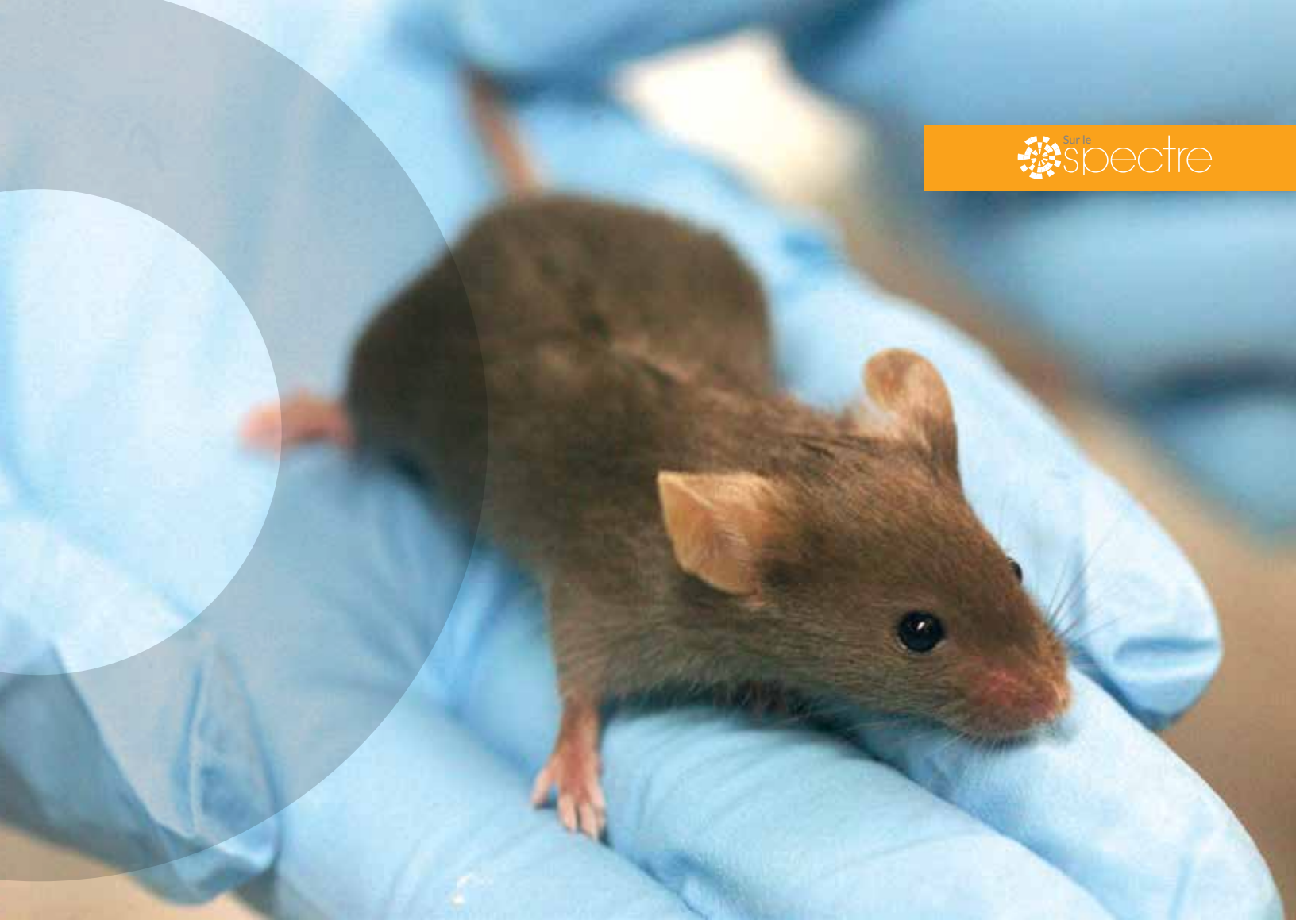

Science FAQ:

Animal models.

By ALEXA MEILLEUR

What is an animal model?

Animal models are animals that are used in the context of scientific research. These can bring a better understanding of complex situations affecting humans, such as infections and genetic mutations. Many different species have helped researchers elucidate important scientific questions. Animal models have contributed to some of the greatest scientific discoveries in the last hundred years, benefiting human beings' health outcomes.

Nobel Prizes awarded to research using animal models: Transmission and treatment of tuberculosis (1905), Discovery of Insulin (1923), Discovery of Penicillin (1945), Development of in vitro fertilization (2010)[1].

Drawing conclusions about human functioning and development from an animal is not so easily done. That being said, it's been done successfully with several animals. Mice, rats, and monkeys share from 85% to 96% of our genetic baggage, which allows researchers to make important medical advances and unravel the mysteries of the human body. Although these animals' brains are markedly different, particularly their size, many basic brain functions can be successfully investigated. In medical and neuroscience experiments, researchers can look at the effects of a chemical agent, an environmental stress, or a gene on the development of an animal.

1. Understanding animal research. (2020, 1er Octobre). *Nobel Prize*. Animalresearch.info. http://www.animalresearch.info/en/medical-advances/nobel-prizes/

Regardless of the chosen animal model, we must stay cautious with the interpretation of findings from animal research

There are many advantages to using animal models:

1. They allow researchers to devise experiments that wouldn't be practical or ethical with human beings. For example, causing a genetic mutation would be reprehensible in human studies. However, with genetic modifications, animal models can shed light on many illnesses like diabetes and cancer.

2. Some human conditions are extremely rare. Thus, recruitment of research participants is very difficult as participants are hard to find. In contrast, with animal models, many participants can be available at once, which would be impossible, costly, and time consuming in human research.

3. Finally, animal research is usually faster than human research since the life cycle of certain species is shorter than that of humans. Notably, a mouse reaches its adult stage between the ages of 50 and 70 days.

Autism and animal models

The mouse is the most frequently used animal model in medical research as well as autism research. The first autism animal models, developed in the early 2000s, were not very precise. They attempted to reproduce conditions that were known to be associated with autism at the time: a viral infection or exposure to valproic acid during pregnancy. Creating these situations in a mouse enabled researchers to study the mouse's development and draw conclusions concerning autism. However, we now know these situations can only explain a small portion of autism cases in the population.

With the discovery of different genes associated with autism, new animal models were developed. Genetic methods were used to change a mouse's genetic baggage and create genetic characteristics that were observed in autistic individuals. Genes like the CNTNAP2, the CHD8, and the SHANK3 were removed from the genetic baggage or altered in mice. The mice models were considered to be genetically analogous to autism in humans.

Once these genetic models were created, researchers studied these mice for any hints of autistic behaviors such as altered social communication. Observable behaviors, like sniffing other mice or making sounds to communicate, were absent from these genetically modified mice. Repetitive behaviors, such as compulsively digging up rocks or jumping and fidgeting were also identified in those "autistic" mice. Different tests were developed to study these behaviors in mice.

One example is the three-chamber test. This test places the mouse in a space with three separate areas, with one of these areas holding a mouse in a small cage. Researchers measure how much time the free mouse spends with the caged mouse as a proxy for social behaviors. The more the free mouse is drawn to the caged mouse, the more sociable she is deemed to be.

What conclusions can be drawn from these animal models?

Given autism is a genetically complex and heterogeneous condition, there are currently no mice models that can genetically replicate it. Despite the relevance of animal models for autism research, one genetic mutation like the SHANK3, for example, only accounts for 1% of autism cases. Moreover, researchers are only able to establish the genetic cause of autism in 20% of cases, and the genes involved are often numerous. Animal research relating to autism must therefore be interpreted with caution, as only a minority of genetic mutations can be reproduced.

Although humans share a large amount of genes with other animals, they hold specific and unique genetic markers that determine when and how our genes are expressed. This means that we have biological indices which regulate our DNA's genetic expression. This way, the same genes in humans will not be expressed the same way as they would in other species.

Ultimately, animals have their own way of communicating and socializing, making it challenging for researchers to draw conclusions on human behavior based on animal models. Is our understanding of animal communication substantial enough to allow us to draw conclusions on a condition like autism? According to some researchers, studying social communication in a species like the mouse could be problematic because their social functioning is markedly different from humans'. Other animals, like the rat or the chimpanzee, would be better suited for studying complex social behaviors because of their extended social structure and communication. Regardless of the chosen animal model, we must stay cautious with the interpretation of findings from animal research.

Main reference:
Special Reports: Spotlight on mouse models of autism. (2018, 21 mars). Spectrum News. Consulté le 5 mars 2021, de https://www.spectrumnews.org/features/special-reports/spotlight-mouse-models-autism/