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Reproductive technologies

GENE EDITING, CLONES AND THE SCIENCE OF MAKING BABIES WAYS OF REPRODUCING WITHOUT SEXUAL INTERCOURSE ARE MULTIPLYING. HISTORY SUGGESTS THAT THEY SHOULD BE EMBRACED

Feb 18th 2017

IT USED to be so simple. Girl met boy. Gametes were transferred through plumbing optimised by millions of years of evolution. Then, nine months later, part of that plumbing presented the finished product to the world. Now things are becoming a lot more complicated. A report published on February 14th by America's National Academy of Sciences gives qualified support to research into gene-editing techniques so precise that genetic diseases like haemophilia and sickle-cell anaemia can be fixed before an embryo even starts to develop. The idea of human cloning triggered a furore when, 20 years ago this week, Dolly the sheep was revealed to the world (see [article](#)); much fuss about nothing, some would say, looking back. But other technological advances are making cloning humans steadily more feasible.

Some are horrified at the prospect of people "playing God" with reproduction. Others, whose lives are blighted by childlessness or genetic disease, argue passionately for the right to alleviate suffering. Either way, the science is coming and society will have to work out what it thinks.

Where have you been, my blue-eyed son?

The range of reproductive options has steadily widened. AID (artificial insemination by donor, which dates back to the 19th century) and IVF (in vitro fertilisation, first used in the 1970s) have become everyday techniques. So has ICSI, intracytoplasmic sperm injection, in which a sperm cell is physically inserted into an egg, bringing fatherhood to otherwise infertile men. Last year another practice was added—mitochondrial transplantation or, as the headlines would have it, three-parent children. The world may soon face the possibility of eggs and sperm made from putative parents' body cells (probably their skin) rather than in their ovaries and testes.

Such methods separate sexual intercourse from reproduction. Most of them bring the possibility of choosing which embryo will live, and which will die. At first they can seem bewildering—disgusting, even. But one thing experience has shown is that, in this area, disgust is not a good guide to policy. AID was treated by at least one American court as a species of adultery and its progeny deemed illegitimate in the eyes of the law. IVF led to anguish among some theologians about whether "test-tube" babies would have souls.

Disgust often goes along with dystopian alarm. Science-fiction versions of gene editing imagine, say, the creation of supermen and superwomen of great intelligence or physical prowess. When Dolly was announced the press was full of headlines about clone armies. In truth no one has the slightest clue how to create *Übermenschen* even if they wanted to. Yet the record shows how fast reproductive science can progress. So it makes sense to think about the ethics of reproductive science even for outcomes that are not yet available.

It helps to start with IVF and AID, which have made the journey from freakishness to familiarity. Both give healthy children to happy parents, who would otherwise have been alone. The same will no doubt prove true for mitochondrial transplants, which are intended to avoid rare but dangerous diseases that affect cellular energy production.

Happy parents and healthy children make a pretty good rule for thinking about any reproductive technology. A procedure's safety is the central concern. Proving this is a high hurdle. Researchers are, wrongly in the eyes of some, allowed to experiment on human embryos when they consist of just a few cells. They cannot, though, experiment on human fetuses. Nor can they experiment easily on fetuses from humanity's closest relatives, the great apes, since these animals are rare and often legally protected, too. So far, therefore, there has had to be a "leap of faith" when a technique that has been tested as far as is possible within the law's bounds is used for real. That should continue, in order to avoid "freelance" operations outside reliable jurisdictions. This is not a theoretical concern. Although Britain developed mitochondrial transplants and was the first country to license them, the first couple known to have had such a transplant travelled from Jordan to Mexico to do so.

Defining the limits of what should be allowed is more slippery. But again, the test of happy parents and healthy children is the right one. Growing sperm and eggs from body cells is surely the least problematic new technique soon to be on offer. One advantage of this approach is that gay couples could have children related to both parents. But the law should insist that two people be involved. If one person tried to be both father and mother to a child, the resulting eggs and sperm would, without recourse to wholesale gene editing, combine to concentrate harmful mutations in what would amount to the ultimate form of inbreeding.

Gene editing and cloning involve more than parents' happiness and children's health. The first gene editing will eliminate genetic diseases in a way that now requires embryo selection—an advance many would applaud. Adults should be able to clone perfect copies of themselves, as an aspect of self-determination. But breeding babies with new traits and cloning other people raises questions of equality and of whether it is ever right to use other people's tissues without their consent.

A sense of identity

The questions will be legion. Should bereaved parents be able to clone a lost child? Or a widow her departed husband? Should the wealthy be able to pay for their children to be intelligent and diligent, if nobody else can afford to do so?

Commissions of experts will need to search for answers; and courts will need to apply the rules—to protect the interests of the unborn. They will be able to draw on precedents, such as identical twins, where society copes with clones perfectly well, or "saviour siblings", selected using IVF to provide

stem cells that can cure a critically ill older brother or sister. Any regime must be adaptable, because opinions change as people get used to new techniques. Going by the past, though, the risk is not of people rushing headlong to the reproductive extremes, but of holding back, and leaving people to suffer out of a misplaced sense of what feels right.

This article appeared in the Leaders section of the print edition under the headline "Sex and science"