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Some ethical issues in biotechnology involving animals

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Abstract

Biotechnological discoveries have given rise to ethical issues, particularly concerning the welfare of animals and the protection of the environment with regard to other animal species. This paper argues that protection of animals and the environment matter most, and that if human beings have the right motivation and intention, then the right actions will follow.

INTRODUCTION

This paper provides a personal view of some of the ethical issues that have arisen in the light of some biotechnological discoveries or ideas, particularly concerning the welfare of animals and the protection of the environment with regard to other animal species. It does not address broader and important legal and consumer concerns, and for these the interested reader is referred to some recent reports.¹⁻⁶ In this paper it is argued that protection of animals and the environment matter most, and that given the right motivation and intention of human beings then the right actions will follow. It is hoped that this essay will generate some discussion that will enable readers to question their own views and attitudes.

BENEFITS OF GENETIC MANIPULATION

Recent advances in our understanding of how cells work at the molecular level have sparked a plethora of ideas as to how to harness this knowledge to our (human) advantage. Adding genes to animals from the same or other species (transgenesis), removing other genes through knock-out technology, and cloning animals using embryonic and somatic cells have been fundamentally important advances, and some of these advances have led, or may

lead to, significant improvements in the health and welfare of both humans and animals. For example, the genetic modification of farm animals to be resistant to zoonotic diseases such as *Salmonella* and spongiform encephalopathy (eg bovine SE or new variant CJD, scrapie) would improve both human and animal welfare. (Note that if animals are sick their welfare is compromised, and so health is one important welfare measure.)

Changing the sentience of animals through gene deletion so that they suffer less stress during their lives could be seen, on the one hand, as a desirable outcome and another aspect of domestication. On the other hand, it might be seen as an undesirable outcome and inherently objectionable as it is goes against the very essence of what an animal is.⁷ Genetically engineering animals to produce leaner meat, to grow faster and to utilise feed more efficiently would be good for both consumers and farmers, but would it be good for animal welfare? The production and isolation of therapeutic proteins from the milk of sheep carrying and expressing human genes (eg human essential clotting factors, alpha-1-anti-trypsin) would help those with haemophilia and emphysema, and possibly those with cystic fibrosis, to have a better quality of life with little impact on the welfare of the sheep.

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Animals as well as humans may benefit

Genetically manipulating (GM) pigs to provide a supply of organs and tissues for those waiting for a human transplant would save lives, and would probably involve little more harm to the animals other than killing it humanely. Note that it is not only mammals that are being utilised in this way. GM salmon that grow six times faster than ordinary salmon have been created, and if they escape (and some GM fish have), theoretically they could make the native salmon population extinct in 40 generations. Similarly, adding cold resistant genes could help create tropical fish for food in other than their natural waters and 'pet' fish (as well as other animals) could be manipulated for size, shape, colour, etc. for the amusement of their owners.

Should human interests always come first?

Finally, in this medley of potential benefits, the 'ultimate' goal of making new organs, tissues and cells from somatic stem cells taken from the diseased patient herself, thus avoiding the need for immunosuppression, would be a significant advance. These advances in stem cell technology, together with a better understanding of cell differentiation, cell signalling and cellular integration in whole organs, provide for exciting prospects for the development of even more ingenious therapeutic modalities.

ETHICAL ISSUES

However, all of these developments have ethical dimensions that should make us think twice before rushing headlong into what seems to be such worthwhile efforts. The persuasive power of the dollar, euro, etc., in our society tends sometimes to conflict with ethical concerns, as making money can appear to be the primary, rather than a secondary, goal at the expense of the sick humans or the welfare of animals. The motivation and intentions of those carrying out these genetic manipulations, or implicated in other ways, such as funding and giving ethical approval, has also to be questioned. There surely needs to be a strong element of good intention if we are to indirectly

affect the welfare of animals or disturb the environment in a serious way before the work starts. Even if finance was not directly involved, there are perhaps some things that we should not do to humans or animals, like altering their sentience (ie ability to experience pain and pleasure) or their gross shape (see Figure 1). Our current predominantly anthropocentric view of life (putting human interests first) in our ecosystem with respect to the environment and animals is increasingly being challenged so that the possible outcomes of our actions should also be fully considered before going ahead. This is not a Luddite statement but rather that we should be giving careful and serious thought to what we do before we do it.⁷⁻¹⁰ The fact that we 'can' do something does not mean we 'ought' to do it.

The ethical issues revolve around what we might do to other humans, to animals and to the environment, and this short paper focuses on animals. Before that it is worth a comment on ethics in science. Scientists often claim that science is ethically neutral; they provide facts and the ethical issues are really about how those facts are used, and not linked to their discovery. But there are ethical considerations to be taken into account before certain lines of investigation are followed. We should consider how that scientific information might be used before carrying out experiments, or the direct impact of an experiment on the



Figure 1: Naturally born conjoined twin piglet

Scientists are responsible both ethically and scientifically for what they do

animals or environment (or on the scientists themselves). Scientists, just as other moral agents, are responsible for their actions and, apart from lines of investigation, it is important that scientific research is conducted in an ethical manner. The following examples illustrate this point.

The very act of transferring a piece of human DNA into animals has been questioned on religious grounds as some believe that it is unethical to do so because being 'human' denotes something God-given and, therefore, special and not to be tampered with. On the other hand, humans have many gene sequences in common with bananas, rats and chimpanzees (nearly 99 per cent), and so the claim that human genes are unique cannot be sustained. However, there may be some unique human genes, for example for self-awareness: would it be right to transfer these into animals?

With shared genes, considerable benefits could accrue from transgenic technology, for example the production of therapeutic proteins in animals – so-called gene pharming. This 'artificial' production of proteins that can be given to humans and animals deficient in them, would produce considerable benefits. An example is the production of human insulin in yeast for the treatment of diabetes (an increasingly common disease in the developed countries). More recently, the production and purification of human proteins from the milk of transgenic sheep is being trialled to treat humans with emphysema, and other proteins being researched include those involved in the clotting process in order to treat people with haemophilia.¹¹

There are also considerable advantages in gene pharming as yields are higher than conventional methods (purification from human plasma) since the resultant products are free from potential human infections such as HIV and hepatitis. So in the instance of therapeutic proteins one might argue that the benefits for humans far outweigh the harms done to the sheep (and maybe cattle) that produce the milk

and it is reasonable to do so. But it should not be forgotten that there are hidden costs to this approach. These are in the *development* of the transgenic animal lines that produce these proteins, and include superovulation and death of the donor animals, embryo transfer into a recipient, sometimes Caesarean sections for the dam, and even then some neonates are die or are abnormal at birth. However, those animals born alive and that survive to a reproductive age may well go on to found the production line. These founder animals and their offspring are likely to have a good quality of life and, almost certainly, a longer life compared with their cohorts that are slaughtered for food, simply because of their economic and scientific value.

Cloning is also being used to generate animals from the transgenic line and although recently there has been some evidence that they have a higher rate of abnormal and overweight lambs than normal animals, and that they may age quicker (by no means unequivocal), these adverse effects may be overcome in the longer term. In terms of what 'society' regards as acceptable for animals, it is relevant to note that these harms are far fewer overall (both in type, intensity and duration) than those caused to millions of intensively farmed animals such as chickens and pigs.

Some companies are writing codes of ethics for their employees to follow. For example, the Genetic Savings & Clone (GSC) company – a biotechnology company which markets genetic services to the public via the Internet – has a Code of Ethics for all its employees. All GSC employees are contractually bound to follow this code which governs the treatment of all the animals involved in the development of their technology and also the future application of their technology.¹²

RIGHTS

If one looks for a moment at the philosophical approaches to establishing what is acceptable or not there are two

Are human genes special?

Gene farming has considerable benefits at production stage by hidden development costs

Same companies have codes of conduct

Are some actions always wrong and does this convey rights to animals or obligations on their keepers?

Is a harm benefit analysis always the most appropriate framework for decision-making?

fundamental types of ethical theories that can be applied to biotechnology or, indeed, anything where there is a choice of actions. One theory, **utilitarianism**, looks at the advantages and disadvantages of a process and then tries to balance those benefits against the harms. In its basic form utilitarianism aims at maximising happiness – ie to permit those actions that make for the greatest good for the greatest number – but with an important rider: it has to be with the least harm to achieve that end. A serious drawback to this theory is that it relies heavily on the accuracy of what might happen in the future.

The other theory, **deontology**, looks at whether the action or process itself is acceptable, such as transferring human genes into animals, taking animal lives, causing animals to suffer. It incorporates notions of moral and legal duties and obligations that are placed on persons to fulfil those duties, eg to protect the sick and vulnerable. This theory can be turned into ‘rights’ language as is frequently done in the USA – ‘the right to bear arms’, and now in Europe concerning basic human rights. It can be agreed that the sick and vulnerable have a right to be protected, but whose duty is it to protect them? For every right there has to be a respecter and giver of those rights. This is where society and individuals within a society have to make fine judgments in terms of who is responsible, state or individual, and our laws reflect those responsibilities. By and large, rights language is not always helpful in deciding what is the best thing to do. For example, how does your right to smoke outweigh my right to clean air? In practice, it often involves a deeper debate invoking risk–benefit analysis and so in reality we tend to use a mixture of these two theories, even in regard to animal protection.

Those who espouse animal rights can be seen as deontologists who ascribe rights to animals, specifically a right to live and a right not to suffer. Animal welfarists on the other hand are utilitarians who balance harms against benefits and who

may, or may not, see killing animals as a moral harm.¹³ For example, at one extreme of utilitarianism there are vegetarians and vegans who say that the suffering (or killing) of animals is not balanced by the pleasure of eating meat. At the other there are those who state that there is no limit or caveat as their pleasure in eating meat is far outweighed any incidental suffering of the animals concerned. Similarly, in regard to animal research some may see no limit on the degree or duration of animal suffering, or the number of animals used, or the species used in research if any knowledge at all can be gained from an experiment. Many, however, would contest that view.

In the UK, the law controlling animal research (the Animals (Scientific Procedures) Act 1986) uses a utilitarian approach when considering whether to grant a project licence for a programme of research work. In the present context, an application for a project licence would have to detail the consequences of developing a transgenic line with descriptions of how it is to be done including any uncertainties, and the anticipated benefits. Both these statements of benefits and harms are, of course, predictions at this stage, and under the 1986 Act the scientist, the local ethics committee (or ethical review process) and the Home Office Inspectorate have then to decide whether the work should go ahead. The Inspector is the final arbiter (although there is an appeal process) and if s/he agrees with the submission then a licence is granted, although often with amendments concerning experimental design and refinement of the scientific protocol.

Deontological analysis, on the other hand, would lead an animal rightist¹⁴ to reject outright nearly all research work, since animals would die as a direct result of the research programme and they would suffer to some degree in their husbandry conditions and from any scientific interference, even if it was only an injection. All the actions and procedures to carry out the research

Are humans and animals different in morally relevant ways or is it that humans are stronger in various regards?

would infringe the notions of a right to live and a right not to suffer and it is argued that humans have a duty to respect those rights, just as they would do for other humans, such as babies or the mentally retarded who might otherwise not be able to consent or make their wishes known. This rule-based approach is also adopted by those opposing the insertion of human genes into animals on the basis that it is always wrong to insert human genes into animals as it is playing God, as they put it, or tampering with the integrity of animals, such as having their sentience reduced in some way.¹⁵ These are the main reasons why believers in animal rights find it difficult to be members of animal research ethics committees.

Another conundrum that some philosophers have raised (notably Singer¹⁶) when opposing the use of animals in science is whether humans have the right to carry out research on animals that would not be carried out on humans. The question is phrased somewhat differently: 'What are the morally relevant differences between animals and humans that make it acceptable to carry out research on animals but not on humans?' To condone current practice, the answer has to place all humans in one 'box' and all non-human animals in another. One answer might be that we are human beings and not animals, but this really gets us no further forward, for what is it about being a human being that separates us from all the other species? Indeed the very reason for using animals as models for ourselves is our close genetic, physiological and anatomical similarities. Some might argue that we use animals in this way simply because it is custom and practice, so why should any change be necessary? But the fact is that all human cultures continually evolve and had this answer been accepted in the past, then we would still have slavery, women would not have the right to vote, and so on. The fact that something happens at present, does not make it right. Perhaps animal research can

be justified because humans are stronger than animals, in which case should women should be used as research subjects? Or if the criterion is intelligence, then perhaps men! But seriously, our ability to reflect on these questions potentially sets us apart as a species, but is this a *morally relevant* difference? Would it protect mentally retarded children for example? Perhaps we should protect the vulnerable and give as much consideration to chimpanzees as to mentally retarded children (who may even be less intelligent than the chimpanzee) and so do research on neither. But do we know where to draw the line between the species – at primates, pigs, dogs mammals, parrots, chickens, reptiles, amphibians, fish, octopus, etc.? The evidence is lacking for our present legal position, but it errs on the side of caution over physical pain and distress.

Another proposition is that 'suffering' is the key objection to animal research and humans would suffer mentally more than animals, eg we can think about the future as well as experience pain, distress and so on. But are we sure that only humans have this ability? As it happens there is increasing evidence that in many non-human primates, and even non-primate species, for some limited degree of self-awareness and can anticipate the future.^{17,18} But to what degree and to what end (their death?) we can only ascertain indirectly and in a very limited way. The recent debate over stag and fox hunting in the UK illustrates this point well. Descartes (1596–1650) was sure that using animals was acceptable on the basis that they could not speak and were irrational, and so they could not suffer; whereas Jeremy Bentham (1748–1832) asked, 'Surely the question is not whether they can talk, or whether they can reason, but whether they can suffer?'

Do religious beliefs help here, even though many people do not have a faith? Religions differ widely on this matter.¹⁹ Compare Buddhists who believe in not harming any living creature as well as in

'Can do', does not mean 'ought to'

Do religious beliefs help?

reincarnation, with the Hindus who protect cows, with the traditional Judeo-Christian belief that animals are put on this earth for us and we have dominion over them. (Linzey disputes this interpretation of 'dominion'; see, eg, Linzey and Turner²⁰ and Linzey.²¹) Overall, there seems to be no universal agreement that can be gained from religion on this matter.

Animal rightists and animal welfarists have fundamentally different underlying philosophies

To summarise then, the use of animals in research when we would not use humans has been termed *speciesism*²² and has been likened to racism, sexism and ageism. It is simply a prejudice, and not a justifiable position. We should either use both animals and humans in the same way²³ or we should use neither. There are other philosophical arguments against the use of animals in research and utilitarians argue that the benefits of the research should outweigh the harms. Where this is not the case, or the anticipated benefit is so unlikely, or the predicted harm is so great, then the work should not proceed. Some research indeed may have no benefit but simply help us understand better how the body works, but that in itself is a benefit, even if less predictable.²⁴ Whatever animal research is carried out for the direct or indirect prevention of human and animal suffering it will always require careful justification.

Decision-making in animal research has to involve more than the three Rs of Replacement, Reduction and Refinement

Going further with the utilitarian line of thought it can be understood that balancing harms against benefits can still be subject to certain ethical rules in order to minimise the harms and maximise the benefits. Indeed, these rules would be seen as good things to do in themselves. Animal welfarists believe it is wrong to cause animals to suffer or to take their lives but their caveat is that it is only permissible when it is unavoidable, ie least harm is caused, and is done for a good reason. In other words it has to be backed by good reasons.

Before deciding whether a particular experiment is acceptable or not, utilitarians might draw on other ethical considerations and ask questions to help them decide. For example, is the work

worth doing? Is it going to answer a scientifically valuable question? Could the scientific objective be achieved without using animals, or by using animals that are not likely to suffer such as bacteria, or invertebrates, or lower forms of vertebrates with a less well-developed neuro-physiological sensitivity? Could cell cultures or computer modelling be used instead, that is could the use of sentient animals be *replaced* in some way? Has the number of animals to be used been *reduced* to the minimum for the work, and has good statistical advice been taken? Is the level of suffering to be caused to the animals the minimum required to achieve the scientific objective, for example through the use of good anaesthetic and analgesic regimes, through good experimental design?²⁵

This *refinement* of experiments to cause only that degree of animal suffering which is necessary, is key to a humane and responsible scientific process (and is part of scientific ethics and a scientist's integrity). The application of these three Rs, as Replacement, Reduction and Refinement are known, were first described by Russell and Burch as long ago as 1959²⁶ and are part of the scientific licensing process in the UK under the 1986 Act.²⁷ But it should be appreciated that applying the three Rs is not the end of the matter, as the 'basic' question still remains, should the work proceed even though there are no replacements, the number of animals has been reduced to the minimum, and there is no avoidable suffering? A weighing of the predicted harms against the anticipated benefits has then to be carried out to try to ensure that the harms done to the animals are in proportion to the benefits, but it is like comparing chalk with cheese: animal suffering versus human benefit. How can it be carried out in practice? This is the subject of current debate and is the meat of ethical discussion that would normally involve scientists, veterinarians, medics, lay members, even an ethicist(!). There is some general agreement that the greater

That counts as a worthwhile benefit?

Cats that glow in the dark

Animals that have been genetically manipulated not to suffer in intensive farming systems and can be force-fed

the scientific benefit, such as developing a vaccine against AIDS or cancer, or making new replacement organs, might merit a higher degree of animal suffering than say for a gain in fundamental knowledge with no anticipated medical benefit.²⁸ However, when it comes to developing a cat that will glow in the dark, or an animal that is likely to run faster, such as a horse or a dog, opinions may not be so clear-cut and there is less consensus.¹

In zoological research there is also controversy as a gain in knowledge, however interesting (eg surgically preparing birds in order to know how they migrate; to trap a beaver underwater to know how long can they can stay submerged), might not be seen as a desirable goal at the expense of considerable animal suffering. On the other hand, if that knowledge involved the treatment of an individual animal of an endangered species, or the results might contribute to the survival of that species, then that might be a different matter.

THE FUTURE

However, let us return to some of our earlier futuristic biotechnological considerations. The prospect of improved and novel therapeutic approaches through gene pharming almost certainly will be welcomed by most as the balance of good over harm would seem to be significantly greater even though during the developmental phase a relatively high price had been paid. Similarly most would welcome the manipulation of animals to promote a genetically determined disease resistance, but how about increased agricultural efficiency and meat quality at the expense of animal well-being or animal integrity? How would you react if lumps of chicken or sheep flesh or steaks were grown in test tubes or plates in a laboratory to contain different flavours or have varying degrees of tenderness? What if chicken eggs were produced by isolated ovaries cultured in test tubes? Many of these 'advances' would certainly be more

welfare-friendly than all current farming practices and avoid the pain, fear and distress and other adverse effects that are presently caused. But should we do it? Is there not something rather unnatural about these means of food production? What about making animals that removed something unwanted, such as meat with no gristle, leading to animals that could not walk but feel no pain, and that made no noise. This might mean that those animals could only feed, even be force-fed by machine (like foie gras) and if they did not feel pain in a controlled and protected environment, then would it matter?

Interfering with the integrity of animals for such commercial purposes is not new; after all, humans have deliberately bred through genetic selection farm and companion animals in this way for centuries. The new technologies may speed this up, or may enable us to produce food in the different ways described above. Perhaps they are 'a step too far' and would cause a public outcry – at the present. 'At the present' as new developments tend to go ahead of public opinion but with time, public opinion changes and a practice becomes acceptable as has already happened with kidney transplantation, freezing semen, IVF, cloning animals, gene therapy. The AEBC Report¹ is calling for increased public involvement in the debate as well as setting up some national forum to oversee such developments. What will happen next? Cloning humans and pet animals, genetic enhancement of babies and pet animals, pigs with six legs (Figure 1 shows a real Siamese piglet and it may be possible to deliberately engineer such animals), udders on wheels, glowing bald cats and dogs, and so on? These are rather wild examples but science has made some pretty impressive developments over the past 200 years, even over the past decade, so it is not unbelievable they will be impossible to create. The question is, should we do it? Or even start to research it? And what does it say about us as human beings if we do?

Producing organs, tissues and cells for transplantation for pets and humans, altering the fundamental structure of animals

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