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Respect for animals through the eyes of a molecular evolutionist

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I believe that several deep-seated and prevalent misconceptions about biological evolution influence people's ideas about the ethics of the use of animals in teaching and research. The purpose of this article is to briefly outline some basic principles of evolution, and to show how a misunderstanding of these principles can cloud debates on animal ethics. The actual ethical debates themselves will not be entered into.

To simplify this discussion I will group major evolutionary events into two categories: macroevolution (e.g., speciation) and microevolution (gradual cumulative changes to the gene pool of populations).

Speciation

Despite a voluminous literature on speciation, including Darwin's famous treatise, it is true to say that this fundamental biological process is not well understood – it remains one of the big "black holes" of biology. Indeed, the definition of "species" is still hotly debated. While many theoretical models for speciation have been put forward, they generally lead to outcomes that cannot be tested using current methods. No one has been able to predict with any certainty when and where a speciation event will occur and how long it will take. Nevertheless, it is clear that there are many populations that have evolved to the extent that the reproductive exchange of genes between their gene pools is severely inhibited. We can call these populations "species" if we like. The difficulties in studying speciation experimentally arise from the slowness of the process and the lack of defined (or definable) stages. In this article, I will assume that extant species trace their evolutionary lineages back through time to shared but extinct ancestral species. At the limit, all species lineages coalesce.

Microevolution

In contrast to macroevolution, which is the controversial part of evolutionary theory, microevolution is an inevitable consequence of a set of conditions, much as the laws of physics lead to predictable outcomes.

The conditions are:

i) the individuals in a population vary in their genetic make-up;
ii) they also vary in their capacity to survive and / or reproduce, i.e., they differ in their "fitness";
iii) at least a component of this variation in fitness has a genetic basis;
iv) more individuals are produced each generation than survive to have offspring themselves.

Given the existence of these conditions in a population (and we know for certain that the conditions do indeed apply to most sexually reproducing organisms) then adaptation of the population will occur through changes to the gene pool. This process of microevolution through natural selection is not open to doubt. A strong theoretical framework of population genetics underpins it. Furthermore, when relative fitness values have been assigned to genotypes it is possible to accurately predict the change in a population's gene pool after a given number of generations. These predictions are supported by extensive experimental observations.

The role of chance

Perhaps the most significant development in our understanding of microevolution involves the realisation that the process is not driven entirely by natural selection. Chance plays a major role. Many of the changes that have occurred in the genome, particularly those in non-coding regions of DNA, have been brought about by chance fluctuations – background noise if you like. A handful of ardent "selectionists" cling to the belief that selection dictates all observed evolutionary change. However, the prevailing view is that chance (the technical jargon is Random Genetic Drift or RGD) and natural selection both fashion the genome to

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varying extents. Interestingly, under some circumstances, e.g., in populations of small size, RGD can alter gene pools in directions opposite to those predicted by natural selection. In such cases, genes that reduce individual fitness may actually increase in frequency. This phenomenon is thought to account for the comparatively high frequency of genetic diseases in certain human populations. For example, the progressively debilitating genetic disease, Huntington Disease (HD), occurs with an unusually high frequency in populations inhabiting the Lake Maracaibo region of northwest Venezuela. This high incidence of HD is almost certainly due to Random Genetic Drift, as all affected individuals trace their ancestry to a single woman who moved into the area about 120 years ago.

Fossils and morphology

There is a tendency to recognise both macro- and micro-evolutionary change by the effects they have on morphology and behaviour. Fossils have made a significant contribution to our understanding of evolution. They can be characterised in detail morphologically and often they can be accurately dated by methods such as carbon dating. But there are two major difficulties with the use of fossils in evolutionary studies.

First, morphological comparisons are poor indicators of evolutionary relationships. It has become clear that changes to a relatively small number of genes can have a great effect on development and ultimately on morphology. Two species can look very different, but be genetically very similar. Conversely, similarity of appearance does not necessarily indicate overall genetic similarity.

Second, although fossils can often be accurately dated using geophysical methods, they cannot be accurately placed on a phylogenetic tree (this topic is returned to later). This severely limits their usefulness.

Molecular evolution

Change to the genetic material lies at the hub of evolution, hence the developing interest in molecular evolution. Genes evolve through alterations to their DNA sequence. Sequence changes originate through random mutations. Those alterations that improve fitness tend to accumulate in the genome over time through natural selection. As already mentioned, chance effects also play an important role. Such alterations may or may not be recognisable by morphological and/or behavioural differences. The classical evolutionary studies that placed great store on morphological comparisons and the use of fossils have now been supplemented, if not replaced, by the analysis of DNA sequence differences. Such differences can be accurately and objectively quantified and are not subject to direct environmental change. DNA sequences can be analysed using powerful computing techniques such as maximum parsimony and maximum likelihood, with the aim of deriving evolutionary relationships.

Increasingly, museum collections are being used in ways that were never previously contemplated. Molecular evolutionary biologists come knocking on museum doors requesting access to dried skins or alcohol preserved specimens, not so that the organism's morphology can be measured, but so that DNA can be extracted. Analysis of this DNA, particularly through the determination of the nucleotide sequences of genes, provides data that can be analysed by computer to derive evolutionary relationships. Claims by sceptics that such relationships are inaccurate have now been largely laid to rest by the results of evolutionary "reconstruction" experiments using both computer simulations and rapidly dividing laboratory micro-organisms.

Species trees

I now turn to evolutionary trees. An often overlooked component of Darwin's theory is that all individuals and species are linked to one another through evolutionary lineages, and that these lineages can be represented diagrammatically in the form of evolutionary "trees". It is usual when we draw an evolutionary tree (a phylogeny), whether it is derived from DNA sequence comparisons or from morphological data, to show different species at the tips of the branches. We can call this a species tree. An example of a species tree (Fig. 1A) shows the evolutionary relationships of some well-known primates, and indicates that humans and chimps last shared a common ancestor (at point X) more recently than either species did with the gorilla. (Somewhat illogically, phylogenies constructed from molecular data often show the root of the tree above the branches. This is the convention I will use).

Evolutionary trees are generally created using a "bottom up" approach, in the sense that a set of existing species have their lineages traced back in time, through extinct common ancestors, eventually to a single point – the root of the tree (Fig. 1A). If we were able to draw trees using a "top down" approach, where we start at the root and work forward in time, we would derive a far more complex tree containing many extinct lineages (dead branches) (Fig. 1B). This leads us to a major problem with the use of fossils for phylogenetic reconstruction.

There has been a tendency to assume, quite incorrectly, that fossils necessarily represent a common ancestral species that occurred at one of the internal nodes of a "bottom up" tree. Consider, for example, a fossil with both human and chimpanzee-like morphological characteristics that has been accurately carbon-dated at 8 mya (million years ago). This fossil may be placed at point X in the tree (Fig. 1A), and the conclusion reached that the most recent common ancestor of humans and chimps existed 8 mya. In reality, the fossil may represent an organism that occurred along one of the branches in the "bottom up" tree (e.g., at position Y in Fig. 1A) or one of the now extinct branches or internal nodes in the "top down" tree (e.g., position Z in Fig. 1B). The potential traps associated with the use of fossils to date speciation events are obvious, yet these traps continue to ensnare the unwary.

While discussing problematical aspects of evolutionary trees, it is worth not-

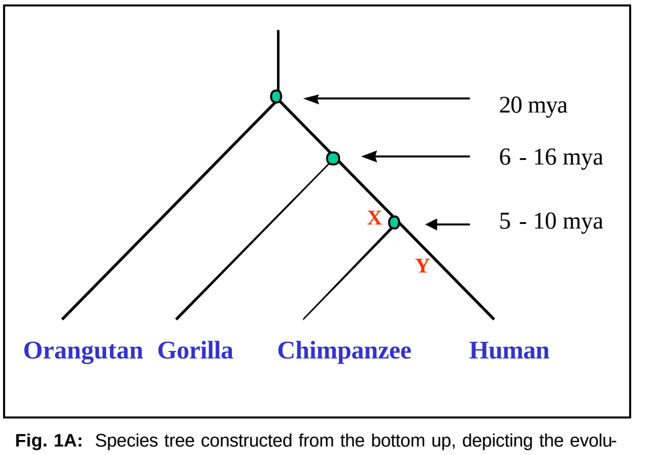

Fig. 1A: Species tree constructed from the bottom up, depicting the evolutionary relationships between four primate species. The "root" of the tree is at the top, the "present" at the bottom. Ages in millions of years ago (mya) are approximate. X represents the most recent common ancestral species shared by chimp and human. For Y, see text. Filled circles represent speciation events.

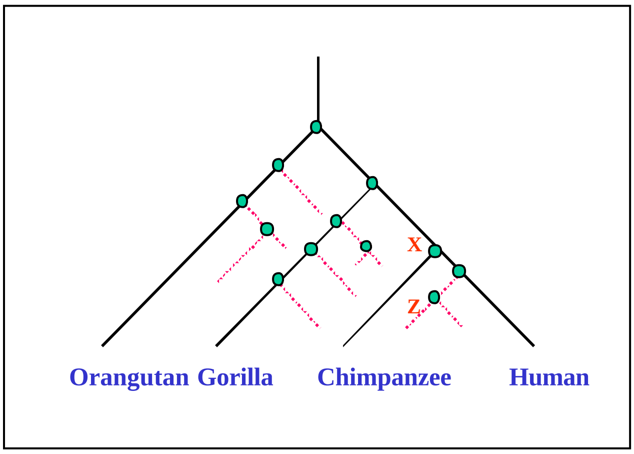

Fig. 1B: As for Fig. 1A, except this hypothetical tree is constructed from the top down and depicts a number of lineages that have gone to extinction (dashed lines). For Z, see text.

ing that speciation is generally considered to be a "splitting into two" process. Yet it is conceivable that speciation events occasionally give rise to three or more species. Resultant phylogenies would have the appearance of a bush rather than a tree. Most of the tree building computer algorithms that use DNA sequence comparisons assume bifurcation.

Gene duplication and gene trees

Turning now to a different type of evolutionary tree – a gene tree. Recent whole-genome DNA sequencing projects have made it clear that the genomes of some species are far more complex than those of others, and that gene duplication accounts for much of the extra complexity. We should not be surprised that gene duplication plays a major role in molecular evolution because the process enables organisms to overcome certain constraints to adaptation, as explained below.

Take a hypothetical gene that exists as a single copy in the genome of an organism. The protein product of the gene may be required to function in different tissues and at different stages of development. Almost certainly different microenvironment (e.g., pH, molarity etc.) will be present in these different places at these different times. It follows that the evolution of this single-copy gene necessarily will be constrained. This is because, at best, it the gene will evolve a compromise DNA sequence to ensure that its protein product functions adequately in all these different microenvironments. The function of this gene will be sub-optimal in any single microenvironment. To function optimally, the protein (and its gene) would have slightly different structures in different microenvironments, but this is difficult (though not impossible) if only a single gene exists.

However, after a gene has duplicated and the two resultant copies have become established in a population, one of the duplicate genes can continue its normal function while the other copy is free to "experiment" with various sequences, perhaps eventually evolving a sequence that encodes a protein with optimal properties in one of the microenvironments. In this way, so called "gene families" have evolved. Gene families are sets of homologous genes that trace their ancestry back in time through gene duplication events. Such genes encode protein products with similar but not identical functions, are often clustered together on a chromosome, and are controlled by common regulatory mechanisms. From this grossly simplified description, it can be seen that gene duplication, a process that occurs at the genome level, shares certain characteristics with speciation. In the presence of environmental heterogeneity, both processes remove constraints to evolutionary adaptation.

Genes duplicate and evolve in DNA sequence over long periods of evolutionary time and therefore gene trees, as distinct from species trees, can be drawn. Unlike species trees that show species at the tips of branches and putative common ancestral species at internal nodes, gene trees show genes at the tips of the branches, and common ancestral genes at the internal nodes. Pairs of genes trace their lineages back to a single gene that subsequently duplicated (Fig. 2).

Gene trees usually involve the members of a gene family but at the ultimate level of reductionism all genes probably trace their ancestry back to a single replicating molecule that evolved from the primordial "soup". It is possible to conceive of genes as having a "life of their own" that is, to some extent, independent of the particular species through which they have passed during evolution, and in which they now happen to occur.

That brings us to a major conceptual problem; how can we incorporate a species tree and a gene tree into a single diagram that depicts both types of major evolutionary event? One answer is to draw what can be called a "bronchial tube diagram" – a term coined by my research colleague Robert Holland. A simple example of such an all-embracing evolutionary tree is provided in Fig. 3.

The molecular clock

It is one thing to be able to derive and draw the sequence of events (i.e., configuration) of a phylogeny such as that shown in Fig. 3, but quite a separate and far more challenging problem to date the speciation and gene duplication events depicted. How do we determine such dates? There are really only two methods. First, we can use evidence from fossils to date speciation (but not gene duplication) events. I have already discussed the major problems that accompany such an approach. Secondly, we can apply the so-called "molecular clock".

The observations that lead to the concept of a molecular clock are counter-intuitive, and grew from analysing macromolecular sequence data – i.e., the DNA sequences of genes and amino acid sequences of proteins. In simple terms, it was observed that the rate of sequence change for a given macromolecule is approximately constant when considered over long evolutionary time periods. For example, if it is observed that 1% of the nucleotides in a given gene have changed over a period of 50 million years, then it is likely that 2% have changed over double that

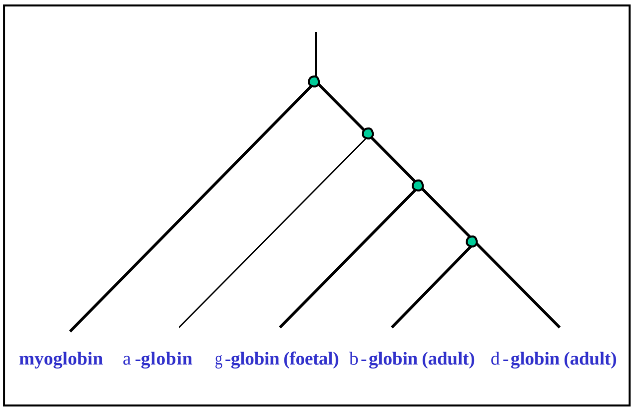

Fig. 2: Gene tree depicting the evolutionary relationships of various human globin genes. Filled circles represent gene duplication events.

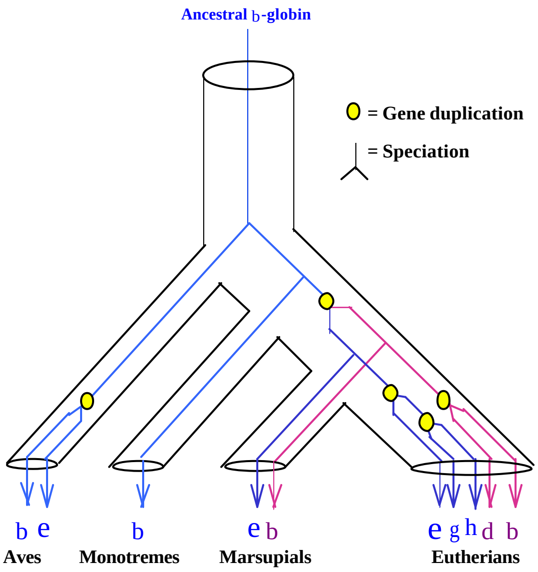

Fig. 3: Bronchial tube diagram showing the lineages of various globin genes as they pass through species, the latter being shown as group of interconnecting "tubes".

period of time. An important consequence of this observation is that once the molecular clock has been "calibrated" for a particular gene or protein it can be used, with a reasonable degree of accuracy, to determine the age of past speciation and gene duplication events. As in nearly all areas of evolutionary biology, there are a number of uncertainties associated with this approach: The clock may not "tick over" precisely constantly with time and is best considered as having a stochastic mechanism. Calibration of the clock is far from straight forward. Genes can become saturated with nucleotide changes after a period of time, at which point the molecular clock becomes useless. It is because of this that the analysis of slowly evolving genes must be used to date ancient evolutionary events.

Two very interesting observations have resulted from studies of the molecular clock. The first is that evolutionary change at the molecular level bears little correlation to evolutionary change at the morphological level. Good examples of this phenomenon are provided by "living fossils". These are species that, judged on comparisons between fossil and extant forms, have remained virtually unchanged in outward morphology for hundreds of million of years. A striking example of a living fossil is provided by the horseshoe crabs (Class Merostomata). This group of organisms has remained essentially unchanged morphologically for over 500 million years. (Sharks and alligators provide other examples). Yet molecular studies have shown that the rate of evolutionary change at the genetic level is no slower than that for species that have undergone rapid morphological change. In other words, the molecular clock (as distinct from the "morphological clock") runs no more slowly in living fossils than it does in other taxa. Examples such as this highlight the fact that there is an "uncoupling" between morphological differences and overall genetic differences. Thus, the degree of morphological similarity is an unreliable indicator of the degree of genetic relatedness.

A second more controversial conclusion from the molecular clock is that the rate of molecular evolution is not greatly influenced by generation time. If we compare the rates of nucleotide substitution over time in a given gene, in the human and rodent lineages, we find they are approximately the same. This suggests that mutation, the ultimate source of all genetic variation, is not necessarily a consequence of DNA replication. But that is another fascinating story.

Primitiveness

One of the most abused words in evolutionary biology is "primitive". Strictly speaking, "primitive" means "first or earliest of its kind; original, not derivative; an original ancestor or progenitor" (Shorter Oxford Dictionary). Using these definitions all existing organisms, including humans, are as "primitive" (or advanced) as one another. Yet, how often do we hear expressions such as "marsupials are primitive mammals" or "humans are descended from the apes" or "yeast is a lower eukaryote"? The concepts alluded to in such statements are widely held by the public and indeed by some scientists, but they are dangerously incorrect and can lead to illogical attitudes of species superiority.

Of course humans are not descended from the apes. If one could travel back in time some 5 million years, one would encounter a common ancestor to humans and chimpanzees (point X in Fig. 1A). Presumably, this common ancestor had some human and some chimp-like features, but it certainly was not a chimp, or a human for that matter. It is not as though the chimp was caught in some form of time warp and remained fixed in its genetic make-up to the present, while the human lineage continued to evolve. Evidence from the molecular clock tells us that the amount of evolutionary change that occurred down the lineage that led to the present-day chimp, is about equal to the amount of change down the other side of the tree that led to humans. So we are not descended from the apes, to any greater degree than the apes are descended from us! In this sense, at least, we can claim no superiority.

A precisely similar argument applies to humans and rats. One would need to go back further in time (i.e., to about 80 million years) to find the common ancestral species. Nevertheless, such a species did exist, and there has been an equal amount of genetic change down the rat branch of the tree, as there has been down the human branch of the tree. Of course, the consequences of evolution down the different genetic lineages often have been very different!

Consider, again, the use of the term "primitive" such as in the statement "marsupials are primitive mammals". Marsupials and placental (eutherians) mammals last shared a common ancestor about 130 mya. Since that time, the two groups have evolved different characteristics but have done so at about the same rate. Quite clearly, one is not a primitive form of the other. These two groups of mammals have attributes that are of adaptive significance to their particular environment and life style.

The commonly held one-dimensional view of evolution involving a linear hierarchy of species, from primitive (or "lower") to advanced ("higher") is a modern-day hangover of Aristotelian concept of the "Great Chain of Being" which depicted a linear hierarchy of increasing "complexity" with "lesser" creatures at the bottom and humans at the top. The chain became extended to incorporate God at the top, followed by angels, kings and queens, archbishops, merchants and shopkeepers, tradesmen, farmers, soldiers, servants, beggars, thieves, gypsies, animals (headed by lions - the "kings of the beasts"), birds, worms, plants and at the very bottom, rocks. Surely it's time we got over this absurd notion?

Darwin himself wrote (Origin of Species, 1859, Chapter 10): "The inhabitants of each successive period in the world's history have beaten their predecessors in the race for life, and are, in so far, higher in the scale of nature; and this may account for that vague yet ill-defined sentiment, felt by many palaeontologists, that organisation on the whole has progressed".

Finale

Returning now to summarise the fundamental misconceptions that I foreshadowed in the opening paragraph. These misconceptions (and the true states of affairs) are:

* Evolutionary change is driven by natural selection. (Chance plays a major role.)
* Morphological resemblance indicates evolutionary relatedness. (Morphology is a poor indicator of relatedness.)
* Evolution is best studied using fossils. (Fossils can be accurately aged but are difficult, if not impossible, to accurately locate in a phylogeny. DNA sequences provide more useful data.)
* The major evolutionary dichotomies are speciation events. (Gene duplication events represent a second major dichotomy.)
* The rates of evolutionary change differ markedly in different species lineages. (For a given gene, the rate of molecular evolution is remarkably constant, even in "living fossil" lineages.)
* There is a linear evolutionary hierarchy of primitiveness amongst extant species, with some being descended from others. (This concept is nonsense – yet it is commonly held in the public and scientific arenas, and its acceptance can lead to delusions about human superiority. Such delusions can influence debates on the ethics of using animals for research.)

All living organisms and the species to which they belong represent the tips of genetic lineages that extend back to sets of common ancestors, and that have undergone about equal amounts of evolutionary change down each side of the evolutionary tree. Many lineages are no longer represented by living organisms, having fallen by the wayside in the long drawn out and testing process of evolution. For every species that has made it through to the year 2002, millions of evolutionary experiments have failed. Those species that are represented today, whether they are rats, ants, humans or gum trees, are the products of a long and immensely impressive evolutionary history – a "struggle for survival". They deserve our utmost respect.

Acknowledgements

I thank Robert Baker and Scott Spargo for their useful comments.

General News

Australian Veterinarians in Ethics, Research and Teaching (AVERT)

Copies of the Proceedings of the AVERT/ANZCCART Conference 2001 entitled "Pain and Practical Pain Therapy" are now available for purchase. You can order a copy through ANZCCART, or directly from Mary Bate: Mary.Bate@newcastle.edu.au

Zoo Times

Keep an eye on *Zoo Times*, the official magazine of the Royal Zoological Society of South Australia. Subscriptions can be organized through www.adelaidezoo.com.au. The April 2002 edition draws attention to the forthcoming ARAZPA (Australasian Regional Association of Zoological Parks) Conference, to be held in Adelaide in April 2003.

Praise for ANZCCART

A recent edition of *Animal Welfare* (Vol. 11 No. 2 2002) contains a very interesting paper by R. H. (Harry) Bradshaw, Department of Clinical and Veterinary Medicine, University of Cambridge, UK. In the paper entitled *The ethical review process in the UK and Australia: The Australian experience of improved dialogue and communication*, the author states that "One of the key elements to the success of the Australian system is an organisation called ANZCCART". Having described our organisation, the author goes on to comment: "Facilitation and communication between all interested parties may be greatly enhanced in the UK by the development of an organisation similar to ANZCCART with a similar mandate".

Australia's Quarantine Function

The Joint Committee of Public Accounts and Audit (Parliament of Australia) is currently reviewing Australia's quarantine function. Details are available from: http://www.aph.gov.au/house/committee/jpaa/Aqis/inqinde2.htm

Housing of rabbits

The New South Wales Animal Research Review Panel recently released a draft guideline on the housing of rabbits in scientific institutions. The document can be viewed at: http://www.agric.gov.au/14098. Comments on the draft can be sent to Lynette Chave, Senior Veterinary Officer, Animal Welfare Unit, NSW Agriculture, PO Box A970, Sydney, NSW 1232
Email: lynette.chave@aagric.nsw.gov.au

Universities Federation of Animal Welfare, UK (UFAW) Symposium

The UFAW is organizing a Symposium entitled: *Science in the service of Animal Welfare* to be held at the University of Edinburgh from 2 to 4 April 2003. Sessions are planned to include the following topics: The science of welfare assessment; Using science in ethical decisions; Applying science to animal welfare; Factors influencing attitudes to animal welfare. Abstracts and expressions of interest are being sought. For further information contact the UFAW Scientific Officer: scioff@ufaw.org.uk

NWAC Report

The Annual Report of the National Animal Welfare Advisory Committee (New Zealand), chaired by Professor David Mellor, has been published. A copy can be downloaded from the NAWAC web site at: http://207.78.129.207/biosecurity/animal-welfare/nawac/

The moral status of animals

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Talking about ethics
Two and a half thousand years ago, Aristotle wrote one of the great books on moral theory. He said something quite surprising: don't teach moral theory at all unless you teach it in depth. His reason? Ethics isn't a science and it's never going to be one. When you find that this is so - and you will - you are apt to become contemptuous of a study which lacks proofs or theorems or determinate, established results.

In this short article, I run that very risk. So please look for no more than some hints on how to think morally about how it can be right ever to perform experiments on animals.

Two reasons why uncertainty is built into ethics are pretty simple. Ethics is not about the way the world *is.* It tells us how it *ought* to be. By itself, not even the most careful observation will settle that. Further, laws of science don't both conflict and survive. Moral principles very often do. Think of the principles of mercy and justice.

Despite this sad state of intellectual affairs, morals will not go away. We can't live as fully human animals without taking up moral attitudes and acting on them - without evaluating them in our peculiarly ethical way. Once you begin morals somewhere, consistency carries it into every sphere. I'll sketch arguments for these claims later.

I also claim, with a mere wave at reasons, that moral principles are not simply matters on which some society or culture agrees - the view called social relativism. Here is a wave at reasons: the bulk of Germans approved of the Fascist policies of Hitler from 1933-45. That approval doesn't mean that the policies were ethical for that society at that time. They got it spectacularly, badly wrong! And other cultures have got it badly wrong at other times, too. Something right underlies social relativism: it's criminal folly to drive on the right in Adelaide streets, but just the opposite in New York. But something deeper unites the locally different laws: drive on the same side of the road as your fellow drivers. Social relativism looks good on the surface, deep down it's superficial.

Why worry about animals?
Animals have a moral status because, like us, they can suffer or enjoy life. And, like us, they are agents with desires and satisfactions. There is a moral principle that whatever can feel pain and stress, on the one hand, or experience pleasure, on the other, merits ethical consideration - briefly, avoiding pain and increasing enjoyment is, all else being equal, a Good Thing. There's another principle that, all else being equal, agents shouln't be thwarted. And they're plausible principles. Most of us are disturbed by an animal screaming in pain, although not everyone is. Most find something ugly in teasing and thwarting animals.

Rationally, too, there is much to be said for these moral principles. The 19th and 20th Centuries saw marked changes in our picture of the likeness of other animals to people. The kinship among mammals has come to seem specially close. And we recognise broader likenesses. Both on behavioural and neuro-anatomical grounds, we have good reasons to believe that pain in animals generally is like our pain, their stress like our stress.

To some degree this is guesswork. But the older view of animals as mere mechanisms is clearly false. The overwhelming trend of current ethical thought about animals is that we must treat them as subjects of pain and stress, pleasure and enjoyment significantly like our own. We must regard them as agents. We have respectable reasons to follow the trend.

Consistency demands that in so far as the pain-pleasure and agency analogies between people and animals are complete, so far, animals merit *the same* consideration as ourselves in respect of relevant values and duties. Their pain and stress bears the same moral cost as ours. So, to justify treating them differently from ourselves, we must find morally relevant differences, other than in suffering and agency, which justify unequal treatment. This is much the more difficult part of understanding the moral status of animals. Let's turn to that problem now.

Why worry so differently about people?
We need some way of marking ourselves off from other animals which does not depend on mere preference for our own kind. We are us - they are them. Let's call that mere preference *speciesism* (a kind of super-racism or chauvinism) to remind us of the morally deplorable attitudes we don't want.

A crucial difference is this: we alone are *moral* agents,

(a) we formulate values and ethical principles and

(b) we pursue them, shaping our lives around them. That is a natural outgrowth of our being animals with a highly developed language, living together in highly developed cultures. Language and culture are interdependent features, for both of which we are genetically well equip-ped.

Our most striking anatomical feature as humans is the large convoluted brain. If we ask what survival advantage it brings, a plausible (but debatable) answer is that it equips us to survive as cultural animals speaking a full-blown language. It has complex sentences with highly articulate syntax and correspondingly detailed and accurate semantics. So I'm suggesting that it's in a linguo-cultural environment that human animals are most likely to live long enough to pass on their genes. There lie the seeds of moral agency.

No viable group of genetically normal human beings, however remote and isolated from the rest of us, ever lacked a true language and a culture. Language and culture depend on each other. They evolve hand in hand.

To learn a language you need a basic culture. You must follow norms, observe standards and learn principles. If not, you won't understand or be understood. You have to talk and listen as any competent user of the language *ought* to talk and listen. More contentiously, you won't get far unless you try to approach linguistic ideals like truth and accuracy. The practices of teaching and learning, observing and guiding, correcting and criticising are built deeply into the whole pattern of realising a human nature - expressing our genetic inheritance in cultural, conceptual life.

Conversely, anything sophisticated enough to count as a culture needs a rich language to sustain it. On an individual level, language is essential for the detailed and articulate forms of self-consciousness which enable each of us to survey our own mental processes, desires, beliefs and actions and make critical judgements on them. These aspects of moral self-critical life develop only when we live with other humans in a cultured life. Human animals *lead* their lives; they don't simply live them out. They owe that to the practice of living and talking *together***.**

If so, then our species stands out as a morally central one. Reflecting on what we do and what we want, we come to modify our motives and our actions and practices. We consider what we *really* want and what it is *best* to do. We formulate not just desires and practices, but values and principles and deliberately pursue them.

Being what we are, we can actually change our patterns of action in the light of our values. We can follow principles and build them into individual and sociocultural life. If we can mould our behaviour by the kind of judgements we make on our actions and motives, then we regard ourselves as, so far, *free*. If free, then surely *responsible* for principles, values and for following them.

We are not just moral agents. We discover, create and invent values. As far as we know, we're the only moral agents and creators. That makes us specially valuable.

In philosophical jargon, human animals are *persons*. No other animals are. The jargon emphasises that persons form a *moral* class, not a biological one. To highlight that, think how easily we understand the idea of non-human persons. ET, the host of aliens and even machines may strike us straight off as in the same class as ourselves - they are persons, not humans. Like us they talk, make plans, pursue values, self-criticise and so on. They are members, with us, in a quite particular moral category, though not the same one biologically

So to make persons morally special is not a form of speciesism. All the features that define persons are morally relevant - indeed central - ones.

Difference and commitment.
Sooner or later, in ethics, we run out of discoveries and not just because we continue ignorant. While the moral differences between people and other animals are there to be discovered, and described, nothing can decide for us what to *do* about the difference: certainly not in our context - whether or not we may ethically experiment on animals against their interests. That depends on the moral weight we give to the difference. This is not inscribed on stone anywhere, nor fixed by further scientific facts about the natures of various animals, including ourselves. We must decide the weight for ourselves, choose it as best we can and commit ourselves to respecting our evaluation. So we, and not the world, are responsible for what we decide. We can't shrug that weighting off onto the way things are, neither to theorems in logic nor scientific findings. That responsibility is down to us.

Almost everyone recognises that persons have a moral value which animals do not have. Many also recognise that this does not negate our kinship with them as sentient agenta, though it may modify that. Deciding how to weight the difference is not like taking a leap in the dark. Yet it obliges us to recognise that others might properly disagree with us as to what the weighting ought to be. This is not ignorance or irrationality on anyone's part. They disagree with us on a commitment: how to weigh costs and benefits *justly*.

For some, taking a moral decision like this is a leap in the dark, the toss of a coin, a matter of taste. Or worse, it is a dogma beyond the reach of argument and discussion. Some of the anger and the resort to extremes is bred of insecurities - the wish to be loyal to a commitment which you are not sure how to defend with reason in a discussion with others. So it is important to understand just how commitments need not be blind leaps - and it's at exactly this point where Aristotle was right to say we must settle down for the long haul, with care and subtlety if we are not to undermine our own picture of ethical thinking.

But let me end with two sketchy hints.

Unlike mere tastes, decisions and commitments face the disciplines of consistency and future consequences. A decision about animals reverberates through the structure of all our values: we easily see that justice demands consistency. So we may find that we can't live with our decision, for it puts unacceptable strains on other values. The future consequences of our commitment can't be foreseen in detail, detail which may upset the balance we reckoned on.

On the experimenter's side, we bear responsibility for the tide of animal death and discomfort. Those who disagree with us bear a responsibility, too: for the limitations on the capacities of people to lead free, vigorous ethical lives. That depends on health and longevity. That's a high cost, but difficult to assess. These things discipline our commitments. We should revisit them often.

Lastly, you can be good at judging moral weights much as you can have a good sense of humour. Things are not *objectively* funny in themselves in the way that they may be objectively cubical or massive. Human consciousness brings laughter to the world, but it is still a response to *what is there*. It isn't truly subjective - you can't laugh at just anything. There has to be a *point*. Missing a joke is missing a point. It's a *cognitive* deficiency. Still, no one yet has a good theory of what humour is. One theme of humour is revaluation - seeing things in a suddenly new ethical light. Wilde's nice quip is a case in point: *to fall in love with oneself can be the beginning of a life long romance.*

Articles in this edition of *ANZCCART News* raise a number of interesting and perhaps controversial issues. Short letters, in relation to these and other issues, will be considered by the editor for publication in future editions.

Animal welfare in institutions of teaching and research: Where have we come from and where are the goal posts now?

Lyndal R. Scott, Animal Welfare Officer
University of Melbourne, Parkville, Victoria

The major role of laboratory animal science and animal welfare interests in Australia as elsewhere in the world has been to set, progress, and promote standards of care and welfare for *animals* bred and used for teaching and research in scientific institutions. The provision of useful guidelines by the NHMRC (National Health and Medical Research Council) through the *Australian Code of Practice for* the *Care and Use of Animals for Scientific Purposes* (1997) and other publications, as well as ANZCCART (Australian and New Zealand Council for the Care of Animals in Research and Teaching), and ANZSLAS (Australian and NZ Society for Laboratory Animal Science) through Fact Sheets and articles, has contributed significantly to supporting the spirit of State Acts and the development of Animal Ethics Committee (AEC) operational policies and procedures in scientific establishments.

Inconsistences identified

While there remain some inconsistencies, for example, with:

(i) institutional and AEC interpretations of definitions and guidelines and acceptable response times to effect change;

(ii) general standards of housing, care and monitoring for animals including farm animals and wildlife; and

(iii) provision of information and training for staff, ethics committee members and administrators.

considerable progress has been made towards changing old attitudes and effecting, through raising standards in Laboratory Animal Science, better quality research.

Effecting change

Effecting change has not, however, been entirely without its trials. In the early years there was the difficulty of trying to find a suitable definition for *animal*. For instance, the definition of vertebrate chosen by the NHMRC and used by ethics committees around Australia varies somewhat from that of the State Act in Victoria where it means any vertebrate except fish. The temptation to skew the value we place on animals towards the upper end of the phylogenetic tree highlighting Peter Singer's view of humans as being speciesist, has from time to time challenged politicians pressured by sections of the community with vested interests, to exclude certain animals of economic importance.

Not surprisingly this phenomenon is not exclusive to Australia. In the USA, for example, rats, mice, and birds continue to remain outside the Animal Welfare Act altogether, an interesting decision given that the first two species in particular are more commonly used in teaching and research than any other on earth. Not to include all vertebrates equally in the ethical debate remains, without question, a hypocritical and an inconsistent notion of animal welfare.

In the interests of animal welfare all animals deserve best practice in standards of housing, care, and monitoring from trained staff. It is, in fact, a major responsibility of Scientific Establishment AECs to ensure that these requirements among others are met when approving Applications for Approvals. While an AEC, in accordance with the NHMRC *Australian Code of Practice for the Care and Use of Animals for Scientific Purposes*, 6th ed. (1997), must include in its membership of decision-makers the standard four categories (veterinarian, scientist, representative from an animal welfare organization and a lay person) acceptance of the value of also including an animal house manager has been somewhat slower. The dedicated and long hours provided by animal house support staff as well as their specialized knowledge on accommodation, supply, procedures, care and monitoring, and general running of an animal facility have proved their contribution indispensable. They, above all research team members, spend more time in the company of their charges than any other. Because of this and the affection held for their animals, grief felt at the conclusion of work when animals must be killed can be difficult, a phenomenon often overlooked and one that many admit does not diminish with time. Others responsible for oversight of approvals sometimes also express this concern.

Evidence of progress

One of the important visible changes in scientific establishments over the last decade has been the substantial improvement in housing for small laboratory animals. The considerable investment made by institutions in upgrading and replacing infrastructure as well as caging, to provide for more appropriate and comfortable space for animals is encouraging. This however, has not necessarily been reflected in the farming and wildlife sectors, partly due to entrenched, outdated views, and partly for economic reasons.

Training programs

In relation to training for research workers, formal part-time programs (currently undergoing national curriculum review) were established for animal technicians by TAFE (Technical And Further Education) colleges in the early 1970s. These in turn were followed in the early 1980s by the introduction of short in-house training seminars/workshops in a small number of institutions around the country for investigators. Almost all large institutions of research and teaching now provide training programs of some description for research and teaching staff, though once again, standards in the farming and wildlife sectors remain variable.

Postgraduate courses for those with an interest in ethics and animal welfare are also offered in some states.

In addition to training for technical and scientific staff, occasional seminars and workshops are held for AEC members and administrators. A topic of constant interest is the difficulty of eliciting from AEC Application for Approvals, a good Lay Language Statement and Project Description, as well as a clear Statistical Justification for animal numbers requested. One can only presume that the pressure on investigators to meet a number of deadlines at the same time on a number of fronts each year, such as granting body submission dates, submissions for new AEC Applications for Approval to use animals, AEC Annual Reporting for the previous year's use of animals, as well as other general compliance requirements including carrying out research work itself, contribute to this. A common frustration for executive officers, however, can be the limited time available to collate and submit the sum total of all institutional compliance requirements, both internal and external, in order to conclude the business of one year and commence the next.

Setting new standards

While much has been achieved much remains to be done. Accepted standards for housing, care and monitoring of animals need constant reviewing and new goal posts set. Scientists at the combined Melbourne/Monash Universities/VIAS Animal Welfare Centre at Werribee in Victoria, in conjunction with industry representatives recently identified and set priorities for farm animal, companion animal, and laboratory animal welfare research for the coming years. Included in concerns identified was the impact of transgenic technology on animal welfare (extending from the manipulation of farm animals for production) such as dairy cows, to the high rates of attrition for the production of transgenic mouse strains, and the need for rationalisation of the industry through use of data base sharing of animals and tissues.

And so, in a world of rapid change and scientific demands for increasing numbers and better animal models, and omits community interests in achieving a happier, healthier, environmentally sustainable world, while meeting requirements for accountability and transparency, in what direction should laboratory animal science and animal welfare set its goal posts for the coming years? Where do our core responsibilities really lie?

Goals for the future

In fulfilling our ethical responsibility, I believe we should all be working harder to:

* Ensure that the application of standards for the care and welfare of *all* animal species including transgenic animals, regardless of their place on the phylogenetic tree is consistent.

* Review more seriously the ethics of some work proposed.

* Provide and improve training programs, and resources for staff at all levels from animal technicians to research and teaching staff, as well as AEC members and executive officers.

* Give more priority to travel opportunities for staff at all levels (including for animal technicians and specialist laboratory animal veterinarians) to attend courses, seminars, and workshops (at home or overseas), if best practice in standards of laboratory animal science and welfare are to be met in coming years.

* Give some thought to carrying out a human resource audit for future requirements of the industry. For example, many veterinarians involved in the establishment of laboratory animal science in Australia are now moving on, and interest in this field, as in research and diagnostic disciplines generally, is not being sufficiently promoted at the undergraduate level in Schools of Veterinary Science in Australia or in the wider scientific community.

* Encourage institutions to invest in appropriate equipment and resources to facilitate their work rather than 'simply making do'. A typical example is the lack of investment in appropriate gas anesthetic machines and basic monitoring equipment for use in small animal laboratory work, not only compromising animal welfare but *ipso facto* scientific data. Deference to cost is no longer acceptable as an excuse.

* Maintain through organizations such as ANZCCART, ANZSLAS, and AATA, a watching brief on new standards developed for housing, care, and monitoring for animals and encouraging the adoption of best practice promoted. While considerable progress has been made in recent years to adopt the use of alternatives in many areas of teaching, more effort to find and progress the use of alternatives also in industries such as the pharmaceutical industry, and in microbiology should be encouraged, as should also humane endpoints for *all* experiments. Granting bodies might care to consider their obligations to these principles.

* Revisit, with the view to rationalizing, the roles and contributions of professional societies/organizations such as ANZCCART, ANZSLAS, and the AATA. Given the commonality of membership between all three, it is probably time to consider reviewing and redefining the territorial role of each, as well as amalgamating (or at least co-ordinating) in the interests of cost effectiveness and attracting maximum attendance and world class speakers, a single conference time at the same location each year, as ANZSLAS and AATA have done for 2002.

On this theme, some consideration might be also given towards implementing on a more regular basis, a successful recent Victorian initiative where a program of overseas speakers was organised to visit and speak in a capital city of each State and NZ, with coordinating and financial help from participating institutions and ANZCCART.

The contribution of animals to science is indisputable. In return, science has an obligation to ensure that it doesn't fail to meet with more vigour, its ethical obligations to minimize harm through the adoption of Russell and Birch's Three Rs, Replacement, Reduction, and Refinement in teaching and research. There is a need to promote standards of care and respect for animals and their needs at all times.

The annual ANZCCART Conference offers an ideal forum to address these issues, to audit progress to date each year, and to set new goals for the future.

Nature's opinion

A recent "Opinion" editorial in *Nature* (Vol. 416: (2002) page 351) entitled *Rights, wrongs and ignorance* states that "Whether or not animals have "rights", we should learn more about their capacity for suffering." The editorial goes on to say that " … most experts would agree that we have barely started to understand animal cognition. Even our knowledge of animal welfare is still rudimentary. We can measure levels of hormones that correlated with stress in people, but is a rat with high levels of corticosteroids suffering? We just don't know". The article concludes that "the science of animal pain and cognition should be given a higher priority".

ANZCCART's 2002 Conference UPDATE

Animal Welfare and Animal Ethics Committees: Where are the goalposts now?

As announced in the March edition of *ANZCCART News*, this year's conference will be held in Australia at the Gold Coast International Hotel, Surfer's Paradise, Queensland, and will run from **Thursday 17 October** to **Saturday 19 October**.

Judged from inquires already received, a large number of delegates from Australia and New Zealand will be attending. In fact, the conference is shaping up to be amongst the most successful ever organised by ANZCCART.

The planning committee, which comprises representatives from Australia and New Zealand, aims to attract to the conference members of Animal Ethics Committees (AECs), and people interested in animal welfare and ethics, and the use of animals for scientific purposes.

Conditions under which AECs operate are changing (hence the "moving goalposts" component of the title) and a major conference objective is to identify changed circumstances and the ways in which these changes can be addressed. Members of AECs require skills in a range of areas (science, welfare, ethics etc.) including the decision-making process itself. The conference will cover all these issues.

The program will include plenary and poster sessions, and workshops. Amongst the session titles are: "Designing learning events in Animal Ethics", "Genetically Modified Organisms and the issues they pose for AECs", "The interface between the public and users of animals for scientific purposes", "Plan it, Do it, Evaluate it: Achieving Animal Welfare outcomes", and "Personal perspectives on Animal Ethics".

Plans for the conference are well advanced and will be posted on the ANZCCART web site on Friday 9 August 2002. At that time, a Registration form will be made available.

The deadline for registration, and the receipt of poster titles, is Thursday 12 September, 2002.

We look forward to seeing you at the Conference.

Rory Hope
(Chair, Conference Planning Committee)

Research priority areas for the Alternative Sustainable Swine Production Program *

Rebecca Morrison
Sustainable Swine Production Systems Scientist
University of Minnesota,
West Central Research and Outreach Center, Morris Minnesota, USA

I came to the West Central Research and Outreach Center (WCROC) in Minnesota 12 months ago and I hold the position of the Alternative Sustainable Swine Production System Scientist. This position was created as part of legislature funding to conduct research into alternative sustainable swine production systems.

I decided to pursue my career in the swine industry and move to Morris, Minnesota, from a strong rural background in Australia where I grew up on a beef, sheep and cropping property. My interest in swine evolved in my final year of my Bachelors Degree in Agricultural Science, and since then I have been devoted to the pig industry. I completed my PhD program with The University of Melbourne and Bunge Meat Industries, Australia. This PhD program was titled *The performance and behaviour of growing pigs in a deep-litter, group housing systems*. Deep-litter group housing systems have a plethora of names associated with them, for example, Hoops, Ecoshelters and Ecosheds, just to name a few. These alternative housing systems have been developed for a number of reasons, which include lower capital cost for the producer and the perception that deep-litter, group housing systems are welfare and environmentally friendly. My PhD research originated because the pig industry that was using deep-litter, group housing systems was concerned that pigs in such housing systems had growth performance problems. Basically, pigs were fatter and had a poorer feed efficiency compared to pigs in confinement or more conventional systems. My research showed that there are certain components of the feeding behavior of pigs in deep-litter, group housing systems that may affect their growth performance. This is one area of research that I would like to continue in the next few years.

These are exciting times for research in alternative sustainable swine production systems, as lately there has been increased interest in the impact of alternative housing systems for swine and animal welfare in general. We are going to have a leading research facility here at The University of Minnesota's West Central Research and Outreach Center, which will enable us to study and improve the performance of pigs in alternative housing systems.

The research priority areas for the alternative sustainable swine production program are as follows:

* Improve feed efficiency in alternative systems.
* Study pig behaviour and handling. (A feature of hoops and other alternative systems is that pigs are often housed in groups of 180 or more. How does this affect pig behaviour? Are the pigs more of less aggressive? Are the hogs healthier overall? What are the best methods for sorting and moving groups of pigs?).
* Determine why pigs in hoops are fatter, and study ways of reducing fat deposition.
* Investigate alternative feeds sources and organic diets.
* Study bedding types and dust control. (What is the best type of bedding for hoop structures and other alternative systems? What is the most economical and environmentally friendly bedding? How do we best control dust? How much of a problem is dust?).

Ultimately, the aim is to conduct research in these areas and improve the performance of growing/finishing pigs in deep-litter, group housing systems and to develop sustainable alternative housing systems for pregnant and farrowing sows.

The well-being of pregnant sows is an issue that the pig industry is facing worldwide. Currently, the majority of pregnant sows in swine barns are housed in individual stalls that prohibit locomotion and social interaction with other sows. There is a good reason for this type of housing system. It reduces aggression between sows at feeding time. The sows are housed in their own pen, and are not threatened by, or fight with other sows. This improves survival of the pig embryos, as the sow is not fighting. However, there is concern from animal welfare groups and the general public that gestating sows should be able to move around and interact with other sows during their pregnancy.

This is a concern that is growing rapidly every day. Large chain restaurants are beginning to consider the welfare of sows in confinement systems. For example, McDonalds has a scientific advisory committee working on this topic alone. They may eventually consider the housing system in which a pregnant sow lives when they purchase pork. Therefore, it is a priority of the pig industry to develop and study alternative sow housing systems that allow the sow to move around and interact with other sows, without the problems of aggression which are usually seen in groups of sows. Deep-litter, group housing systems for pregnant sows have been developed to overcome some of these concerns.

The WCROC has built a facility (in collaboration with the Alternative Swine Task Force) that allows sows to live in social groups of 15, with a base of deep-straw for thermal comfort and environmental enrichment. Individual feeding stalls eliminate aggression during feeding. We will be conducting comprehensive research in a study funded by the Minnesota Pork Producers (in collaboration with Dr John Deen (University of Minnesota's Swine Center) and Dr Sam Baidoo (Southern Research and Outreach Center, Waseca). This research will be studying the well-being of sows in deep-litter, group housing systems compared to conventional confinement systems, reproductive performance and other factors such a the economics of these alternative housing systems for pregnant sows.

*** Editor's note:**

Each year we intend to ask a previous winner of the ANZCCART Student Award (see opposite for details, or visit the ANZCCART web site) to write a short article for *ANZCCART News*. This is the first such article.

Rebecca Morrison (Sargent) received the Award for a paper she presented at ANZCCART's annual conference in 2000. The title of her paper was *The welfare, behaviour and performance of growing pigs in a deep-litter, group-housing system*.

Rebecca's paper appeared in the Conference Proceedings: *Farm animals in research – can we meet the demands of ethics, welfare, science and industry?* published by ANZCCART in 2001.

Order forms for this, and the many other ANZCCART Publications, can be obtained from -

www.adelaide.edu.au/ANZCCART/

ANZCCART STUDENT AWARD FOR 2002

ANZCCART is again offering its Student Award, in conjunction with the 2002 Conference on the Gold Coast, Queensland, on 17-19 October. The theme is *Animal welfare and Animal Ethics Committees: Where are the goalposts now?*

The purpose is to encourage attendance and involvement at the Conference by honours and postgraduate students.

ANZCCART's mission is to provide leadership in developing community consensus on ethical, social and scientific issues relating to the use of animals in research and teaching. Its key objectives are to promote:

- **excellence in the care of animals used in research and teaching;**
- **responsible scientific use of animals; and**
- **informed discussion and debate within the community regarding these matters.**

The award is open to students of all disciplines and is worth $A1,000. It is intended to provide for travel costs, accommodation, registration and the conference dinner.

Students are required to submit an abstract of not more than 1,000 words on an animal welfare theme relevant to the conference and be prepared to give a 10 minute talk and/or a poster at the conference.

Applications should be submitted by 23 September 2002 to:

Dr Rory Hope
Director
ANZCCART
Room 128, Darling Building
Department of Environmental Biology
The University of Adelaide, SA 5005

Telephone: (08) 8303 7586
Facsimile: (08) 8303 7587
Email: anzccart@adelaide.edu.au
Homepage: www.adelaide.edu.au/ANZCCART/

Book Reviews

The Design of Animal Experiments: Reducing the use of animals in research through better experimental design

Michael F.W. Festing, Philip Overend, Rose Gaines Das, Mario Cortina Borja and Manuel Berdoy

Laboratory Animal Handbooks No. 14
Laboratory Animals Limited / Royal Society of Medicine Press, London, 2002

ISBN 1-85315-513-6

For many researchers, the idea of "statistics" conjures up images related more to black magic and voodoo than the supposedly real world of experimental science. To others, "stats" may represent a last gasp attempt to gain a "significant" result for a critical publication or grant application. Perhaps these attitudes underlie the fact that around 60% of papers in the biomedical literature use statistics incorrectly. Such errors can lead to misinterpretation of data and misleading conclusions, which, in the extreme, can have potentially serious consequences for health care. As stated by one leading medical statistician, the "misuse of statistics is unethical". Apart from issues of increased patient risk, misuse of statistics and poor experimental design can lead both to wasted resources and to unnecessary further work. *The Design of Animal Experiments* [1] by Michael Festing and colleagues presents an elegant and innovative approach to dealing with these matters, with the ultimate aim of reducing the number of animals that are used in biomedical research.

This is not your usual introduction to statistics and experimental design. Nowhere do we see pages of arcane discussion of probability theory. There is not a single mathematical model of random sampling or a derivation of the *t*-distribution. Standard deviations, standard errors and the all-pervasive *P* do not make an appearance until the second last chapter. Instead, the authors develop a compelling logical framework based on realistic examples of typical experiments. This framework is familiar and accessible to anyone working in the laboratory environment. By taking this approach, the book avoids the problem facing many introductory statistics texts (and courses!) that spend most of their time expounding the theoretical bases of simple statistical tests, then leave the novice statistician without the tools to design and analyse experiments in a practical way.

So how do the authors develop their unique approach? First, they make the link between good experimental design and good statistical analysis. Good experimental design involves many things, not least of which is forming a clearly defined hypothesis that will be tested explicitly by the proposed study. Central to good design is the choice of the appropriate experimental unit for replication and the control of variability from unit to unit. Not surprisingly, much of the book focuses on these two aspects. The second feature of the book is the use of the concept of "signal-to-noise" ratios to introduce the fundamental nature of statistical testing. This concept is well-understood by most researchers and provides a readily accessible path into the statistical interpretation of experimental results. Finally, the authors appreciate that most investigators usually carry out experiments that involve the analysis of the effects and relationships between many different factors acting on a range of variables. Analysis of such experiments lies well beyond the reach of simple *t*-tests. Consequently, much of the book is concerned with techniques based on analysis of variance (ANOVA) .

The first chapter of the book covers the basic principles of the design of animal experiments. This brief chapter should be mandatory reading for all researchers, reviewers and editors; it alone justifies the price of the book. In less than 16 pages, it covers not only the elements of good experimental design, but the most common errors that undermine the interpretation of experimental data. The second chapter discusses a wide range of issues relating to the appropriate choice of experimental animals, with special emphasis on the clear genetic definition of your animal stocks.

Chapter three introduces the concept of signal-to-noise ratios in experimental design and statistical testing. Put simply, statistical tests compare the size of the biological effect in which you are interested (the "signal") with the amount of unexplained variability in the data (the "noise"). If you have a large signal-to-noise ratio, you are likely to have strong statistical significance. If your signal-to-noise ratio is low, it is going to be difficult to detect a significant effect of your experiment. How do you improve the signal-to-noise ratio? You can increase the signal; you can decrease the noise; or you can try an alternative signal. Good experimental design and analysis requires identifying sources of variation and controlling them either experimentally or statistically. This reduces the noise and allows more sensitive detection of the signals (i.e., effects) of interest.

The key to identifying sources of variation in the data and controlling for them is the technique of analysis of variance (ANOVA), as discussed in chapter four. The type of ANOVA that is used is inherently linked to the underlying experimental design and the choice of the appropriate experimental unit (e.g., the animal, the tissue sample, the culture well, or whatever). A surprising consequence of ANOVA-based designs is that, as experiments become more complex, with more factors in the mix, the number of replications per combination of factors that is required actually decreases. This consideration above all else can lead to significant reduction of animal use, and is discussed in chapter five along with other potential influences on the choice of adequate sample size.

These chapters, together with the final two chapters on interpreting and presenting data, provide the conceptual framework to use the powerful statistical programs that are now widely available. With this background, a researcher also should be able to make good progress with classic full scale texts such as Sokal and Rohlf's *Biometry* [2] or Winer's *Statistical principles in experimental design* [3], both of which provide extensive accounts of the application of ANOVAs and related methods to experimental design.

Reducing the numbers of animals used in biomedical research makes sense ethically, economically and scientifically. This excellent little book makes an important practical contribution to researchers developing the skills necessary to make the most of their experiments in the light if these issues. It can be read from cover to cover in less than an hour. All biomedical researchers, even those who understand statistics well, will gain lasting benefit from an hour well spent.

[1] Altman, D.G. (1991) *Practical statistics for medical research*. Chapman and Hall, CRC Press, Boca Raton.

[2] Sokal R.R. and Rohlf F.J. (1994) *Biometry: the principles and practice of statistics in biological research*. 3rd ed. Freeman, New York

[3] Winer, B.J., Brown D.R. and Michels, K.M. (1991) *Statistical principles in experimental design*. McGraw-Hill, New York.

Reviewed by:
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Animal Models - Disorders of eating, behaviour and body composition

edited by J.B. Owen, J.L. Treasure and D.A. Collier

Published by Kluwer, B.V. (KAPG) (2001)

ISBN: 0792370953

The systematic scientific study of behaviors in humans poses significant challenges. Arguably the most complex of these are the behaviors associated with the regulation of energy balance. Much has been learned about the physiology and molecular basis of the regulation of energy balance by the study of animals.

The book, *Animal Models – Disorders of Eating Behavior and Body Composition*, edited by John B. Owen *et al.* aims to review knowledge on the disorders of eating behavior and body composition in some of the non-primate higher animals and to relate these to similar conditions in humans. The book is (somewhat arbitrarily) divided into five parts. Part one deals with human disorders of eating behavior and body composition, including the obesity syndromes, the spectrum of eating disorders and the economics of eating. As such there is a clinical and genetic discourse, a somewhat more psychological approach to the analysis of the problems and an outline of the economic phenomenon governing diet selection. The second part deals with diet selection and aberrations of body composition in wild animals. Parts three and four examine genetic models of animal obesity and genetic susceptibility to leanness, respectively. The final part looks at animal models of anorexia.

At once this book appears to be an overview of the field of the regulation of energy balance, but also claims to provide an analysis of animal models used to study energy balance. Ultimately this book is not particularly successful on either count. To do justice to the subject requires a much broader treatise in comparative physiology as it relates to all aspects of energy balance, and a considered analysis as to which of the lessons learned can be extrapolated to humans. Second, the strengths and limitations of each particular model deserve greater emphasis. In many cases the selection of the animal model is based largely in the expertise of the author. Third, and perhaps of most relevance to readers of *ANZCCART News*, the ethics of animal experimentation are afforded scant attention, and should, in my view have had a dedicated chapter in a book of this sort.

Each of the chapters is a worthy enough essay, which may serve as an introduction to a particular topic for the uninitiated. There is, however, considerable repetition between chapters. In other cases the relationship of one chapter to another is not always apparent. In some cases there is detail which I would have thought beyond the scope of the book, and in others there are significant omissions. For example ,Ghrelin and Orexin are not even mentioned, and the discussion on the physiology of the recently discovered uncoupling proteins, UCP2 and UCP3 frustratingly limited at best and at worst naive.

There is more unevenness of style than is acceptable, even for multi-author books, and most strikingly in Chapter nine the font size changes.

While there is much in this book of interest, it is not clear who it is aimed at. Nevertheless it is certainly of sufficient interest to warrant browsing through if found on the library shelf.

Reviewed by:
Gary Wittert
Department of Medicine
The University of Adelaide
South Australia

Clunies Ross National Science and Technology Award 2003

Nominations are now invited for this award, which recognises people for their successful application of science and technology for the economic, social or environmental benefit of Australia.

For additional information, contact:
info@cluniesross.org.au

Coming up

Fourth World Congress on Alternatives and Animal Use in the Life Sciences
New Orleans, USA
11-15 August, 2002

email: dpease@hsus.org

website: www.world congress.net/

ISAZ Conference
University College London
20-21 August, 2002

Program and Registration details can be found at:

www.vetmed.ucdavis.edu/ CCAB/meetings.htm

World Veterinary Congress
Tunisia
25-29 September, 2002

website: www.world-vet2002@planet.tn

ANZSLAS Annual Conference
University of Melbourne, Parkville
30 September - 4 October, 2002

Invited speakers include: Dr Carol Cutler Linder and Jennifer Corrigan (The Jackson Laboratory) and Prof. Bernard Rollin (Colorado State University)

For further information, contact Denise Noonan
email: Denise.Noonan@adm. monash.edu.au

UFAW Symposium
Science in the service of Animal Welfare
Edinburgh, Scotland
2-4 April, 2003

Contact: UFAW Scientific Officer
email: scioff@ufaw.org.uk

Further details can be found at website: www.ufaw.org.uk

News

Animal welfare leadership

The only Animal Welfare Chair at an Australian university is to be established at The University of Queensland following donations of $2 million from government and industry sources.

The chair will build on existing Queensland University expertise in the animal welfare field and create a source of reliable information based on impartial research and study both for livestock industries and the broader community.

Non-Animal test methods pass major international hurdle

Three sets of non-animal testing guidelines recently passed their last major hurdle leading up to adoption by the Organization for Economic Cooperation and Development (OECD), an economic alliance of 30 industrialized nations, including the United States, Japan, and member states of the European Union. At their 29-31 May meeting, OECD National Coordinators approved cell or tissue-based guidelines for assessing whether chemicals cause skin corrosion or phototoxicity, or can penetrate the skin (and thereby be absorbed by the bloodstream). These guidelines are expected to be formally adopted by the OECD after a series of meetings later this year.

A newly formed alliance, the International Council for Animal Protection in OECD Programmes (ICAPO), welcomed the National Coordinators' consensus approval of the non-animal guidelines. ICAPO is officially recognized by the OECD as an "expert group" and thereby participates in key OECD meetings.

ICAPO had urged member countries to approve the non-animal guidelines at the National Coordinators meeting and to consider them as replacements—not supplements—to animal-based (*in vivo*) testing. "We were pleased to see these guidelines pass what many observers regard as their final technical hurdle before adoption by the OECD", said Dr. Martin Stephens, ICAPO secretary and vice president for animal research issues at The Humane Society of the United States. "Once adopted, they will become the international standards for these forms of testing."

For further information contact:

Gina Alvino
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New website for the NCA

The Netherlands Centre for Alternatives to Animal Use (NCA) website has a new URL.

The old URL (http://prex.las.vet.uu.nl/nca) has been changed to:

http://www.nca-nl.org

A new feature on the NCA site is the database search. This database comprises Three Rs research projects.

These projects were originally funded by the Dutch Platform on Alternatives to Animal Experiments. Currently, these projects are funded by the Programme Committee on Alternatives to Animal Experiments of the Dutch Health and Research Council (Dutch acronym: ZON).

ANZCCART Workshop: Monitoring animal welfare and promoting refinement

A very successful ANZCCART workshop, organized by Associate Professor Margaret Rose, was held at the Darlington Centre, University of Sydney, on 19 June 2002. It was anticipated that about 30 people would attend but the final count was near to 70. After a brief welcome by Professor Mike Rickard, Chairman of ANZCCART, five short presentations were made to highlight relevant issues and expectations from different perspectives. The presenters were Dr Mark Lawrie (RSPCA), Dr Mary Bate (University of Newcastle), Dr Malcolm France (University of Sydney), Dr Kevin Keay (Royal North Shore Hospital, Sydney) and Ms Amanda Paul (New South Wales Department of Agriculture). Then followed a general “brain storming” session where key issues were identified and grouped under major headings. Working groups were then assigned to deliberate on each major issue and, after lunch, spokespersons reported back to the general audience. Discussion then took place with the aim of identifying further actions and setting tasks and goals.

Whilst both the need for and the importance of monitoring the well-being of animals used for scientific purposes is not questioned, this occurs in a range of circumstances and conditions and the same approach will not suit every situation. The purpose of this workshop was to focus on issues which influence the various approaches to monitoring aniaml welfare in different circumstances with particualr reference to those who are primarily involved in these activities, i.e., researchers and animal care staff.

Judged by informal feedback from participants, the workshop format encouraged lively and useful discussions. It was pleasing to see the number of scientists who actively participated in the workshop. ANZCCART is now in the process of writing a report on the workshop and a discussion paper on the issues raised. It is likely that the workshop will be repeated in other major cities next year.

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