Un rapport d'André Ménache

September 2010

The replacement of non human primates in brain research

one voice

pour une éthique animale et planétaire

Sommaire

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FOREWORD

Is it possible to avoid primate experiments in brain research?

Here are the opinions of three scientists involved in the field of neurology.

Dr Aysha Akhtar, medical doctor and neuroscientist:

"Researchers can study human neurology in an ethical manner. Many clinical centers use imaging and neurophysiologic tools to map and monitor the human visual and other neurological systems. Centers such as Princeton University, the University of Chicago, the University of Pennsylvania, and Minnesota State University use functional MRIs, PET scans, and evoked potentials (which record the brain's electrical patterns) to collect relevant data on human neural processing and anatomy."(1)

Dr Marius Maxwell, neurosurgeon:

"The abuse of primates in medical research for Parkinson's disease lies at the very epicenter of the debate about the scientific relevance of vivisection to human health today... Because human research itself culminated in the technique of deep brain stimulation in Parkinson's disease, one can only conclude that primate vivisection has amounted to an expensive, savagely cruel, and scientifically invalid sideshow. It inhabits a parallel universe of biomedical curiosity if you will, drawing from but contributing nothing to bona fide human scientific discoveries in Parkinson's disease. All it has done is to reinvent the wheel of Parkinson's disease research over and over again." (2)

Professor Paul Furlong, neuroimaging specialist (at a presentation to the European Parliament in 2008):

"Current neuroimaging techniques such as Magnetoencephalography (MEG) and functional Magnetic Resonance Imaging (fMRI), offer significant opportunities to replace non-human primate experimentation in behavioural neuroscience." (3).

The author

Born in Belgium in 1954, André Menache obtained his degree in veterinary medicine in 1980 in South Africa. In 1999 he proposed an amendment to the Declaration of Helsinki to encourage the wider use of non animal methods. This proposal was subsequently accepted at the 52nd General Assembly of the World Medical Association and included in the Declaration. Dr Menache served as president of the UK organisation Doctors and Lawyers for Responsible Medicine, before joining Animal Aid as scientific consultant. He is currently director of Antidote Europe, based in France.

PREFACE

Are there limits to what society will accept in order to discover new knowledge?

The use of non human primates has presented society with a double-edged moral dilemma. Researchers who use animals are eager to point out that the evolutionary proximity between humans and non human primates is a good enough reason to experiment on them. However, other scientists, especially behaviourists, recognise the fact that these animals are so like us in terms of their capacity to suffer - physically as well as mentally - that we should afford them special protection.

The EU currently uses about 10,000 primates annually (4). The increased demand for primates has decimated their natural populations worldwide. The strategic response of the research community has been to establish breeding farms to try to meet the demand. Worldwide, it is estimated that around 100,000 primates are used in research each year. Most of the research is conducted in the US, Europe and Japan. Macaques, baboons and marmosets are mostly used, in addition to chimpanzees.

There can be no doubt that *all* primate species in the wild are either dwindling, or elseendangered to some degree, due to human activity. An IUCN report on the conservation status of primates showed that "almost 50 percent are in danger of going extinct according to the criteria of the IUCN List of Threatened Species" (5). The range of human activities that directly or indirectly threaten primate species worldwide include increased human habitation and urbanisation, deforestation, illegal poaching and trafficking, the consumption of bush meat and the killing of primates where they are considered to be "pests". When one considers - in addition - their capture in the wild for research and testing purposes, it becomes clear that their natural populations are now facing an existentialist threat.

After seeing video images such as those obtained by One Voice of caged infant primates in Cambodia

http://www.one-voice.fr/fr/article/des-bebes-arraches-leur-mere

We must surely ask ourselves the question: is this really necessary? In fact, 80% of European Union citizens are opposed to most experiments on primates (6). In addition, an official EU poll taken in 2005 showed 82% of citizens believe we have a duty "to protect the rights of animals whatever the cost". A resolution to end the use of primates, presented at the fifth World Congress on Alternatives and Animal Use in the Life Sciences (also in 2005) was signed by renowned primatologist Jane Goodall together with 57 individuals and organisations from 19 countries. This initiative was followed up by a parliamentary written declaration launched in 2007 calling for an end to the use of Great Apes (such as chimpanzees) and all wild-caught primates in experiments, and a phase-out of experiments on all primates. The declaration received the support of 433 MEPs, which constitutes a majority in the European Parliament (7). And yet the EC has so far failed to translate a clear consensus by society into law.

The revision of EU directive 86/609/EC on the "protection of animals for use for experimental and other scientific procedures" will in all likelihood be decided in 2010. However, the result for animals will probably pale in comparison to a recent legal victory in Switzerland that clearly illustrates the fact that civil society will not accept the promise of future medical progress using animals at any cost. Swiss law requires that the benefit to society must be weighed against the burden of suffering to animals before any animal experiment is approved; and in 2009, two neurological projects using

macaque monkeys were rejected by the high court in Zurich. Like so many other cognitive (learning) monkey studies taking place at other institutions in other countries, these projects did not have any direct benefit for human health. What saved these particular animals was the unique Swiss legal system and ethical review process. Since 1992, the amended Swiss constitution protects the "dignity of animals". In addition, the canton of Zurich makes provision for animal experiment licences to be challenged by an external advisory committee of experts.

The above discussion indicates that the moral dilemma associated with using non human primates in research could bring their use as laboratory tools to an end. Some animal researchers have openly expressed the moral conflict they face when experimenting on primates. On occasion, these researchers will acknowledge the very negative effects and symptoms of family separation, isolation and boredom, in addition to the pain and suffering inflicted on the animals during the course of the actual experiments. If, in addition to the ethical concerns raised above, it can be demonstrated that modern science has no need to conduct such studies on primates, the collective weight of these two arguments - the moral and the scientific - should be enough to convince animal researchers and society that we should stop experimenting on these animals. That is the aim of this report.

INTRODUCTION

There is no legal requirement for researchers to use animals when conducting fundamental research. In fact, many researchers in the field of neurology do not use animals at all. Society has left the decision in the hands of the individual scientist, to decide whether or not to use animals. This is different to the situation regarding pharmaceutical drug testing, where the law makes it very difficult to avoid animal experiments. In the case of fundamental research, animal researchers have enjoyed almost complete immunity from public accountability or scientific challenge. The vast majority of tax payers have no idea how their money is being spent by scientists conducting invasive brain experiments on monkeys. However, thanks to undercover investigations documenting the capture, breeding, transportation, incarceration and actual experiments that these animals are subjected to, we can no longer claim to be ignorant of what is taking place. In addition, as the following examples in this report will show, one must ask the question: how honest have animal researchers been about their work? Is it possible that they have exaggerated their claims in order to keep their grant money flowing and keep the public on their side?

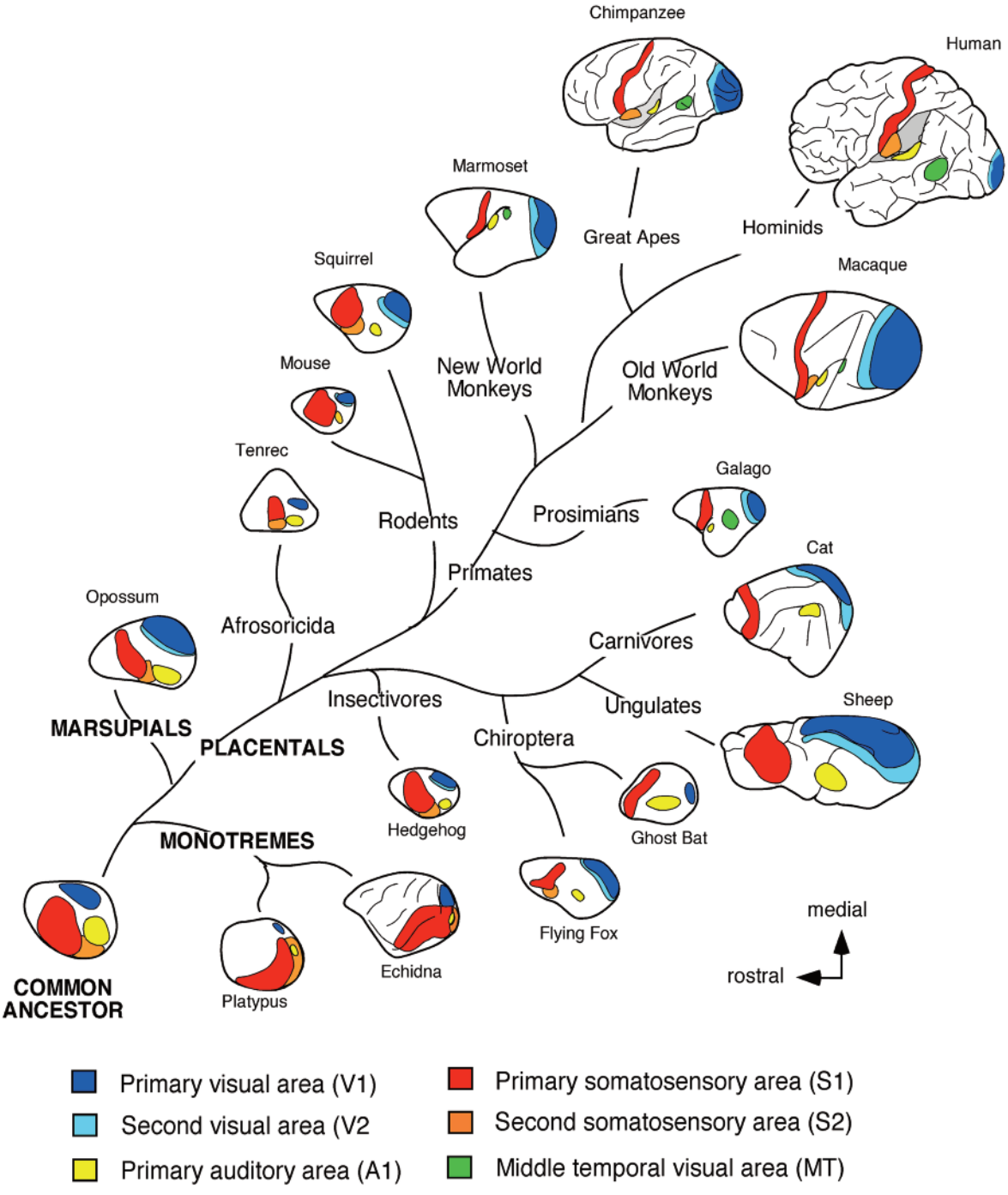
The brain is by far the most complex organ in the human body and contains 100 billion nerve cells (neurons). Much of the brain research conducted today is in the realm of *fundamental research*, generally defined as scientific investigation for its own sake, without regard as to whether or not the knowledge discovered will be of any practical use. However, in practice, there may be an "overlap" between basic and applied research, e.g. the study of brain function to find a treatment for a particular disease, such as Parkinson's disease.

Scientists applying for funding grants for fundamental research will often exploit this "overlap" as a means of increasing the likelihood of receiving a grant. Realistically, the chances of human benefit arising from such animal studies is exceedingly remote. The scientific evidence does not support the translation of fundamental research using animals into useful treatments for people. A survey of 25,000 articles searched produced about 500 (2%) containing some potential claim to future applicability in humans, of which about 100 (0.4%) resulted in a clinical trial and only one (0.004%) led to the development of a clinically useful class of drugs (for lowering blood pressure). As it turns out however, this useful discovery was not due to animal experiments, but rather the result of computer studies (8). ***There is no other comparable scientific discipline that tolerates such a high failure rate***.

The human brain versus the non human primate brain - structural and functional differences

What sets the human brain apart from that of any other living mammal is its sheer size, with the exception of mammals such as elephants, dolphins and whales. The most developed part of the human brain is the neocortex (the six layered portion of the cerebral cortex thought to be responsible for language, memory and complex thought). Although the brain size of sea mammals such as whales and dolphins is comparable (and even larger) in size to that of humans, their brains are uniquely designed for a marine environment, characterised by the development of a powerful sonar system for navigation and communication (9,10).

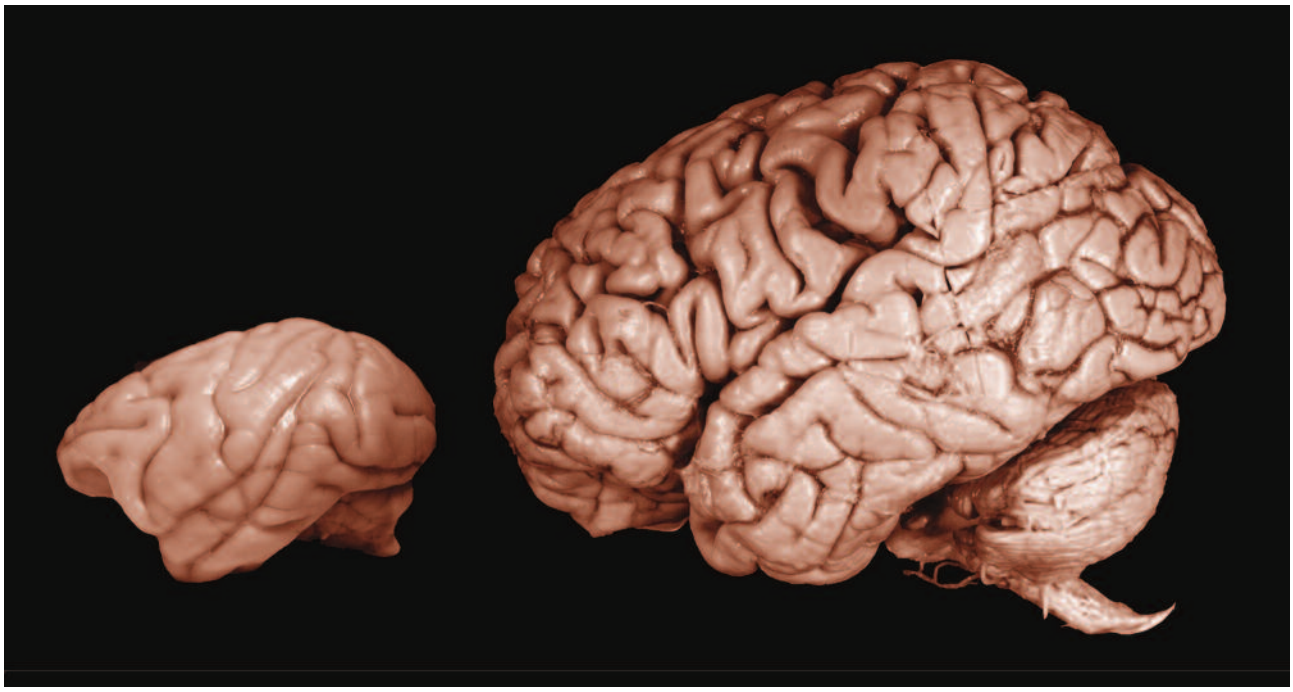
The non human primate is considered by some researchers to be the most appropriate model for the study of brain function. Among non human primates, the *rhesus macaque* monkey is the animal of choice for cognitive studies, while the smaller *marmoset* monkey is more often used in stroke research. The even smaller *mouse lemur* (*microcebus*) is currently being used in France to study Alzheimer's disease. While there may be similarities between the brains of human and non human primates, ***it is important to realise that the monkey brain is not a scaled down version of the human brain*** (11). Rather, each primate brain is the unique result of evolutionary biology, moulded over millions of years in response to environmental, social and genetic influences. In the case of the human brain one would include the effects of cultural evolution as well.



Evolution and specialisation of the brain in various primate species
Copyright Leah Krubitzer

The brain works much in the same way as an orchestra. The different types of brain cells (neurons) represent the various musicians and their instruments in the orchestra. Using non human primates to study the human brain is like using bongo drums to play Tchaikovsky.

In comparing the brain of humans and non human primates, it is important to consider apes and monkeys separately. In terms of evolutionary biology, the apes (chimpanzee, orang utan, gorilla and gibbon) are our closest living relatives. Among these, the chimpanzee is the animal closest to humans, separated from us by about five million years of evolution. The chimpanzee brain is about one quarter the size of the human brain and the macaque monkey brain is around one quarter the size of the chimpanzee brain. Humans have larger brain volumes (~1300 cm3) than other primates such as chimpanzees (~340cm3), gorillas (~380cm3) and rhesus macaques (~80cm3).



Cerveau de macaque (gauche) et cerveau humain. Copyright Dr Hadwen

There are numerous differences in the anatomy and physiology of the central nervous system between monkeys and humans, including differences in locations of specialized areas in the brain, and survival capabilities of neuronal cells. It is a well-known fact that the visual and other neurological systems of monkeys differs in considerable ways from that of humans, both in structure and function. For example, humans have visual processing areas that do not exist in monkeys, the Visual 1 area comprises 10% of the total monkey cortex, but only 3% in humans, and anatomically corresponding visual areas in monkeys and humans can perform very different functions. The human brain is far more complex in architecture and physiology than the monkey brain. One indication of this is the length of time it takes for the brain to develop in its major phase: 136 days for monkeys and 470 days for humans. The following is a referenced list of just a few of the other ways in which the monkey and human brain differ:

1. The human cortex has 10 times the surface area of that of a monkey. (12)

2. The number of synapses-or connections-a human neuron makes is between 7,000 and 10,000. In the rhesus monkey, that number is between 2,000 and 6,000. (12)

3. The expression of at least 91 genes involved in a variety of neural mechanisms differ between monkeys and humans. (12)

4. As a researcher on monkeys stated " There are "dramatic differences in the pattern of convolutions" in the brains between monkeys and humans" (12)

5. The visual areas differ in relative size between humans and monkeys. (12)

6. While there are some visual areas in the monkey that correlate to those in humans in regards to location, there are many that do not. (12)

Examples of experimental protocols on non human primates involving invasive procedures - ethical and welfare issues

Let us follow the fate of a monkey used in a laboratory experiment, to get an idea of what these animals endure.

The following excerpts from a recent statement by Nedim Buyukmihci, professor of veterinary medicine at the University of Davis, California, accurately sum up the fate of these animals before they even reach the laboratory (13).

"The capture of macaques from the wild unavoidably inflicts substantial suffering for the monkeys and is inherently cruel. Macaques are highly social animals whose sense of well-being and whose welfare are strongly and inextricably dependent on intact family and similar social structure. Removal of individuals from the social group results in fractured families and social bonds. This causes extreme stress and distress for those taken as well as those left behind, the effects of which last indefinitely. It is not being anthropomorphic to state that the situation would be similar, in principle and in much of its effects, to similarly disrupting human families and social groups. In addition, it is common for monkeys to be injured or killed during trapping. It has been my experience that people doing the trapping demonstrate little to no regard for the monkeys who are viewed either as unwanted "pests" or simply a source of income."

Dr Buyukmihci continues: "The normal relationship between mother and infant is several years with respect to providing normal development. Removal prior to this time constitutes maternal, as well as social, deprivation." This would mean that monkeys used in brain research are developmentally challenged to begin with.

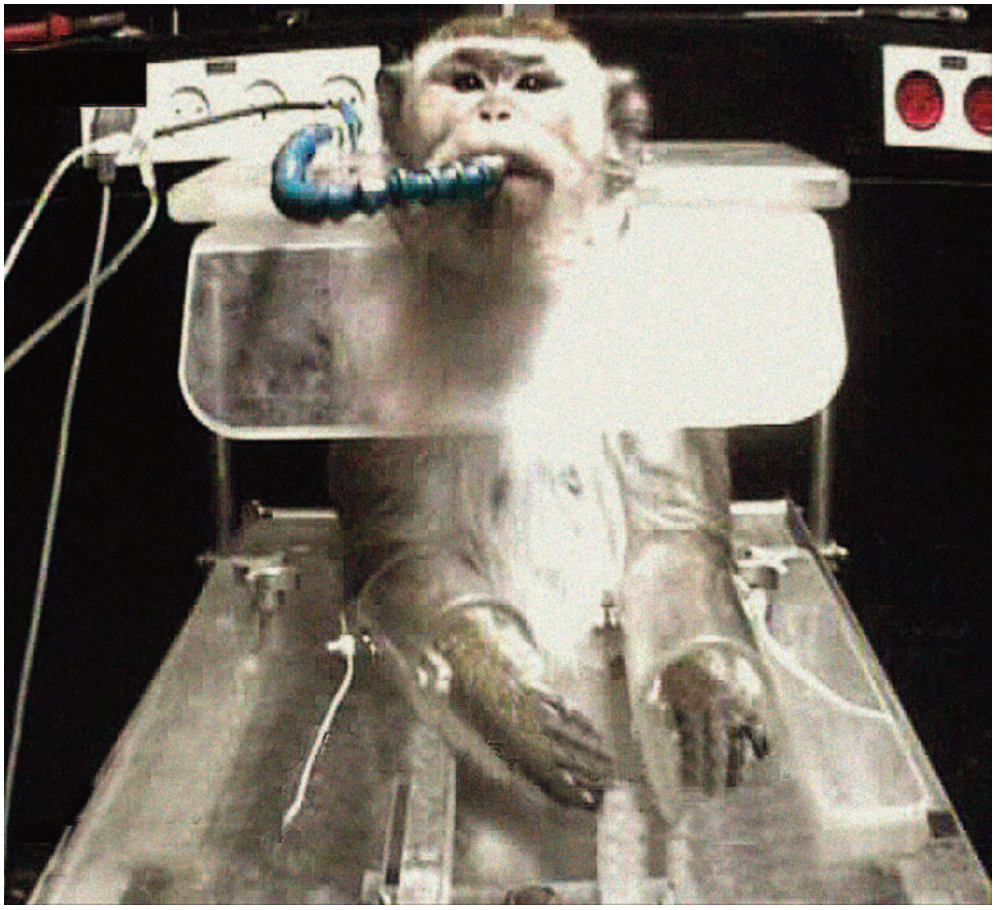
The next stage in the monkey's ordeal will be transport from the holding or breeding facility, to the actual laboratory. Long distance transportation involves being packed singly in crates, before being shipped to countries half way around the globe. It is not uncommon for travel times to last up to 58 hours (14) and for some of the animals to die before, during, or after transportation to their destination. Those that do survive this ordeal and reach the laboratory, or are actually bred in the country in which they will be used, then face an existence of incarceration in small steel cages, devoid of the environmental enrichment and rich social interaction for which they have evolved.

Macaques are extremely intelligent primates that naturally live in complex societies and form strong social bonds. Thus, it should be no great surprise that, in the isolated and unstimulating environment of the laboratory, macaques show signs of severe distress. Many macaques kept in standard laboratory cages exhibit stereotypical behaviour (15). These can include more 'moderate' activities such as rocking, head-twisting and pacing back and forth, to more extreme behaviours, including self-biting, eye-poking, body-throwing and head-banging.

A neurological study can last up to several years from start to finish. The researchers may require one to two years in order to train the monkeys to perform complex tasks, such as repeated pressing of a lever in a correct time sequence in response to a light stimulus. A typical training session will begin by the forceful removal of the monkey from a cage. This will require some form of physical restraint such as a collar and pole. The monkey will then be transferred to a primate chair, in which its body movements will be severely restricted. The monkey may spend up to eight hours a day in a primate chair (see photo). During the training session, the monkey will usually receive a "reward" of a few drops of water for every correct response. Since this method is only effective if the monkey is thirsty the researchers deliberately restrict the amount of fluids that the monkey receives in order to ensure "compliance" with the training regimen.

Once the initial training period has been completed, the monkey will undergo invasive brain surgery, either to selectively damage one or more parts of the brain, or to insert recording instruments, such as electrodes, into the brain. After the monkey has recovered from the surgery, the actual study will commence. The monkeys will once again spend many hours in a primate chair over a period of weeks or months, while the researchers collect their data. In cases where the monkey's brain has been deliberately damaged, the researchers will observe what effect this has on the monkey's performance during the recording sessions (compared to the performance before the brain damage). Once again, water restriction and "reward" will be applied to ensure that the monkey complies with the researchers' wishes.

Primate chair



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Once the entire study has been completed, the monkey is killed and the brain studied. It is not uncommon for researchers to conduct very similar experiments over periods of 10, 20 and even 30 years, with minor variations, and with no clinical application in sight.

The proof of this is quite simple. All one needs to do is choose the name of a researcher (in the published scientific literature, e.g. Pubmed) who conducts research on monkeys and then search for the same name 10, 20 or 30 years in the past (16,17).

Many of the procedures described above, if performed on domestic pet animals, would constitute animal cruelty in the eyes of the law. And yet this type of experiment is allowed to continue essentially unhindered - until now. The recent legal victory in Switzerland against two research proposals marks a change in the attitude of society to invasive primate experiments where there is no clear benefit to human medical progress. The Swiss ethical system should be seen by the rest of the world as a flagship in this respect and a wonderful example to follow. The decision not to allow the monkey experiments was based on Switzerland's unique amendment in 1992 to its constitution, recognising the "dignity of animals". In addition, there is provision in the ethical review system for an external panel of experts, whose task it is to weigh up the cost of suffering to the animals, versus the perceived benefit to society. Once again, Switzerland is unique in this respect, of having an independent ethical review conducted by suitably qualified individuals who are not affiliated to the institution where the animal studies are conducted.

How is society to judge whether these animal experiments are genuinely 'ethically justified'? We are told that any research proposal involving living animals is first subject to approval by a local ethical review committee. The review panel consists largely of scientists employed by the institution where the animal research will be conducted. There may, or may not, be lay persons on these panels. However, assuming that a lay person or animal welfare representative is present, that individual will be hard pressed to challenge the aims of a complex animal study, much less suggest a non-animal replacement. Furthermore, a lone lay person will be out voted by the rest of the panel.

Article 7.2 of EU Directive 86/609/EC (which deals with animal experimentation in the EU) states that: "An animal experiment shall not be performed if another scientifically satisfactory method of obtaining the result sought, not entailing the use of an animal, is reasonably and practically available."

But how will members of the general public know whether a non-animal method exists? The only objective way to find out is to challenge the project licence holder with a suitably qualified scientist in the same field of research, who does not use animals. This idea sounds logical and fairly straightforward to most people. However, a non-animal scientist would be forbidden by most institutions, from speaking openly against an animal researcher. The few scientists who have been courageous enough to challenge the system have found themselves ostracised by their peers and subjected to 'institutional intimidation' at their places of work.

According to university scientist Jarrod Bailey, "*Institutional intimidation aimed at critics of animal research is widespread, and undoubtedly acts as a formidable obstacle to transparency and accountability when challenging the value of animal experiments, inhibiting the cherished concept of academic freedom*" (18).

Examples of current NHP models for the study of human conditions

Stroke

Stroke (also referred to as a « brain attack ») is the sudden loss of brain function due to disturbance in the blood supply to the brain. Seventy five per cent of strokes are caused by a blockage of an artery supplying blood to the brain, while 25% are caused by a rupture of the blood vessel. Early and correct diagnosis are therefore essential. Stroke research in animals is a sad example of a spectacular failure to translate findings in animals to people. In this case, the rat has probably suffered at the hands of animal researchers more than any other species. For example, genetically modified rats have been used to study hypertension and stroke for more than 20 years. What has all of this research achieved? "No promising clinical result in sight" according to a leading group of scientists (19).

The primate of choice for the study of stroke in humans is the marmoset monkey. The symptoms of stroke are artificially induced by tying or blocking one of the major arteries supplying the brain in an otherwise perfectly healthy animal. Animal studies have contributed little or nothing to our understanding and treatment of stroke in humans. This is perhaps not surprising given that animal and human brains are so different anatomically and functionally. For example, human brains have a folded cerebral cortex (a gyrencephalic brain) whereas smaller primates, such as the marmoset, have a smooth cerebral cortex (a lissencephalic brain).

None of this appears to deter researchers from pursuing studies in primates in a repetitive fashion. Considering that the marmoset has already been used unproductively for decades, it is disturbing to see researchers still trying to justify their use in 2010 with statements such as: "The profile of brain damage and functional deficits seen in the marmoset suggests that this model could be suitable to test therapies against stroke" (20).

At the same time, we see other scientists offering a more realistic and honest commentary of experimental treatments for stroke that appear to work in animals, but not in people: "Efficacy in young, healthy, male animals is a poor predictor of clinical outcome" (21).

Out of a total of 912 treatments that apparently worked in animals, 114 were evaluated in humans and all were found to be ineffective. This example illustrates one of the major weaknesses in animal research - confusing hindsight with prediction. If one tests enough treatments in a sufficiently large number of animal species, one will eventually - by sheer luck - find a treatment that works both in animals and in humans. But this is not a scientific method. Many researchers confuse "hindsight" (i.e. retrospective comparison of a human outcome) with "prediction" (22).

Ultimately, the most important factors affecting the outcome of human stroke victims are the time lapse between onset of stroke and admission to emergency medical facilities, and the time taken to identify the type of stroke, to determine what course of action must be taken. This vital information is already well established on the basis of human clinical findings and is unrelated to animal research (23).

Parkinson's disease

Parkinson's disease is a degenerative disorder of the central nervous system that affects movement, speech and other functions. It is characterised by muscle tremors and a progressive slowing of physical movement as a result of insufficient brain chemical called dopamine. Among the environmental causes of this disease is exposure to pesticides. Although no cure exists at present the use of L-DOPA is the treatment of choice. However, as the usefulness of this treatment decreases over time, other treatments may be employed, such as deep brain stimulation.

According to neurosurgeon Marius Maxwell, "*The "official" and highly selective primate vivisection-based narrative of deep brain stimulation misleadingly begins with the serendipitous discovery of symptoms of parkinsonism in young drug addicts exposed to the narcotic contaminant MPTP (1-methyl-4-phenyl-1,2,3,6-tetrahydropyridine). This gave researchers the idea of seeing whether monkeys would also display Parkinsonian symptoms in response to this toxin and indeed, in 1983 monkeys poisoned with MPTP were found to exhibit similar, albeit temporary, symptoms and the non-human primate model of parkinsonism was born (Burns et al. 1983).*

All well and good, it seems. The general public is served a compelling tale of successful medical research borne on the back of primate misery and has come to believe that human sufferers of the ravages of Parkinson's disease have been treated thanks to cutting-edge research performed on our close primate cousins.

But what will they say when they find out that the importance of the subthalamic nucleus to the treatment of Parkinson's disease had in fact been known more than 30 years before by neurosurgeons who employed this knowledge to successfully treat hundreds of human patients? How will they react when they discover that deep brain stimulation has been used since the 1940s, and that early implanted stimulators were used in human patients with Parkinson's and other movement disorders years before the first ever description of the MPTP-primate model?

This discovery and use of deep brain stimulation therefore predates the very first description of the MPTP-primate model of Parkinson's disease by nearly 40 years! As we shall see, deep brain stimulation would not realise its full potential until 1980 when a fully implantable and reversible stimulator system for movement disorders was developed, this still a full three years before the Parkinson's disease MPTP-primate model was even first described." (24).

We live today in an era of evidence based medicine. Many medical treatments developed through animal experiments and considered to be "standard therapy" have subsequently been discontinued following careful comparison of treatment outcomes between large numbers of treated and untreated patients. The same is true for deep brain stimulation (which is not without its risks and complications). There is very little reliable evidence available as to the efficacy of deep brain stimulation. Few randomised trials have addressed this question, which is why the University Of Birmingham (UK) has undertaken the first large randomised trials to study the overall outcome of surgery for Parkinson's Disease. It is important to note that this study will involve only human patients and not animals. The results of this study will be published once they have been fully analysed (25).

Alzheimer's disease

Alzheimer's disease is the result of a progressive loss of brain tissue leading to reduced mental activity such as memory. As with stroke, the use of animals in the study of this disease represents another spectacular failure of the animal model, together with a huge investment of public money in the wrong direction. Some researchers have selected the mouse lemur (microcebus) as a suitable primate model for the study of ageing in the human brain and for the study of Alzheimer's disease. This concept has been vigorously challenged by scientist Kellie Heckman, who considers the use of mouse lemurs as scientifically questionable based on the following (26):

- these captive animals are usually inbred (cosanguineous). Therefore any signs of ageing could simply be the result of a lack of genetic diversity
- there is no evidence that genes homologous with those known to be associated with Alzheimer's disease in humans, actually exist in the mouse lemur
- another concern with this animal model is the premature ageing of lemurs as a result of an unnatural light cycle
- in addition, the stress of the laboratory environment could lead to abnormal brain development as has been documented in other primates species housed under similar laboratory conditions

Although the exact causes of Alzheimer's are still poorly understood, it appears likely that genetic and environmental factors play a significant role. It therefore makes sense that the actual causes of this condition will be found by studying people. Similarly, it is through human studies that we will find ways to prevent and treat this condition. Such studies are already well underway. For example, a retrospective epidemiological study in France in which 3000 people were observed over a period of 14 years revealed early warning signs 12 years before the condition was actually diagnosed. A larger study involving 10 000 individuals in three French villages is currently in progress (27).

Photo of microcebus

Autism

Autism is a disorder of neural development characterized by impaired social interaction and communication, and by restricted and repetitive behavior.As with Parkinson's and Alzheimer's disease, autism does not occur in animals. One must therefore question the validity of the monkey experiments conducted using animals. Autism is a complex and not well understood spectrum of symptoms that occurs in young children. It is therefore misleading to raise hopes of treating autism in children on the basis of monkey experiments (28).

Cognitive neuroscience

Cognitive neuroscience is the study of complex mental functions such as perception, memory, language and emotion and their implemention within the brain. A key factor in the development of this new discipline has been technological advances in methods for non-invasive brain imaging which allow scientists to study the relationship between brain activity and cognitive mechanisms in awake, behaving, human subjects (29).

In addition, this umbrella concept in neurological research has provided animal researchers with a sea of infinite possibilities to study primates. Examples range from the almost non invasive observation and recording of eye movements, to very invasive brain damaging experiments, where the animal is reduced almost to a vegetative state.

The justification for using primates is that the brains of non primates (rats, cats, dogs) are not sufficiently similar to ours. The other main reason put forward is the need to understand the *mechanism* by which the brain works. This position can be summed up by a statement made by an animal researcher: "***It is inconceivable that humans should understand their place in the universe and their world, but not the way in which their own brains achieve this understanding***" (30).

With reference to the above quotation one cannot ignore the influence of the mechanistic world view of French philosopher, Rene Descartes, who first proposed the concept of the "animal-machine", devoid of a conscience and incapable of independent thought. According to Descartes science should one day be able to create a machine that is indistinguishable from an animal (31).


Photo of chimp

This Cartesian view of animals contrasts sharply with a video footage of the death of Pansy, who at the age of about fifty years, was the oldest chimpanzee in the UK. The film captures for the first time the complex reactions of our nearest evolutionary cousins to the death of a group member. In the final hour, they huddled around, studied her face and shook her gently as if to revive her. And when the others had drifted away, one stayed behind to hold her hand (32).

Non invasive imaging techniques

Modern day brain imaging allows researchers to observe the human brain almost in "real time" as well as being able to see the interactions between different areas of the brain. As stated earlier, the brain works much like an orchestra and not as a single musical instrument. Animal studies contain several in-built limitations. The study of minute areas of the brain in monkeys, including the study of a single nerve cell is not an accurate representation of the interactive way in which the human brain functions. Although this may be interesting from an academic perspective, it has very little application in the real world since nerve cells work in conjunction with each other at the level of groups (clusters), columns or networks of cells and not on the level of the individual cell.

Animal researchers themselves have stated that they will never achieve the level of detail for the human brain that they have for the macaque brain, since this would require invasive procedures in humans that would not be acceptable. The logical conclusion is that we should learn what we can about human brain function with all of the amazing technologies already available to us today, taking all due care not to harm patients. Here are some examples of such technologies:

Positron emission tomography (PET) is a nuclear medicine imaging technique which produces a three-dimensional image or picture of functional processes in the body. The system detects pairs of gamma rays emitted indirectly by a positron-emitting radionuclide (tracer), which is introduced into the body on a biologically active molecule. Images of tracer concentration in 3-dimensional or 4-dimensional space (the 4th dimension being time) within the body are then reconstructed by computer analysis. In modern scanners, this reconstruction is often accomplished with the aid of a CT X-ray scan performed on the patient during the same session, in the same machine (33).

Magnetic resonance imaging (MRI), or nuclear magnetic resonance imaging (NMRI), is primarily a noninvasive medical imaging technique used in radiology to visualize detailed internal structure and limited function of the body. MRI provides much greater contrast between the different soft tissues of the body than computed tomography (CT) does, making it especially useful in neurological (brain), musculoskeletal, cardiovascular, and oncological (cancer) imaging (34).

Electroencephalography (EEG) is the recording of electrical activity along the scalp produced by the firing of neurons within the brain. In clinical contexts, EEG refers to the recording of the brain's spontaneous electrical activity over a short period of time, usually 20-40 minutes, as recorded from multiple electrodes placed on the scalp (35).

Magnetoencephalography (MEG) is a technique for mapping brain activity by recording magnetic fields produced by electrical currents occurring naturally in the brain, using arrays of SQUIDs (superconducting quantum interference devices). Applications of MEG include localizing regions affected by pathology before surgical removal, determining the function of various parts of the brain, and neurofeedback (36).

Transcranial magnetic stimulation (TMS) is a noninvasive method to cause depolarization in the neurons of the brain. TMS uses electromagnetic induction to induce weak electric currents using a rapidly changing magnetic field; this can cause activity in specific or general parts of the brain with minimal discomfort, allowing the functioning and interconnections of the brain to be studied. A

Imagerie MEG non invasive.

variant of TMS, repetitive transcranial magnetic stimulation has been tested as a treatment tool for various neurological conditions such as migraines, strokes, Parkinson's disease, dystonia, tinnitus, depression and auditory hallucinations (37).

Political initiatives to ban NHP research

It is no secret that politicians respond to public pressure. The question is whether we can exert sufficient pressure to overcome that of industry and animal researchers. There is no doubt that medical progress can be made without using animals. The solution lies in the use of intelligent testing strategies (such as non invasive imaging techniques) based on human subjects and human data. Animals have no-one on whom to rely except those of us who care about them. It is therefore an informed public and public opinion that has the potential to make a change for the better.

The vote that took place on 5th May 2009 at the European Parliament was a clear example of MEPs buckling under massive pressure exerted by the pro-vivisectionist lobby. A Commission proposal for all animal experiments to require prior authorisation was overturned. Instead MEPs backed measures that will require prior authorisation only for "moderate" and "severe" and experiments on primates. This leaves an estimated 4.3 million experiments on animals that will not require scrutiny before being authorised, thus approaching half of the experiments in the EU that do not require examination to assess whether a non-animal method might be available (38).

In reality, the dice are weighted heavily against the animals in Brussels. Consider the following two events.

• In February 2009, at a meeting of the EU parliament's Environment Committee, a controversial opinion was voted in, at the expense of animal welfare and wild-life conservation. This led the rapporteur for the ENVI (Environment) Committee opinion, Slovenian MEP, Mojca Drcar Murko, to demand that her name be removed in protest, at what she stated, was ***intense misleading lobbying by the animal research industry to water down the European Commission's proposals***. (39).

• According to the European Commission's *Scientific Committee on Health and Environmental Risks* (SCHER), primates are needed chiefly in the safety testing of pharmaceutical products, research on infectious diseases, studies of the human brain, and research on organ transplants (40).

But just how independent is the expert opinion of this committee? Having personally attended one such meeting in November 2008 in Bruxelles, my colleagues and I were astounded that ***not a single non animal researcher*** had been invited to give oral testimony to the SCHER.

Legal initiatives

Sometimes the best way to correct an injustice is through the courts of law.

There are several examples where primate experiments have been legally challenged, notably in Switzerland and Germany. In September 2009, the Swiss supreme court refused researchers permission to experiment on rhesus macaque monkeys, on the grounds that the likely suffering to which the animals would be exposed was out of all proportion to the rather vague expected outcome of the study, thus setting a very important legal precedent.

This success story has been a long time coming and illustrates the point that persistence pays off. The EU directive that regulates animal experiments (Directive 86/609/EC) will normally not allow an animal experiment to take place if the data being sought can be obtained by methods not involving the use of animals. It is time to vigorously pursue this legal avenue.

In Belgium, the Coalition Against Animal Experiments (ADC) launched a legal challenge in September 2009 against animal researchers at the Catholic University of Louvain. The case involved invasive primate experiments similar to the ones conducted in Switzerland. As a veterinary surgeon, I submitted written testimony in evidence to the Belgian courts on the basis of article 7.2 of directive 86/609/EC.

Conclusion and public strategy

Let us be quite clear. Our aim is not to transfer animal experiments that would normally not be tolerated or permitted in the EU to other countries (such as China). Animal research is simply bad science and represents a failed technology, irrespective of whatever country it takes place in. Primate experiments do not stand up to scientific scrutiny as has been discussed above. The animal research community is fully aware of this and keeps the public in the dark about the true nature of the debate by relying on very superficial slogans, such as “scientists versus terrorists” or “it’s your dog or your child”. The last thing they want is a serious scientific debate because they know they will lose. The scientific case against primate experiments has already been won. It is now a political battle, to transpose positive public opinion into law. The only reason primate experiments continue at all is because of the enormous influence of the vivisection industry.

Jarrod Bailey PhD: “Those of us who oppose animal experimentation are getting closer each day to achieving our aim, and realising an end to it. Though we still face many battles against self-interest, corporate power, the status quo and simple human inertia and resistance to change, the truth about vivisection is irresistible. More people than ever are learning the reality of life for animals in labs; the cruelty involved in their incarceration, in depriving them of the ability to follow their natural behaviours and instincts, and in the procedures they are subjected to. People now know about the scientific failings of vivisection and the enormous human harm that has come from it - failures in virtually every field of medicine including cancer, AIDS, heart disease, Alzheimer’s and Parkinson’s diseases, among many others” (41).

“There is not a crime, there is not a dodge, there is not a trick, there is not a swindle, there is not a vice which does not live by secrecy. Get these things out in the open, describe them, attack them, ridicule them in the press, and sooner or later public opinion will sweep them away. Publicity may not be the only thing that is needed, but it is the one thing without which all other agencies will fail”

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