



## On the need for animal experimentation in biomedical research

The debate over the need for animal experimentation in research is mainly conducted in very emotional tones. For this reason the fact that without experimenting on animals tremendous advances in medicine would not have been possible, is often overlooked: vaccines and antibiotics, painkillers and anaesthetics, radiotherapy, blood transfusions and organ transplants, heart surgery and kidney dialysis – all these therapies were developed on animals and this is accepted by everyone who wishes to remain healthy or get better.

There are many further examples of the benefits to people of the knowledge derived from animal experimentation that has been carried out carefully and responsibly. A little-known example is the rhesus-factor system of blood groups, whose name comes from its discovery in rhesus monkeys. An understanding of this has meant that millions of new-born babies have been protected from serious harm or even from death.

## All of us Benefit from Animal Experimentation

**Facts – a few historically important discoveries and developments in biomedical research, where animal experimentation has been of assistance.**

*(Source: Understanding Animal Research)*

**Before the 20th Century:** Discovery of the malaria cycle, vaccines against smallpox, rabies, cholera, typhus and against the anthrax pathogen, development of anaesthetics.

**Beginning of the 20th Century:** Blood transfusions, treatment of rickets, cornea transplants, local and modern anaesthetics, discovery of vitamin C, insulin, vaccines against tetanus and diphtheria, anticoagulants

**Middle of the 20th Century:** Discovery of penicillin and streptomycin, discovery of the Rhesus factor, kidney dialysis, vaccine against whooping cough, heart-lung machines for open-heart surgery, vaccines against polio, artificial hips, kidney transplants, (heart) pacemakers, medicines for high blood pressure, transplantation of heart valves, discovery of Chlorpromazin and the development of further psycho-pharmaceuticals, heart transplants and coronary bypass operations, measles, mumps and rubella vaccine, development of antidepressants and antipsychotics

**Middle of the 20th Century:** Computer tomography, chemotherapy for Leukaemia, therapies for asthma and migraines, medicines for the treatment of ulcers, magnetic resonance imaging, prenatal corticosteroids, treatment of river blindness, life support systems for new-born babies, medicines to prevent the rejection of transplanted organs, vaccine against hepatitis B, treatment of viral diseases, treatment of leprosy, HIV therapies, vaccines against meningitis, medicines for breast and prostate cancer, medicines for type-2 diabetes, new medicines for asthma, statins to reduce cholesterol levels.

**Beginning of the 21st Century:** Deep brain stimulation in Parkinson's disease, monoclonal antibodies for leukaemia in adults and against lymphoma, vaccine against cervical cancer, vaccine against bird flu

## Current Examples of Medical Research

*(Source: DFG-Broschüre; Tierversuche in der Forschung)*

Better diagnostic and therapeutic options for diseases of the heart and blood vessels

Improvement of treatment in diseases of the metabolism such as Diabetes mellitus (diabetes)

New forms of treatment for autoimmune diseases such as rheumatism and multiple sclerosis (MS)

Improved treatment of allergies

Development of treatment methods and vaccines for AIDS

Diagnosis and targeted treatment of neurological diseases such as Parkinson's and Alzheimer's

Improvement of organ transplantation

Development of artificial organs to replace failed organ functions (biomaterials)

Neuroprosthetic approaches to the rehabilitation of paraplegics

Improvement of non-invasive diagnosis/ for example magnetic resonance imaging

Research into the potential of stem cells as a therapy

Development of new approaches to somatic gene therapy in inherited immune deficiencies.

## Without basic Research, Successful Medicine is Not Possible

Almost every person aims to live to the greatest possible age and in the case of illness falls back on the currently available diagnostic and therapeutic methods. Ultimately we have basic biomedical research, which as the name already suggests, develops the scientific basis for understanding disease processes in our bodies, to thank for the chances and possibilities of recuperation.

Researchers laying this basis at the Werner Reichardt Centre for Integrative Neuroscience (CIN), who want to understand how the brain works, not least to establish a basis for the understanding of diseases of the nervous system. Although the uses of basic research cannot be predicted and often cannot be foreseen in the short term, biomedical research cannot be envisaged without it.

There are many examples that show how basic research leads to direct uses in medicine through unexpected discoveries: David Hubel and Torsten Wiesel received the Nobel Prize in 1981 for their discoveries about information processing in vision systems. They worked with newborn apes and observed that by experimentally closing the lid of one eye in the first year of life led to the eye growing more. That constituted the start of research into the causes of short-sightedness, holding out the prospect of promising approaches to prevention.

The discovery of mirror neurons also illustrates how the findings of basic research can suddenly achieve clinical relevance. They were originally found in the brains of Rhesus monkeys – in the meantime it became known that mirror neurons are also to be found in humans and that they are responsible for our ability to empathize with other people. On the basis of these basic scientific findings medical research is being carried out into how serious impairments of human interaction, such as in autism, can arise.

Scientists at the CIN are for example deciphering the numerical basis of general processing principles of the brain on the basis of specific questions. Research into higher mental performance (faculties) such as the ability to think in abstract terms, the understanding of rules and of decision-making, must be carried out using specific examples. This is very much the case in the use of numbers. The understanding of numbers is particularly suited to the investigation of abstract brain processes in animal models. Numbers are processed in the brain in special regions that are affected in many conditions of the brain, such as schizophrenia for example. A disruption of the power to think in abstract terms is particularly striking in people who suffer from such conditions. When the brain mechanisms of such capacities have been successfully deciphered, the foundation for medical treatment in the future will have been laid.

## Animal Experiments are Ethically Justified and Necessary

Animal experiments are ethically justified and necessary because the treatment of diseases of the sensory system and insights into psychiatric and neurological diseases calls for knowledge of how the healthy brain works at the level of nerve cells, and these insights can only be gained through animal experiments.

In 2010 around 2.9 million animals died in Germany because of animal experiments, among which the biggest group were mice and rats, at two million. The purpose was, in equal measure, basic research and research into medicines and medicinal products related to application. At first sight this number seems to be very high, but in comparison: in the same time period 740 million animals were slaughtered to be eaten, 4.8 million animals were hunted. So only 0.4% of all the animals that lost their lives for animal experimentation.

Another way of counting makes the comparatively small number of animals that are used for the purposes of research even clearer: if one compares the 2.9 million animals to the total size of the whole population of Germany, 0.035 animals per head and per year and (on the

basis of an average life expectancy of 75 years) only around 2.5 animals have to die for the benefit of the health of a single person.

### How Does the CIN Deal with Animal Experiments?

Around half of the research groups at the CIN work with animals, whereby mice and rats are mainly used. Five research groups use non-human primates (Rhesus monkeys) with a view to the need to pose quite specific scientific questions – for example to investigate cognitive processes in the brain. Only then do the scientists use these more highly sensory-physiologically developed animals when research on a 'lower' species does not suffice for the aims being pursued. This basic principle is rightly promoted by German animal protection laws.

An important and, for an understanding of how the brain works, indispensable approach is the investigation of nerve cells in the fully-intact brain. It is therefore essential because only the interconnections of an incredibly large number of nerve cells forms the basis of our ability to think, to feel, to relate to others, to remember and to develop an awareness of oneself and of the world. Non-human primates are the only realistic animal model for these questions which are meant to be applicable to humans. Only if the basic neurobiological principles are investigated and thereby understood can diseases of the brain be investigated and thus cured.

#### **Examples that show the immense significance of neurobiological experiments on non-human primates for the improvement of the diagnosis and treatment of psychiatric and neurological diseases**

*(Source: MPI für biologische Kybernetik Tübingen):*

Studies into the effects of microstimulation on the brain that made possible the 'brain pacemaker' in the treatment of Parkinson's disease.

The treatment of deafness with inner ear prostheses developed in animal trials where sounds are converted into electrical impulses and thus directly connect to the auditory nerve.

Research into the neurobiological bases of seeing, recognised by the award of a Nobel Prize, which laid the foundation for our understanding of sight disorders in childhood in strabismus and the development of myopia

The investigation of how the frontal lobe functions in Rhesus monkeys, which has given an important boost to the treatment of psychiatric disorders.

The important progress in the development of neuro-prostheses for the rehabilitation of patients with paralysis following spinal cord injuries or accidents are based on experiments on Rhesus monkeys.

Research on monkeys forms an increasingly important basis for research into ageing and the investigation of neurodegenerative diseases such as Huntingdon's disease (Chorea).

The study, recognised by the award of a Nobel Prize, of the transmission mechanisms of prion diseases such as kuru, scrapie and Creutzfeld-Jakob disease with considerable implications for the understanding of Mad Cow Disease (BSE), which can also be transmitted to humans.

The CIN is aware of the great ethical responsibility that is associated with animal experimentation in basic biological and medical research. All of the animal experiments that take place here are carefully checked by the commission on animal experimentation and approved by the competent authorities. There are regular checks to see that the conditions are being complied with. Animals used for experiments are kept with due regard to all of the provisions of animal protection law and international conventions. In scientific experiments on non-human primates, as well as on rodents in many cases, through working together concertedly the animals are trained to behave in particular ways that promote their health and well-being.

Alternative methods are worthwhile and most welcome, and whenever possible they are put in place and developed further. However, in the current stage of scientific knowledge animal experiments cannot be completely replaced by alternative methods. Non-invasive imaging procedures such as fMRI or fMRT (magnetic resonance tomography) do indeed offer a view into the brain and are an important enhancement of the range of methods in brain research. Nevertheless, the possibilities offered by this technology are greatly over-estimated. Only when imaging procedures are put together with studies that experiment with animals is it possible to gain reliable knowledge of how the brain functions.

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