

Schmitt, C. and Benecke, M. (1997) Five cases of forensic short tandem repeat DNA typing. *Electrophoresis*, **18**, 690–694.

Sensabaugh, G.F., Lincoln, G.F. and Olaisen, B. (eds) (2000) *Progress in Forensic Genetics*, 8, International Congress Series 1193. Elsevier Science, Amsterdam, The Netherlands, pp. 489–585.

Stead, J.D.H., Buard, J., Todd, J.A. and Jeffreys, A.J. (2000) Influence of allele lineage on the role of the insulin minisatellite in susceptibility to type 1 diabetes. *Hum. Mol. Genet.*, **9**, 2929–2935.

Mark Benecke is a researcher, consultant and certified expert in forensic biology. He is based in Cologne, Germany, and works internationally, with main focuses in the fields of forensic entomology, DNA typing and blood-spatter analysis. In the Philippines and Vietnam, he helped to set up their main DNA typing laboratories.  
<http://www.benecke.com/>  
E-mail: [forensic@benecke.com](mailto:forensic@benecke.com)



DOI: 10.1093/embo-reports/kvf121

# What to call human cloning

The technical terminology increasingly used in the cloning debate sidesteps the ethical questions raised • by *Dónal P. O'Mathúna*

On April 4, 2002, the Italian physician Severino Antinori announced that a woman was 8 weeks pregnant with a cloned human fetus (Daniel, 2002). On April 15, 2002, Brigitte Boisselier, scientific director of Clonaid, a firm linked to the Raelian movement,

announced that they had developed human clones to the blastocyst stage and planned to implant them into women. Later that month, Antinori told Italian state television that three cloned pregnancies existed in the world at that moment, two in Russia and one in an Islamic state. If these claims prove to be true, and the fetuses survive full-term, debates over the ethics of human cloning will no longer be theoretical exercises. We will have to consider how we treat cloned humans.

announced that they had developed human clones to the blastocyst stage and planned to implant them into women. Later that month, Antinori told Italian state television that three cloned pregnancies existed in the world at that moment, two in Russia and one in an Islamic state. If these claims prove to be true, and the fetuses survive full-term, debates over the ethics of human cloning will no longer be theoretical exercises. We will have to consider how we treat cloned humans.

Judging by the vociferous condemnation of these reports, most people regard human cloning as immoral and would like to outlaw the procedure. On April 10, 2002, US President George W. Bush urged the US Senate to ban human cloning completely because it treats human life as a commodity, and stated that 'no human life should be exploited or extinguished for the benefit of another'. The US Senate is closely divided on the

issue of cloning and although it is expected to ban 'reproductive cloning', it is still debating whether to allow research involving 'therapeutic cloning'.

While both these terms remain widely used, some scientists are urging their abandonment because of the negative

public response they generate. Indeed, in a recent report, the US National Academy of Sciences (NAS) chose to call therapeutic cloning 'nuclear transplantation to produce stem cells' (NAS, 2002). This exemplifies the desire on the part of some within the scientific community to eliminate the term 'cloning' from the discussion about the production of embryonic stem cells by somatic cell nuclear transfer (SCNT). But the NAS report admitted that exactly the same methodology is involved

SCNT produces cloned embryos. 'Clones contain identical sets of genetic material in the nucleus [...] of every cell in their bodies. Thus, cells from two clones have the same DNA and the same genes in their nuclei' (NAS, 2002).

Another influential group of scientists proposed that cloning 'is properly associated with the ultimate outcome or objective of the research, not the mechanism or techniques used to achieve that objective.' Yet they define cloning as a 'term that refers to producing a copy of some biological entity—a gene, an organism, a cell' (Vogelstein *et al.*, 2002). By their definition—and the common use of this term in scientific language—cloning is a procedure regardless of its objective.

Dissociating the term cloning from the generation of human embryos is an attempt to influence the ethical debate while simultaneously avoiding discussion of central ethical problems. The term 'therapeutic cloning' certainly creates problems of its own: Vogelstein *et al.*

**One controversial and morally questionable action—embryo destruction—is being used to justify another controversial and morally questionable action—human cloning**

**If destroying human embryos is one of those inherently unethical means, the ends of technological progress or therapeutic benefit should be pursued by other means**

in both reproductive and therapeutic procedures, except that in the former the cloned blastocysts are implanted into a uterus and in the latter they are experimented upon; thus by their own definition,

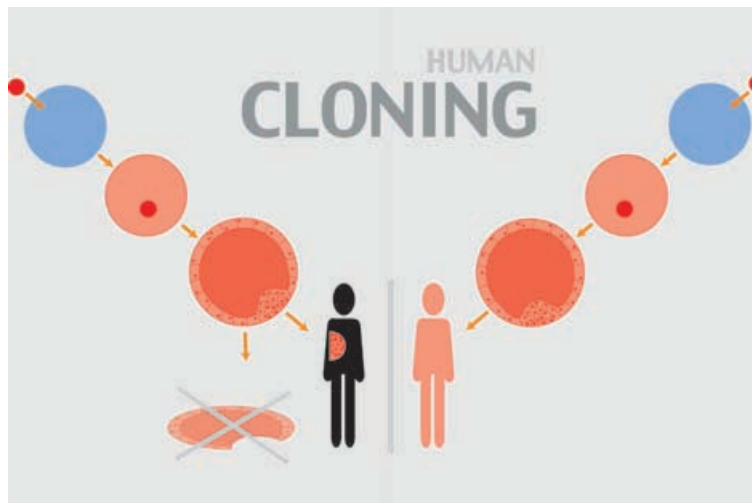
(2002) noted that Antinori tries to justify reproductive cloning by claiming that it is therapeutic for those suffering from male infertility. They point out that he has simply relabelled a controversial technique, but

they fail to explain why their renaming of therapeutic cloning is any different. If therapeutic cloning is defined and justified by its objective, Antinori has a point. But while he may be logical, his experiments with human cloning should still be viewed as unethical.

Simply renaming the technique, however, is hiding the fact that therapeutic cloning involves two highly questionable procedures. The first is the cloning of humans itself. The second is the destruction of human embryos. Phrases like ‘reprogramming somatic cells’ or ‘nuclear transplantation to produce stem cells’ manipulate language to blind people to the true nature of these procedures. This use of technical, objective terminology is inappropriate when it separates us from the very human and emotional aspects of an ethical controversy. One of science’s strengths is its ability to be objective and quantifiable, but when taken to the extreme, this can be a significant weakness. Therapeutic cloning is not just about the manipulation of somatic nuclei and the extraction of stem cells from blastocysts. It is about the deliberate production of cloned human embryos so that through their destruction, patients may receive treatment. One controversial and morally questionable action—embryo destruction—is being used to justify another controversial and morally questionable action—human cloning. Society has deep moral misgivings about both, and two wrongs do not make a right. While the ethical issues are being debated, it is disingenuous of scientists to combine the two procedures, label them scientifically, and carry on without allowing adequate ethical reflection.

Vogelstein *et al.* (2002) claim that SCNT is ethically justified in the case of humans, for in it lies the potential to overcome tissue rejection with stem cell-based therapies and the opportunity to increase understanding of cellular development. In their language, the potential ends justify the means. Clearly, the desire to alleviate suffering is a powerful argument, both morally and emotionally. When asked how far one would go to cure one’s child, the pursuit of therapeutic

cloning can seem morally justified. But this question reveals a fatal flaw in such utilitarian thinking: if the ends justify the means, I can justify anything in the name



of relieving suffering. What if a friend offers to get pregnant, have an abortion at 8 months—which is legal in most parts of the USA—and donate vital organs to my child suffering from organ failure? Tissue compatibility issues aside, most people would strongly object to this ‘therapy’. Yet if the relief of suffering is an ethical trump card, all objections can be overruled.

Thus, other values or principles must be introduced, ones that a utilitarian calculus does not permit. The proposed means—not the ends—should be ethically evaluated and made explicit. Arlene Klotzko, a lawyer and bioethicist, touches

---

**It is disingenuous of scientists to combine the two procedures, label them scientifically, and carry on without allowing adequate ethical reflection**

---

on this problem at the core of the debate, but then skirts around it by defining therapeutic cloning as ‘human cloning that produces embryos, not persons’ (Klotzko, 2001). President and CEO of Advanced Cell Technology (ACT), Michael West, says his experiments that reportedly produced human embryos by SCNT were ‘making human cellular life, not a human life’ (CNN, 2001). Vogelstein *et al.* (2002) claim that therapeutic cloning has ‘nothing to do with

producing a human being.’ The NAS report (2002) distinguishes therapeutic cloning from reproductive cloning because the latter produces ‘genetically identical individuals’.

These arguments seek to justify the cloning of human embryos on the basis that their destruction is no more problematic than the destruction of human somatic cells or animals. Consequently, human embryos are declared to be neither human life, nor human individuals. Yet in every sense of those terms they are human, they are alive—and they can develop into human beings if allowed to. The crux of the debate, then, is whether or not they are already human beings. Even if they are not

viewed as people in the same sense as adult humans, the use of biotechnology—SCNT or any other procedure—to produce and eventually destroy human embryos might be considered so ethically questionable or repugnant enough that it ought not to be sanctioned or permitted by society.

Human cloning itself raises a number of ethical problems that are addressed at length elsewhere (Klotzko, 2001). Apart from the risks, Leon Kass (2001), chair of President Bush’s Council on Bioethics, warns that cloning depersonalises human life through ‘the transformation of begetting into making, of procreation into manufacture.’ As already discussed, it is not enough to claim that great benefits could come from therapeutic cloning. Medical research, although without doubt beneficial, has been restricted in many ways for ethical reasons because the Nazi research atrocities demonstrated that the ends do not justify all means. If destroying human embryos is one of those inherently unethical means, the ends of technological progress or therapeutic benefit should be pursued by other means.

Society is still divided over how to regard the moral rights of, and its duties towards, the human embryo. The US Council on Bioethics remains deeply divided on the issue and has given up hope of arriving at a consensus statement before presenting recommendations to President Bush. The 1994 report of the National Institutes of Health’s Human

Embryo Research Panel proposed what seemed like a compromise. The panel held that while human embryos are 'entitled to profound respect' they could be destroyed in certain types of research. The comments of bioethicist Daniel Callahan (1995) on such wordsmithing are worth recalling: 'I have always felt a nagging

newborn babies need not be viewed as persons. Regarding decisions about caring for handicapped newborns, one medical ethicist put it this way: 'I believe that the issue turns on the question of personhood and that it is because the newly born infant is not a person that it is justifiable in cases of severe handicap to

subjects—especially those who cannot speak for themselves—should be treated with their best interests in mind. They should not be 'researched to death' regardless of their prognosis. The same standard should apply to unborn humans until clear and convincing evidence overturns this standard. Thirdly, presumption is strongly influenced by the risk of being wrong. In a controversy, the greater the harm that would arise from committing ourselves to a position that turns out to be wrong, the greater the burden of proof required for that position. If the position is taken that human embryos are not persons and may be destroyed, and that position turns out to be wrong, we will have endorsed the killing of thousands if not millions of human beings. If, on the other hand, human embryos are not persons, but we treat them as if they were, the potential harm is that therapies might become available more slowly.

Arthur Caplan, a US bioethicist, evaluates this dilemma as follows: 'It's a little hard to argue potential cure against real harm to a human embryo. It's not so hard to argue the moral priority of curing your child of diabetes or getting somebody out of a wheelchair—if it works—against the same standard' (Powledge, 2002). But this approach neglects other ways of resolving the dilemma. Embryos can be protected and stem cell therapies pursued at the same time. Embryonic stem cells may have certain advantages in developing therapies, but many of the benefits can be, and already have been, achieved using adult stem cells. For example, in treating severe combined immunodeficiency, stem cells were removed from infants' bone marrow, underwent gene therapy, and were transfused back into

---

### The greater the harm that would arise from committing ourselves to a position that turns out to be wrong, the greater the burden of proof required for that position

---

uneasiness at trying to rationalise the killing of something for which I claim to have a "profound respect". Eventually, all positions come down to one of two views: human embryos either are or are not entitled to protection from intentional destruction.

The embryo's moral status can be settled only after careful discussion based on clearly articulated arguments, and not by scientific data and reasoning alone, in spite of what ACT's West claims: 'A human life, we know scientifically, begins upwards, even into 2 weeks, of human development, where this little ball of cells decides, "I'm going to become one person or I am going to be two people." It hasn't decided yet' (CNN, 2001). Ironically, even while denying the embryo 'personhood', West describes an embryo doing something held to be indicative of personhood.

Although numerous attempts have been made to describe the essential characteristics of the human persona, all of them have significant problems. Joseph Fletcher (1972) proposed a list of 20 criteria to describe the essentials of personhood, which he later condensed to four, and then one: 'neocortical function is the key to humanness, the essential trait, the human *sine qua non*.' This influential view is now more often expressed as the necessity of self-consciousness for personhood (Walters, 1997). Personhood seems thereby to be objectively determined. Since an embryo is not self-conscious it cannot be a person and therefore may be destroyed in research.

This view, apparently held by proponents of therapeutic cloning, has major philosophical problems. Even the assumption that personhood requires the presence of certain attributes or abilities is strongly debated. If personhood is achieved when life becomes self-conscious,

"allow it to die" (Gillon, 1986). The 'severe handicap' referred to here was Down's syndrome with no complicating symptoms. Gillon supported giving the baby large doses of narcotics and allowing it to die.

When personhood is assigned by the presence of certain human attributes, ethical boundaries gradually evaporate. Attempts to declare that certain humans are non-persons are usually part of a strategy to justify treating those humans as property, or killing them. Both motivations apply to human embryos. The only consistent approach is to view all humans, whether embryos, fetuses, children or adults, as entitled to the protection warranted by any human, and respect them so that they can develop to the best of their potential.

Apparently, there is a huge gulf separating the two sides. How is society to proceed in the midst of this disagreement? The question is where the burden of proof lies. Which side will be given the presumption of holding sway while the other side is required to prove their case and change the status quo? Much of the jockeying over which language should be

---

### Scientists should be forthright about what they want to do: clone human embryos and then destroy them to obtain their stem cells

---

used is really an attempt to establish presumption and burden of proof.

I would argue that the burden of proof lies with the proponents of therapeutic cloning. First of all, the accepted wisdom is that human cloning is morally questionable, if not repugnant. Defenders of human embryo cloning thus need to persuade others of their position by substantive arguments, not semantics. Secondly, the accepted standard for medical research is that all human

the infants (Cavazzana-Calvo *et al.*, 2000). Ten months later their immune systems were normal. Such experiments overcome the tissue rejection problem that makes embryonic stem cells attractive.

Embryonic stem cells are also sought after for their pluripotency. Yet adult stem cells are demonstrating greater multipotency than originally expected. Human mesenchymal stem cells transplanted into ischaemic rat brains expressed markers for neuroectodermal cells and significantly

ameliorated the neurological deficits of experimentally induced strokes (Zhao *et al.*, 2002). This approach points to a way of treating strokes and head injuries with a patient's own bone marrow stem cells, avoiding tissue rejection problems as well as the ethical pitfalls that come with using embryonic stem cells.

Therapeutic approaches using embryonic stem cells are further behind and only now being reported with animals. In the first such report, the success of using modified stem cells was so low that the authors commented that their results, 'raise the provocative possibility that even genetically matched cells derived by therapeutic cloning may still face barriers to effective transplantation for some disorders' (Rideout *et al.*, 2002).

The term 'therapeutic cloning' is rightly criticised and it should be abandoned for creating a false image. It is a poorly defined and disingenuous phrase invented to 'obscure the fact that the clone will be "treated" only to exploitation and destruction, and that any potential future beneficiaries and any future "therapies" are at this point purely hypothetical' (Kass, 2001). Replacing it with more technical terms is not the answer. Scientists should be forthright about what they want to do: clone human embryos and then destroy them to obtain their stem cells. Then society can more clearly debate the ethics of these procedures.

Through this debate, the profound ethical problems with human cloning and embryo destruction should be acknowledged. We can affirm the goals of

relieving human illness and suffering. But the ethical means to those ends are to aggressively pursue adult stem cell research. While that might delay progress in some areas, adult stem cell research is already producing clinical success. More importantly, adult stem cell therapies will be obtained while upholding the highest ethical standards for medical research.

## References

- Callahan, D. (1995) The puzzle of profound respect. *Hastings Center Report*, **25**, 39–40.
- Cavazzana-Calvo, M. *et al.* (2000) Gene therapy of human severe combined immunodeficiency (SCID)-X1 disease. *Science*, **288**, 669–672.
- CNN (2001) Human embryo created through cloning. Accessed at [www.cnn.com/2001/TECH/science/11/25/human.embryo.clone/index.html](http://www.cnn.com/2001/TECH/science/11/25/human.embryo.clone/index.html) on November 25, 2001.
- Daniel, K.S. (2002) Human cloning project claims progress. *Gulf News Online Edition*. Accessed at [www.gulfnews.com/Articles.print.asp?ArticleID=46275](http://www.gulfnews.com/Articles.print.asp?ArticleID=46275) on April 4, 2002.
- Fletcher, J.F. (1972) Four indicators of humanhood—the enquiry matures. *Hastings Center Report*, **4**, 4–7.
- Gillon, R. (1986) Conclusion: the Arthur case revisited. *Br. Med. J.*, **292**, 543–545.
- Kass, L.R. (2001) Preventing a Brave New World: why we should ban human cloning now. *The New Republic*, **224**, 30–39. Available at [www.thenewrepublic.com/052101/kass052101\\_print.html](http://www.thenewrepublic.com/052101/kass052101_print.html).
- Klotzko, A.J. (2001) Voices from Roslin: the creators of Dolly discuss cloning science, ethics, and social responsibility. In Klotzko, A.J. (ed.), *The Cloning Sourcebook*. Oxford University Press, New York, NY, pp. 3–27.
- National Academy of Sciences (2002) *Scientific and Medical Aspects of Human Reproductive Cloning*. National Academy Press, Washington, DC.
- Powledge, T.M. (2002) Will they throw the bath water out with the baby? *EMBO rep.*, **3**, 209–211.
- Rideout, W.M., Hochedlinger, K., Kyba, M., Daley, G.Q. and Jaenisch, R. (2002) Correction of a genetic defect by nuclear transplantation and combined cell and gene therapy. *Cell*, **109**, 17–27.
- Vogelstein, B., Alberts, B. and Shine, K. (2002) Please don't call it cloning! *Science*, **295**, 1237.
- Walters, J.W. (1997) *What is a Person? An Ethical Exploration*. University of Illinois Press, Urbana, IL.
- Zhao, L.-R., Duan, W.-M., Reyes, M., Keene, C.D., Verfaillie, C.M. and Low, W.C. (2002) Human bone marrow stem cells exhibit neural phenotypes and ameliorate neurological deficits after grafting into the ischemic brain of rats. *Exp. Neurol.*, **174**, 11–20.



Dónal P. O'Mathúna is Professor of Bioethics and Chemistry at Mount Carmel College of Nursing in Columbus, OH, and a Fellow of the Center for Bioethics and Human Dignity in Chicago, IL. E-mail: domathuna@mchs.com

DOI: 10.1093/embo-reports/kvf122