Why research using animals is important in psychology

Stacey A. Bedwell argues the case

The use of animal models in psychology research that is not of a neurobiological nature is quite rare in UK laboratories. This may lead many psychologists to consider the use of animals in scientific research as irrelevant to them. With the continued advancement of technologies and non-invasive methodologies, many ask whether experiments involving animals still have a place in psychology and neuroscience research. It is easy to overlook the basic biological investigations that many areas of psychology are built on, and will rely on in the future to continue to develop. I hope to address this issue, offering an explanation as to why animal models are important to contemporary psychology research.

Animals in scientific research

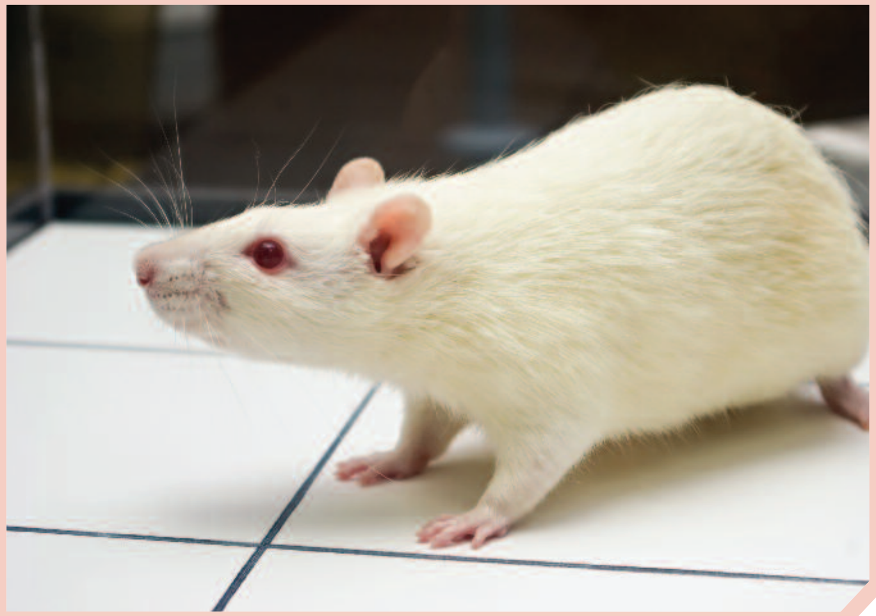
Historically, animals have played a vital role in scientific research. Much of what is known about the anatomy and physiology of humans, as well as other animals, has come from animal research in various forms. Many of the major researchers in sensation and perception – Hubel, Wiesel, Lettvin, Jacobs, Newsome, Sperry, Bekesy, DeValois, Melzack, and more – used animal subjects in their groundbreaking research.

Animal studies have provided valuable contributions to the development of great medical advances, including general anaesthetics, asthma inhalers, vaccinations against TB, HPV and malaria, and insulin. Nearly half a million people in the UK with Type I diabetes rely on insulin, developed by Macleod and Banting in 1921 through research on rabbits and dogs (see Bliss, 1983), to maintain a quality of life that would otherwise not be possible. Smallpox has been eradicated from the earth thanks to knowledge gained from studies on animals. Advances in surgeries and treatments such as kidney dialysis and heart transplant were also perfected with the use of animals. Cancer survival rates are also continuing to improve due to research using animal models. For instance, Herceptin was developed in mouse models and has greatly improved the survival rate in breast cancer. The development of anti-retroviral drugs using animal models has had a great impact on the lives of those diagnosed with AIDS – it is no longer the death sentence it once was.

It is clear that some medical discoveries have been possible without the use of animals: for instance, Fleming discovered penicillin without animal experiments. However, it was his work with Florey and Chain with mouse models that enabled the application of penicillin to fight bacterial infection.

Animals in neuroscience and neuropsychology

In neuroscience, our current knowledge of homeostasis, intrinsic and extrinsic reward, primary and secondary reinforcement and the effects of reinforcement on persistence all derive significantly from animal research. A large body of our present understanding of the physiological and neurophysiological bases of hunger, thirst and sexual motivation has been developed through experiments involving the use of animals. Without these experiments and their findings, our understanding of large areas of neuroscience may be much less. However, what is often unclear is whether the same level of knowledge could have been reached from different, non-invasive methodologies, perhaps without the use of animals at all.



Our current understanding of the neurological and psychological effects of stimulants, glucose and the enzyme calpain on memory (Coon, 1992; Kalat, 1993; Wortman & Loftus, 1992), the occurrence of retrograde amnesia (Baron, 1992) and the role of calcium channels in neurological function (Wortman & Loftus, 1992) stems from research carried out on animals. This is in addition to a large body of animal research carried out to increase our knowledge and understanding of various brain regions and networks. For instance, the complex anatomical organisation of the prefrontal cortex (Bedwell et al., 2014, 2015) and the topographic ordering of cortical and subcortical connections (Berendse et al., 1992; Hoover & Vertes, 2011; Kondo & Witter, 2014) could not have been observed in such detail without the use of neuroanatomical tract tracing in animals. It is currently the best available method for gaining meaningful and detailed data about anatomical organisation of cortical networks. Due to its invasive nature, this kind of work must be carried out on animals. Animal studies have therefore greatly increased our understanding of the basic principles of brain structure and function. Without this knowledge our ability to further develop neurological models and psychological theories of brain function would be impaired.

My recent area of research relies heavily on the use of animals (see box). Therefore, from a personal perspective, I can appreciate that animal models still hold an important place in neuroscience research. I also believe that the anatomical knowledge gained from these studies will form the basis for improved understanding of the prefrontal cortex from a psychological perspective, making animal models important for advancements in psychology as well.

Animals in behavioural and social experiments

Research into psychological development has relied greatly upon the use of animals, particularly primates. A well-known example is Harlow's work on emotional development and maternal deprivation in rhesus monkeys (Harlow et al., 1965; Harlow & Suomi, 1971). To carry out these experiments using human babies would have been highly unethical and impractical. Without these experiments, work that followed in the field of development may have differed; however, it is not clear whether such observational research truly benefited from being carried out on primates.

Beyond social psychology, animal studies have been of great importance in the increased understanding and development of treatments for neurological and psychological disorders. Behavioural therapies are derived from animal research. For instance, aversion therapy, desensitisation and extinction therapies, token economies and systematic reinforcement were all developed from studying animal behaviours and the pioneering work of animal researchers like Pavlov, Skinner and Thorndike. Biological interventions such as psychosurgery, antipsychotics and antidepressants would not have been developed without the use of animal models and experiments using animals. These interventions now improve the quality of life of thousands of patients who would otherwise have faced institutionalisation. It is important to note that the safe use of drugs, across medical science, not just in psychology, relies heavily

Meet the author

'I came into research with rodents through my PhD in neuroscience. Prior to this I had always had an awareness and interest in the ethical treatment of animals. I had spent time during my gap year working with rescued and orphaned primates. I think my care for animals made me a good candidate to work with animals in the lab. I was confident that the project I was undertaking would be beneficial to the field and that the use of animals was a necessary component of the project to meet the desired aims.

My experience of working in an animal lab was positive. Everyone I know working on animal experiments is well trained and the animals are very well cared for. I never experienced an animal suffering either as part of an experiment or while being kept in the facility.

When starting out in the project I was faced with many accounts of scientists in animal testing who faced problems with antivivisection activists. Although I have encountered people who disagree with the use of animals in scientific research, I have taken the opportunity to explain the reasons behind my research and why I think using animals in my studies was beneficial. I have also used the opportunity to dispel common myths about animal labs.

I was always confident in the value of the work I was carrying out and the high standards of animal care in my studies. I am proud of what I achieved from these animal experiments and am keen to explain its importance in the grand scheme of understanding the human brain.'

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upon research carried out on animal models.

How transferrable to humans is data from animal studies?

As with every experimental methodology, there are disadvantages to using animals in experiments. A common argument against the use of animals in experiments is that animals are not good models for humans, based on the observation that we are not simply larger versions of lab rats – our bodies (and minds) work differently. Interestingly, biology shows that rodents are actually rather good models of the human body.

All mammals, including humans, are descended from common ancestors, and all have the same set of organs (heart, kidneys, lungs, etc.) that function in essentially the same way with the help of a bloodstream and central nervous system. Some controversy, however, comes with the study of the mammalian brain in psychology and neuroscience. This is one organ that does differ in some aspects, particularly in terms of cortical volume, quite substantially between species. Despite this, there are many common characteristics between all mammalian brains (e.g. basic cytoarchitecture and structure and neuronal physiology).

The application of findings from animal studies to humans is often a concern in psychology, especially in studies involving complex regions or behaviours thought to be far more advanced in humans, making us unique. If humans are so much more advanced than other animals, especially in abilities such as executive function, then it is understandable why many would question the point of psychology experiments on much less advanced animals like rodents. An animal model is never going to be 100 per cent representative of human anatomy, physiology, cognition or behaviour. However, mice and rats (which share 95 per cent of our genes) are very close models and actually excellent representations of most human characteristics and attributes. For instance, with transplanted human tissue, mouse models can be regarded as possessing a human immune system (Melkus et al., 2006; Shultz, et al., 2012).

My research using animal models has been on the anatomical connectivity of the prefrontal cortex. The prefrontal cortex is a specific region thought to be much more developed in humans compared with other animals, so it is understandable that the usefulness of animal models in experiments involving the prefrontal cortex is sometimes questioned. The presence of prefrontal cortex (PFC) has been recognised in a range of species; however, there remains some controversy in the literature with regard to the presence of PFC in non-primates (e.g. rodents). Brodmann's (1909) representation of prefrontal cortex in monkeys greatly resembles that of the human (although some homologies are unclear). There is a consistent opinion that the architecture of human prefrontal cortex is largely similar to that of other primates (Petrides & Pandya, 1994; Semendeferi et al., 1998). Rose and Woolsey (1948) described orbital prefrontal cortical regions in rats, cats and rabbits based on the connections identified and their similarity to the orbital medial prefrontal cortex described in primates. More recent studies confirmed similarities in both OMPFC and dorsolateral prefrontal cortex between primates and rats (Goldman-Rakic, 1988; Uylings & Van Eden, 1990). There are also thought to be functional similarities between specific prefrontal regions across species, for example dmPFC in rats is thought to represent similar functions to prefrontal cortex regions in primates (Groenewegen & Uylings, 2000; Uylings et al., 2003). It is clear that rats possess much of the prefrontal cortex properties found in primates and humans. However, there is no dispute that rats lack the granular prefrontal cortex found in primates, thought to be a product of evolution. Despite this, neuroscientists have claimed, based on similarities in the effects of lesions and on anatomical and physiological similarities, that the medial aspect of frontal cortex in rats is homologous to the granular lateral PFC in primates (Kolb, 2007; Seamans et al., 2008).

Based on the above evidence, it is reasonable to conclude that although the human brain, even in the highly complex prefrontal cortex, is more complex than those of any laboratory animal model in many ways, there are a substantial number of homologies between species. These homologies not only make mammalian models relevant to humans, they also make the development of increasingly complex models possible, creating the possibility of understanding complex cognitive processes.

Advantages and alternatives

A living organism is a far more accurate way of, for example, testing the effect of a drug or therapy than any other currently available method. There are alternatives in some cases, for example human neuronal cells can be cultured. However, the complexity of a living animal and all of its interconnected systems cannot be fully emulated in culture.

An obvious example is behaviour. Behavioural observation of animals is crucial in determining the effects of lesions, other neuronal damage or the behavioural effects of drugs. Observing behaviour is especially important when investigating the effects of possible pharmacological treatments for disorders including depression, schizophrenia and psychosis. For a start, the behavioural symptoms cannot be simulated in cell cultures, only in living organisms. The case is the same with behavioural effects: it would be impossible to observe the effects of a treatment (pharmacological, cognitive or behavioural) without an animal or human to observe them in.

There are many areas of psychology and neuroscience in which human participants are readily used and where human studies provide a vast amount of useful and informative findings. Human participants are used for the majority of the time in social psychology and observations of childhood development (Freud, 1951) and social learning (Bandura, 1971). Research in clinical psychology also uses human participants from clinical populations for the most part. However, animal models are implanted when investigating biological underpinnings of clinical disorders and developing pharmacological treatments, where human participation is not possible.

In neuropsychology non-invasive fMRI, EEG and TMS methodologies enable researchers to investigate functional organisation, localisation of function and cortical activity in great detail. However, it is worth noting that human imaging does not provide enough fine-scale detail in some instances, such as identifying the anatomical structure of specific pathways, which requires neuroanatomical tracing and microscopic analysis of histological samples (Bedwell et al., 2014, 2015). Many studies of neuroanatomy, neurophysiology, and neurotransmitter function require the use of invasive techniques that are unethical to carry out with humans, making animal models a necessity in this field.

Reductions in neuroscience funding in recent years from research councils as well as the closure of pharma-funded neuroscience institutes in the UK may give the impression that research into neurological deficits, psychological disorders, pharmacological treatment and the underlying basic neuroscience is no longer a priority. This inevitability leads to an opinion that the use of animal models in brain research, be it behavioural, physiological or anatomical, should also not be a priority or a necessity. Despite the reduction in available funding, the fact remains that we still have a long way to go in understanding the human brain, from biological, behavioural, clinical and social perspectives alike. Further research across all aspects of brain science is necessary. In my opinion, animal models continue to provide an important contribution to many areas of brain science. It is evident that the use of animals does not play an important, or arguably even relevant, role in most aspects of contemporary human social, behavioural or cognitive psychology. However, animal models are an important aspect of biological research, including anatomy, physiology, behavioural and cognitive neuroscience. The brain is a complex organ comprising a combination of multiple systems and processes. Without the knowledge gained from work with animals in neuroscience labs on the underlying structure of complex functions, we can never hope to fully understand the social, behavioural and cognitive aspects of the human brain.

Guidelines on the use of animals in research

It is worth noting that in the UK the Home Office licensing procedure is very strict, and experimenters are required to consistently follow the 3 Rs (reduction, refinement, replacement: see Russell & Burch, 1959). Researchers are required to demonstrate that consideration has been given to replacing animals where possible, reducing the number of animals and refining methodology to minimise suffering. The experimenters must show that there is no suitable alternative way to gain the same quality of findings, and justify the benefits of proposed research compared with the costs to the animals.

The majority of animal use in psychology is in research, and this is covered by the Animals (Scientific Procedures) Act 1986. In the UK the Home Office is responsible for legislation in the field of animal welfare. Members of the British Psychological Society have a general obligation to minimise discomfort to living animals. The BPS *Guidelines for Psychologists Working with Animals* can be found at tinyurl.com/bpsanimals.

Conclusion

It is evident that there are and will always be drawbacks to neuroscience and psychology research carried out and developed from studies using animal models. Despite these, animal studies have historically provided great advances in our knowledge of the brain and continue to provide us with important information in developing a greater understanding of such a complex organ. Therefore, even though it may be indirect, I consider animal studies to hold a significant place in contemporary psychology.

The importance and reliance on animal models may change in the future along with the development of more advanced technologies, but for the time being experiments involving animals are vital for progression in our understanding of the brain and the continued development of neurological and psychological treatments.

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