'merely environmental' does not enter into an organism and modify its internal parts resulting in an entity with a new developmental trajectory." This statement appears to overlook the fact that, at least from implantation onwards, there is a constant acquisition of substances from the outside that modify the embryo's internal parts, including its gene expression (Waterland & Jirtle, 2003).

In our article, we speculated that further advances in science might help to resolve what is crucial for development into an adult organism. Indeed, researchers recently created mice from reprogrammed cells (Zhao *et al*, 2009; Kang *et al*, 2009). No egg cytoplasm was used. This clearly demonstrates that even somatic cells alone have the potential to become an adult human being.

George and Lee might reply that when reprogramming cells, the new being comes

into existence only after the reprogramming is complete. But such a response would miss the point that the potential was there before the cells were reprogrammed. If we are concerned about moral status, then it is hard to see why the embryo should have a moral status that is markedly superior to that of the reprogrammable cell, just because it is one step further along the path towards becoming, if everything goes well, a mature human being.

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Response to Sagan and Singer

Agata Sagan and Peter Singer strive heroically to salvage their claim that a stem cell, no less than an embryo, is an entity with the potential to become an adult. Their salvage operation fails, but not without advancing the discussion on an important point.

They note that factors that alter gene expression in a cell are in many cases environmental, as opposed to intrinsic factors and changes that generate a new type of cell or organism. This is evident, for example, in diseases arising from altered gene expression caused by poor nutrition in a developing embryo. But this is beside the point. In the process described by Sagan and Singer, whereby a stem cell is joined to an enucleated ovum and a developing embryo is produced, the epigenetic constitution of the stem cell nucleus is dramatically changed from one that orients it to functioning as a part of a larger organism, to one that programmes it to develop itself into the mature stage of the organism as a whole. This shows that the cell produced by that process—just like a zygote produced in natural fertilization—is a new, whole organism.

The epigenetic state of a nucleus is not sufficient to define an entity as an embryo. If a zygotic nucleus formed by fertilization

were transplanted to an enucleated muscle or skin cell, the reconstituted cell would not be an embryo, and would not develop into an adult under any circumstances. When a stem cell is joined to an enucleated ovum the stem cell nucleus similarly becomes part of a newly constituted cell, with fundamental properties that are distinct from the original stem cell.

We need a criterion to distinguish between a mere alteration of a cell or organism that persists after the change on the one hand, and a process that results in the production of a new organism on the other hand. In pressing the issue, Sagan and Singer advance the discussion by showing the need for such a criterion. When an isolated cell A interacts with B, does A survive as a distinct whole and merely become modified by its relation to B, or does this process generate a new entity, C, composed of the constituents previously in A and B? In the first case, B can be viewed as an environment for A. In the second case, A does not survive as a distinct whole but becomes part of a larger entity, and B is more than merely environmental. The criterion for how to answer this question for different cases could be expressed as follows: if A and B become stably joined, and a