The Humane Society of the United States: Animal Research Issues Section, USA

We, the Animal Research Issues Section of The Humane Society of the U.S. would like to submit the response below to the Council's request for comments on the Animal in Research document.

We would draw the committee's attention specifically to the following challenges.

1. Scientists and scientific organizations usually justify animal research (either explicitly or implicitly) in utilitarian terms arguing that the benefits far outweigh costs. Peter Singer criticizes animal research in the same terms arguing that the costs far outweigh benefits. For some reason, no-one has attempted to contrast these two claims directly or to develop a detailed empirical analysis of the conflict. The assessment of benefits and costs is certainly difficult but, in a world where we are trying to put an economic value on mountains and wetlands, certainly not impossible to attemtp.

2. There is wide-spread lipservice to the notion that scientists are doing what they can to eliminate animal pain, distress and suffering. However, with the exception of a few individuals, there is little REAL effort to even begin to understand animal pain, distress and suffering, to identify what these terms describe or should describe (they are NOT synonyms although they are usually used as such), and then to address what we need to do to eliminate such states. Some work is now being done on appropriate anesthetic and analgesic regimens (which address mainly the pain part of aversive states) and our ability to treat rodent pain has improved in the last decade (although those abilities are still not appropriately employed all the time). In the farm animal field, extensive research is being conducted on animal welfare, a lot of it involving behaviour. In the laboratory animal field, one can count the people studying lab animal behaviour or welfare across the world on the fingers of two hands and, for the most part, there is little or no public support for such research. And yet, one can easily demonstrate that minimizing or eliminating distress and maximizing well-being is beneficial not only for the animals but also for the scientific outcomes. In other words, the long-term indirect (or direct) benefits of developing better methods to detect and eliminate distress should easily cover the costs of such research.

3. The public concern about animal research is directly related to the perceived level of pain and distress experienced by the animal and the perceived utility of the scientific outcomes. A lot of time tends to be wasted "educating" the public about the necessity of animal research. Such efforts would be better spent demonstrating what scientists are doing to detect and eliminate animal pain and animal distress.

4. Finally, the debate is sometimes framed as those who use animals in research versus those who are against such animal use. This sets up a false dichotomy and division. If the truth be told, we all (scientist, animal activist and the general public) would rather that animals are not used in research and testing. Dr Colin Blakemore made exactly this point at a meeting in the USA a few years ago. The crux of the debate is not whether we should or should not use animals but rather how much effort should we put into reducing and eliminating the use of animals in studies that cause them harm and how soon can we all reach this common goal.

Yours sincerely

Andrew N Rowan, PhD
Chief of Staff
The HSUS
2100 L Street NW
Washington, DC 20037
(301) 548 7770; (301) 548 7726(fax)
arowan@erols.com

[Full Response Below]

by

The staff of the Animal Research Issues Section (Dr Andrew Rowan, Dr Martin Stephens, Ms Katie Conlee) of The Humane Society of the United States.

Section 1.

Page 9. There were more animals used in research than the 2.73 million reported. The animals that are killed to provide tissue should not be overlooked as a "cost" even if there is no suffering involved in their housing and handling (unlikely).

Page 10. It is stated that basic biomedical research does "not necessarily have immediate use but the understanding gained may lead to applied research." However, when scientists apply for funds to support their work, they almost always will point to the probable practical implications of what they hope to elucidate. When John Orem's sleep laboratory at Texas Tech was vandalized by the Animal Liberation Front, research institutions rallied round and defended his research because of its importance in uncovering what was going wrong in Sudden Infant Death Syndrome (SIDS). Orem later wrote in a comment piece in The Chronicle of Higher Education (1990, March, pp. B2-3) that he was almost as disturbed by this defense as by the vandalism because he was doing his studies to understand the basic biology of the sleep center in cats and not to look at SIDS mechanisms. Thus, the question of what is or is not basic biomedical research is relatively fluid and context dependent. The public will and does detect such dissonance and thus the Nuffield Group needs to exercise greater subtlety in how they define the different types of research and testing.

Page 10. Diabetes is a poor example of how animals are used in basic research to elucidate the process and treatment of disease. Critics have argued that clinical observations were more important than the animal studies. Michael Bliss' book, The Discovery of Insulin (University of Chicago Press, 1982), describes the shoddy animal work done by Banting and Best and argues convincingly that Banting misrepresented the data the two of them had collected when he gave his celebrated Boston talk. In fact, Bliss indicates that one of the key developments was Collip's use of rabbits and mice as bioassays of insulin's presence in the extracts and the recent development of better assays for blood glucose. The bioassays allowed Collip to purify insulin from the pancreatic extracts and then were important as Eli Lilly standardized the batches of insulin it prepared. We would suggest that a much better example of the use of animals in basic research is available in Comroe and Dripps' analysis of the key papers in the

development of cardiovascular surgery (in a 1976 Science paper, vol. 192:105) or the description by Brown and Goldstein of their discovery of the role of cholesterol metabolism in atherosclerosis. Brown and Goldstein's Nobel lecture (published in Science, 232:34, 1986) is an excellent description of their research. Most of their work was done in vitro using human cells but some of the questions could only be answered in vivo and so they used the Watanabe rabbit.

Page 12.

1. Does research on animals produce answers that cannot be provided by any other methods?

Clearly the answer is yes, given that society has decided that humans should not be used in research that is likely to cause them harm. The Goldstein and Brown research into atherosclerosis could largely be done in vitro but there were some questions that needed more invasive techniques and rabbits were used for these. However, it should be recognized that technical developments and improved knowledge are reducing the places where animals may need to be used in order to provide the sort of data that are being pursued. Sir Peter Medawar noted in 1969 (See The Hope of Progress, Methuen, 1972, pg 86) that animals would not continue to be used in ever-increasing numbers in biological sciences. He predicted that animal use would peak in ten years (he was about three years off since use peaked in 1975/6). He further stated that, only by doing research on animals, would we one day be able to develop enough knowledge to eliminate their use altogether. This seems to us to be an excellent slogan/organizing principle for biomedical science!

2. Can results from research on animals be transferred to humans?

In many cases, yes. The genetic code was worked out using viruses and bacteria. These results were transferable to all species although we are now learning that there are some quirks that we need to watch out for. As we delve deeper into what is actually happening re information storage and retrieval in mammalian genetics, we learn that E. coli is not a perfect mimic for mammals.

As we debate the use of animals in research, we need to develop a far more sophisticated view of the use of animals as models of human biology and disease. Most of the to-and-fro debates argue about whether animals are sufficiently like humans to be useful models of human functioning. This ignores the potential that differences can be even more important in helping us understand what is going on. For example, a comparative study across species of the levels of the two glycolysis pathway enzymes,

phosphofructokinase and fructose-1,6-bisphosphatase, in skeletal muscle, found that fructose-1,6-bisphosphatase was unusually active in bumble bee flight muscle. This then led to the concept of substrate cycling and its role in the regulation of the activity of metabolic pathways. This is just one of innumerable examples of how ìdifferences" have been very important in advancing our understanding of general biological phenomena. Ken Shapiro, in his book critiquing animal models, understands this fact and has presented the most nuanced discussion of the role of animal models in biomedical research. The Nuffield study group needs to be careful not to fall into the "similarity" trap.

We would like to make one final point about the similarity or dissimilarity of animal models to the human experience. Critics of animal research (e.g. Greek & Greek, 2000, *Sacred Cows & Golden Geese*, Continuum; Shanks and LaFollette, 1996, *Brute Science: Dilemmas in Animal Experimentation*, Routledge) point on the one hand to the dissimilarities between human and animal biology and argue that these dissimilarities completely invalidate the utility (for humans) of animal studies. At the same time, they will argue that animals deserve similar or the same moral consideration because of their similarities (e.g. in sentience) to humans. Defenders of animal research find themselves in the same but opposite trap. They look at the similarities when defending the relevance of animal research and at the dissimilarities when arguing that animal research is morally justified. To date, this fundamental dissonance at the core of the arguments of both sides of the debate has rarely been subjected to careful analysis (the Smith and Boyd book, 1991, *Lives in the Balance*, Oxford University Press, being one of the few exceptions).

3. Does the acceptability of research depend on the purpose of the research?

Research on animals is usually justified on the basis of its utility for humans. Research interests argue that animal research causes little animal suffering and great benefit. By contrast, one of the key critics of animal research, Peter Singer, is a Utilitarian who argues just the opposite - namely, that animal research causes substantial animal suffering and produces little human benefit. In theory, these opposing claims should be resolvable by careful research and analysis. Therefore, the purpose of the research (leading to human benefit) is a key factor in the justification of animal research. The New Scientist poll (22 May, 1999) of public attitudes to animal research demonstrated very clearly and dramatically that "purpose" is a key issue in public acceptance of the use of animals. While public acceptance should not be the sine qua non of the moral justifiability of animal research, it is clearly an important part of the context of the debate.

4. Do different types of research justify the use of different types of animals?

This is an odd question. Clearly a study of ascorbic acid dependency will be different in guinea pigs (who require dietary ascorbate) and rats (who do not). Since humans also require dietary ascorbate, it would seem obvious that, all other things being equal, guinea pigs would be better research animals than rats. This references the notion that some biological models are better than others for particular types of research and gets us back to the question of what makes a good model. We would also refer the Nuffield group to the discussion on animal models in Russell and Burch's book (*The Principles of Humane Experimental Technique*, Methuen, 1959. Their discussion deserves much more attention. They give an example of the use of models in the begging behavior of herring gull chicks. The replica of the parent bird head is not as effective as eliciting begging behavior as a white stick with a bright red band at the end. The stick turns out to be a "super" stimulus because it highlights the key discriminating factors - white color with red band and elongated structure.

The other potential meaning of the above question is whether some species deserve greater consideration than others. This issue will be addressed in more detail later.

5. How much do animals suffer during research?

The available data on this issue is relatively poor and is problematic because of the lack of any consensus on what constitutes animal suffering or whether some animals even can suffer. In the United States, the term suffering is not even used routinely (cf. the National Academy of Sciences Press' 1992 publication on *The Recognition and Alleviation of Pain and Distress in Laboratory Animals*). In The Netherlands, the regulatory authority reports that about 45% of animals experience moderate to severe distress. In Canada and Switzerland, the authorities report that about 30% of animals fall into this category. In the USA, the authorities report that only 8% of animals (but rats, mice and birds are excluded) experience moderate to severe paid and distress. Each country is using different definitions and standards (see papers on pain and distress on "http://www.hsus.org/ace/15808" in the animal research section).

We use the following model to identify what we mean by suffering. Various adverse stimuli (e.g. pain, anxiety, fear, malaise/illness, discomfort) will lead to distress if the stimulus is of sufficient intensity and/or endures for a sufficient length of time. Distress occurs when the product of Intensity X Duration reaches a certain level (as yet undefined). According to our model,

distress will then cause suffering where the animal has the cognitive capacity (e.g. some sense of self in time and space, some intentionality) to recognize that s/he is experiencing an adverse state. Clearly, "distress" will be easier to define and demonstrate than "suffering" in this model scheme. We suspect that the term "suffering" in the above question is a very broad and ill-defined concept that incorporates all the different levels of our model - namely, pain and fear (stimuli), distress (outcome) and suffering (cognitive outcome). We will assume that the Nuffield's group use of "suffering" covers what we refer to as "distress" and "suffering."

The handling of most laboratory animals (unless they are habituated to such handling - which is rare) is likely to cause an adverse state. For example, picking up a mouse elevates its heart rate from around 450 bpm to 650-700 bpm. It is being stressed by the handling. Whether this stress causes distress/suffering is less clear. We would argue that cage cleaning and handling causes minor to moderate distress normally. Research that causes obvious disease or abnormality would cause moderate to severe distress. In toxicology studies, the anecdotal reports indicate that at least 40-60% of animals experience moderate to severe distress.

6. What level of suffering do you think would be unacceptable no matter the potential benefits of the research for humans?

We would argue that the elimination of animal suffering (as defined in our model) should be a major goal of all who support studies that cause suffering in animals. Clearly (to us) the great apes have the cognitive capacity to suffer and have substantial housing requirements before they can be kept in situations where they will not suffer. Such conditions are not present in laboratory situations and therefore we would argue that laboratory experiments on great apes should not normally be permitted. This is already the case in Europe and Australasia, either in theory or in practice. This position then leads to a challenging question as regards the use of all primates (and perhaps companion animals and farm animals) in research projects. We are moving toward a position that would call for the elimination of most (if not all) projects involving primates.

We would also argue that severe distress and suffering caused to mammals and birds in the course of research is no longer warranted. We have definitional problems as regards what constitutes severe distress but suspect that a practical set of guidelines using exemplars would be able to identify with reasonable confidence what constitutes severe distress.

Page 16. Genetically modified animals

Do GM animals raise new issues and are they unnatural?

We would argue that the new genetic technologies clearly raise a host of new issues that are reflected in the debate on the patenting of genetically modified animals. Nobody ever considered the patenting of new breeds of farm animals or new strains of research animals but patents on genetically modified animals are now being routinely pursued. Thus, the patent mechanism recognizes that the new genetic technology is "different" from older selective breeding processes.

On the question of the naturalness of GMOs, we would argue that the level of intervention now possible clearly means that GMO creation is not natural. We recognize that most of nature is affected by human activity and that there are few, if any, truly natural environments where there is no anthropogenic influence or change. Nonetheless, there is a clear difference between Wytham Wood outside Oxford (probably the most studied and manipulated piece of woodland in the world) and a tree-lined street in North Oxford. The public's concern about GMOs reflects this gut-level understanding of this difference but we do not yet have a defining line that can be used.

The ability to manipulate the basic information material that encodes a specific animal (albeit still relatively crude manipulations in the absence of a sophisticated understanding of the regulatory genes) does represent a new level of the "commodification" of animals. Such commodification then tends to work against viewing the animal as a sentient creature. One sees this tendency in another venue - namely, intensive animal agriculture where the creatures become simple production units rather than beings with natures and desires that the "farmer" should respect. The more we see a mouse as a self-replicating computer, the less likely we are to pay attention to its broader needs as a sentient creature.

What are the issues with different types of animals that may be created?

The creation of strains that will experience distress places a particular burden on the scientist to assess the likely level of distress and then to develop strategies to minimize the distress. An example of this are the experimental allergic encephalitis (EAE) mouse models in which the animals are unable to feed properly or use watering devices when they are in an active phase of the EAE. Maggie Lloyd (then at Oxford) and Victoria Hampshire (then at NIH) developed care regimens that greatly reduced the impact of the disease on the mice by providing them with "jello" cubes containing both nutrition and water on the floor of the cage that they could feed on. Not only did these regimens reduce the distress experienced by the mice, they also improved the quality of the research being done.

Cloning studies and the trend to make greater use of clones on farms and in pharming are also of concern. The low level of cloning efficiency means that large numbers of animals experience some distress in the creation of the original clones. In addition, ongoing monitoring of clones reveals that cloning has significant adverse health impacts. Finally, it is increasingly recognized that clones are not true duplicates of the original. There are significant epigenetic effects that affect the development process. In fact, it has been clear for some decades that identical genetic make-up does not lead to identical phenotypes. Isogeneic strains of mice have sufficient individual difference that one can produce different strains by applying appropriate selection criteria (e.g. select for "bold" and "timid" individuals).

Page 18. **Alternatives**

There has been a long-standing resistance from biomedical funders to supporting research on "alternatives." Eventually, the Home Office ended up with a small fund to support alternatives research but the Medical Research Council and other funders continued to resist the idea that they had some responsibility to fund alternatives. We believe that this resistance to funding alternatives research is the result of a perception that specific funding for "alternatives" would be politically dangerous and scientifically inappropriate. Both perceptions are incorrect.

It is clear that nobody would use and kill animals in research that causes the animals harm if they did not believe that it was necessary. Dr Colin Blakemore, at a meeting in Boston about five years ago, noted that scientists do not want to use animals and it is clear that the critics also do not want scientists to use animals. Where the two groups differ is on what might be the appropriate extent of the resources devoted to the goal of eliminating the use of animals in studies that cause the animals harm. Scientists claim that they are already doing enough in the ordinary course of their research while the critics want to see specific initiatives aimed at developing alternatives.

This brings us to the scientific value of research into "alternatives." At its base, an alternative is simply a new method that uses fewer or no animals or that causes animals less distress. Studies that support methods development and distribution have never been popular targets for research funding and yet, any relatively superficial analysis of the literature, demonstrates the importance of the development of new methods in scientific advance. The Nobel winners are often individuals who developed and pioneered the use of a new technique (e.g. Yalow - radioimmunoassay, Enders, Weller and Robbins - human cell culture and poliovirus growth, Milstein - monoclonal antibodies). Stephens (1986, Advances in Animal Welfare Science, Humane Society of the U.S.)) did an extensive analysis of

Nobel winners and argued that many of the prize-winning discoveries could be identified as alternatives. (It is noteworthy that Leader and Stark – 1987, Perspectives in Biology & Medicine, 30:56-71 - did a similar, if more superficial analysis with the intention of demonstrating the importance of animal models and ended up citing many of the same scientists that Stephens identified as having used alternatives.) Medawar's book on the process of scientific discovery is titled The Art of the Soluble (1969, Pelican). It is not difficult to ask intriguing and important questions in science but breakthroughs often have to wait until someone develops a new technique that enables one to collect the data to provide the answer. Thus, active support for new technique development should be an integral part of the funding of scientific research and, if that support happens to favor techniques that reduce animal use or reduce harm to animals, then one has an "alternatives" center!

In addition, it is clear that techniques that reduce the distress experienced by the animal have a beneficial impact on scientific outcomes. Vernon Riley described how he could not do his research on psychoneuroimmunology until he developed low stress housing in which to keep his mice (Science, 1981, 212:1100). The stress reduction techniques used by Lloyd and Hampshire for EAE mouse studies improved the outcomes of those studies. The control of disease in animal houses (husbandry improvements) has had important benefits for scientific data. In other words, support for refinement studies (an important area of "alternatives" although usually relegated to second or third place - after replacement and reduction) would also lead to improvements in scientific data.

We argue that the usual sources of research funding should also fund research into the development of new methods and the refinement and improvement of existing methods. Such research will not only address scientific concerns about the use of animals in studies that harm the animals, it will also lead to better science and important political benefits in terms of public support for science and scientists.

Duplication and information sharing.

It is very probable that some duplication does occur. The availability of powerful computer search algorithms means that it is possible to search the existing literature (at least that portion that is on-line) more effectively than before.

In selected areas where the moral burden is high, greater efforts to reduce duplication may be warranted. For example, the use of primates in research could require an explicit public debate (such as is occurring over the proposed Cambridge Center - although we do not get the impression on this

side of the Atlantic that the debate has been particularly constructive or well-organized to date). With modern information technology, it should be possible to build a more comprehensive database on worldwide uses of animals (starting with species of particular moral concern) that would diminish the likelihood of extra primates, for example, being used in the same field of research simply to establish a priority claim.

Journal reports of animal research

Since early in the twentieth century, science journals have tended to sanitize reports involving animal research (see Susan Lederer, 1992, Isis 83:61-79). It is not clear to what extent the practice continues today. However, journals are always looking for ways to save space and "unnecessary" methodological details will be edited out. Michael Festing has, over the past few decades, shown in a variety of papers that important details about animal use are often omitted from journal papers. Editing such details out leaves the general impression that these activities are less important and de-emphasises animal care.

Page 20. **Moral status**

What is the moral status of animals?

In the last thirty years, Singer, Regan and others have challenged philosophers and others to identify what the morally-significant characteristics of animals might be. By and large, most philosophers have focused on one single characteristic. For Singer, it is sentience (identified as the ability to suffer pain and distress or experience pleasure). For Regan, it is being the "subject of a life." We would argue that no single characteristic works in developing a coherent and rational argument on how we should weigh humans and non-humans in the moral scales. What is needed is a complex of characteristics with both prescriptive (e.g. group membership) and proscriptive (e.g. do not permit sentient beings to suffer) qualities. Some of the characteristics that we believe (following discussions in the philosophical literature) **may** carry moral value are as follows:

a) aesthetic characteristics

b) having life (e.g. do not knock the heads off flowers for no reason)

c) being sentient (e.g. do not cause aversive states - the characteristic emphasized by Singer))

d) being self-aware

e) having personhood

f) being part of a group (a prescriptive rather than proscriptive duty - e.g. parents have stronger duties to family than to non-family).

Using such a complex of characteristics, it is possible to construct a moral order in which mice have greater moral considerability than mosquitoes and humans more than mice. Whether such a scale or weighting would justify causing a mouse to suffer in order to benefit humans is another matter, however. We would argue that causing severe suffering to any sentient creature is undesirable and that we can only justify such suffering **IF** we have made a significant effort to find other means of achieving the same end. At the present time, we do not believe that enough of an effort has been made to identify and measure animal distress and suffering and that, failing such effort, we cannot justify the use of mammals in projects that cause severe outcomes - e.g. toxicity testing.

How can we know how much animals suffer?

We have discussed the question of animal distress and suffering earlier and that discussion is relevant here. Since there are no consensus definitions of "suffering" and "distress," the question is not really answerable at the present time. We believe that definitions and the study of both states are both possible and necessary.

The discussion document asks if concepts such as "pain" and "happiness" are extendible to animals and whether animals can experience both physical and psychological pain. We would argue that evolutionary theory would hold that concepts such and pain and happiness have to be applicable to animals. The real question is to which animals can such concepts be extended. It can be argued that invertebrates do not need to be able to "feel" pain and that simple nociceptive reflex loops (such as a person with a high spinal lesion might experience when an aversive stimulus is brought to the foot and the foot is withdrawn due to the spinal reflex) can explain most insect responses to aversive stimuli. As the processing power of the CNS increases, then the possibility that the organism is "feeling" pain increases (see DeGrazia and Rowan, 1991 for a more detailed discussion). Similarly, it seems idiotic, from the perspective of evolutionary extrapolation, not to ascribe a range of emotional states to the great apes and mammals (if not to birds and other vertebrates). Those who wish to deny such states in these animals are using Occam's razor incorrectly. It is more parsimonious to assume that they share emotions with us than it is to assume that emotions only appeared with modern humans, especially since the brain structures that are involved in emotional processes are evolutionarily older than the frontal lobes.

We would also argue that it is incorrect and metaphysically sloppy to divide pain into physical and psychological categories. We are not sure what is

intended by the two concepts but, without appropriate CNS processing, there is no felt (or phenomenological) pain. Hence all pain is "psychological." If one intends "psychological pain" to refer to fear, anxiety, heartache and the like, then we would argue that those terms should be used instead. We have a range of excellent terms that could be used to refer to aversive psychological states and we should not confound them with "pain." Using a human example, there are a few unfortunate individuals who are organically incapable of "feeling" pain. It is still not clear what the genetic or organic defect is in these people but they usually do not survive beyond the age of about 30. They do not adjust their limbs when they are asleep and they suffer numerous injuries when awake because of the lack of aversive feedback (e.g. leaving one's hand on a stove's hot plate). Nonetheless, in one case, the individual reported being terrified of surgery and the thought of having to go into hospital caused her considerable suffering (see DeGrazia and Rowan, 1991, Journal of Theoretical Medicine 12:193-211). This individual did not suffer "physical" pain but still had a full range of emotions that could and did cause distress and suffering.

We are just beginning to understand how animals experience the world. We would argue strongly that, while animal research continues, much more effort should be made to determine what the animals are experiencing and that the knowledge gained should be used to eliminate animal suffering as soon as possible. For the most part, we suspect that there will be little need to subject animals to any more distress than they are already likely to experience in the process of ongoing research. Every effort should be made to employ study techniques that do not cause animals distress simply for the purpose of studying it. For example, the International Association for the Study of Pain has guidelines that encourage studies in which the animal works for a reward against painful stimuli and is allowed to terminate the study on his/her own terms. (It turns out that non-human primates will stop working for a reward at the same intensity of an aversive stimulus as human volunteers.)

Can we justify making animals suffer?

We argue that humans have sufficient ingenuity and creativity to avoid causing most animals used in research to suffer. However, with the lack of clear assessment tools for animal suffering and its extent, there is no general agreement of what causes suffering and how much is caused. The UK animal research regulatory system relies heavily on the Inspectorate and we suspect that the inspectors provide considerable guidance to institutions and individuals on severity bands. For the most part, however, such guidance is not apparent to the public or subject to broader public debate.

6. Informing the public

As the New Scientist poll indicated (22 May, 1999), the public tends to accept the need for animal research when the purpose is viewed as important and animal suffering is perceived to be minor. However, public support declines dramatically when the reverse is true. Therefore, the acceptability of animal research will depend on the extent to which the public perceives scientists to be concerned about animal distress and honest about the necessity of their animal studies. The research community has, to date, either not understood what is being asked of it, or has not been sufficiently bothered to provide the necessary reassurances. To a great degree, scientists tend to perceive the public as ignorant of what they are doing. Therefore, most of the scientific responses to criticism have either involved attempts to explain the research better (i.e. describe the science in more detail) so that public comprehension increases or have simply lamented that public ignorance is an unbridgeable barrier to proper understanding and thereby support of what is being done. However, Pifer et al (Society and Animals, 1994, 2:95-113) surveyed publics from across the developed world and found that there was no direct correlation between knowledge and understanding and support for science.

Scientists have a difficult challenge when trying to defend and justify their animal research to the public. This is because science tends to suffer from a Jekyll and Hyde image (Rowan, 1995, Scientists and animal research: Dr Jekyll or Mr Hyde? Social Research 62:787-800). The public wants the fruits of science (the Dr Jekyll side) but is uneasy about or abhors the methods by which such fruits are obtained (the Mr Hyde side). It is also important to understand that public approval of science is more the exception than the norm. Two analyses (R D Haynes, 1994, *From Faust to Strangelove*, Johns Hopkins University Press, Baltimore; G.S. Allen, 1993, Master mechanics and evil wizards: science and the American imagination from Frankenstein to Sputnik, *Massachusetts Review* 33:505-558) argue that there have only been two periods since 1600 when science was supported by the public – the period after Newton's death in 1727 and the period after the Second World War. Therefore, the current tendency to be suspicious of science and scientists is more the norm than the exception. Allen's analysis identifies two stereotypes – the scientist as wizard (the brilliant person living in the big house on the hill – removed literally and figuratively from the norms and moral constraints of the community) or the technically competent mechanic who makes life better and helps the community prosper. Therefore, to the extent that scientists look down on the public and regard them as too emotional or too stupid to understand the need for animal research, then they are simply reinforcing the wizard stereotype and turning the public against them and what they do.

We argue that the public might be persuaded to be more supportive of biomedical research but only if those responsible for overseeing such studies take steps to emphasize the care and concern for the research subjects and demonstrate that such concern is real and not simply a public relations exercise.