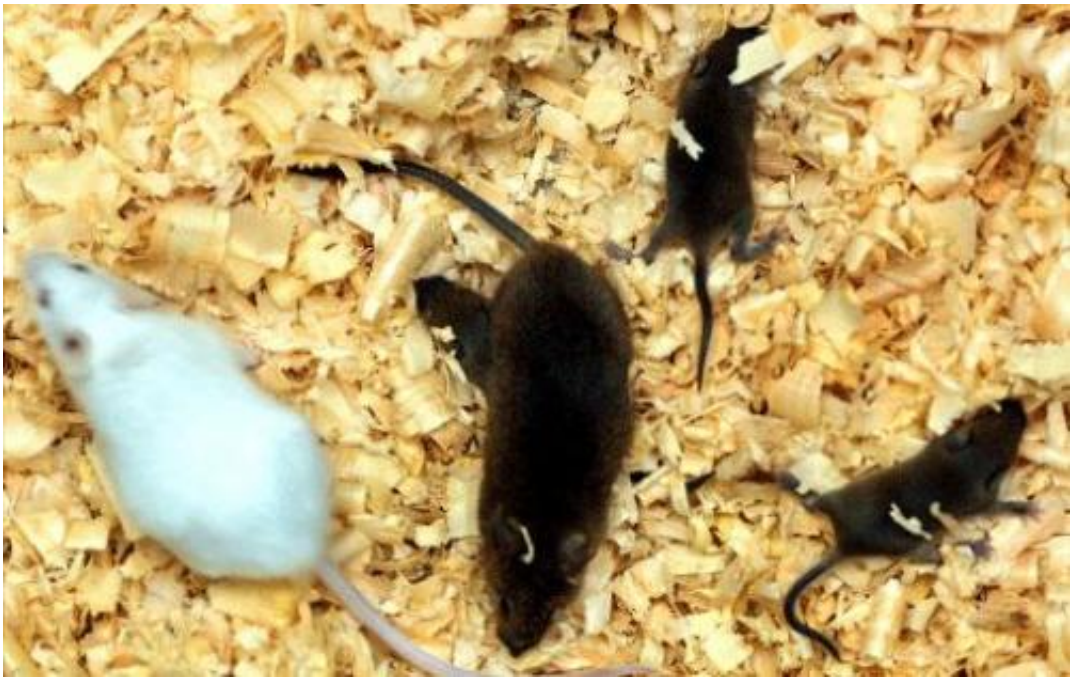
Mice can 'warn' sons, grandsons of dangers via sperm

December 1 2013, by Mariette Le Roux



A study published in the journal Nature Neuroscience shows lab mice trained to fear a particular smell can transfer the impulse to their unborn sons and grandsons through a mechanism in their sperm

Lab mice trained to fear a particular smell can transfer the impulse to their unborn sons and grandsons through a mechanism in their sperm, a study said Sunday.

The research claims to provide evidence for the concept of animals

"inheriting" a memory of their ancestors' traumas, and responding as if they had lived the events themselves.

It is the latest find in the study of epigenetics, in which environmental factors are said to cause genes to start behaving differently without any change to their underlying DNA encoding.

"Knowing how ancestral experiences influence descendant generations will allow us to understand more about the development of neuropsychiatric disorders that have a transgenerational basis," said study co-author Brian Dias of the Emory University School of Medicine in Atlanta, Georgia.

And it may one day lead to therapies that can soften the memory "inheritance".

For the study, Dias and co-author Kerry Ressler trained mice, using foot shocks, to fear an odour that resembles cherry blossoms.

Later, they tested the extent to which the animals' offspring startled when exposed to the same smell. The younger generation had not even been conceived when their fathers underwent the training, and had never smelt the odour before the experiment.

The offspring of trained mice were "able to detect and respond to far less amounts of odour... suggesting they are more sensitive" to it, Ressler told AFP of the findings published in the journal *Nature Neuroscience*.

They did not react the same way to other odours, and compared to the offspring of non-trained mice, their reaction to the cherry blossom whiff was about 200 percent stronger, he said.

The scientists then looked at a gene, M71, that governs the functioning

of an odour receptor in the nose that responds specifically to the cherry blossom smell.

Shown is an image of an olfactory glomerulus, the functional unit of odor processing within the olfactory bulb of the brain. The blue fibers represent the sensory projections from the nose to an individual oval-shaped glomerulus, which is about 50 microns in diameter. It is one of approximately 1,000 different specific glomeruli in each olfactory bulb. Each glomerulus is specific for a different odorant receptor. Dias and Ressler showed that pairing an odor with a shock leads to an increased number of odor-specific cells in the nose and size of the odor-specific glomerulus in the adult mouse, which then persists for at least two generations through inheritance. Credit: Kerry Ressler

The gene, inherited through the sperm of trained mice, had undergone

no change to its DNA encoding, the team found.

But the gene did carry epigenetic marks that could alter its behaviour and cause it to be "expressed more" in descendants, said Dias.

This in turn caused a physical change in the brains of the trained mice, their sons and grandsons, who all had a larger glomerulus—a section in the olfactory (smell) unit of the brain.

"This happens because there are more M71 neurons in the nose sending more axons" into the brain, said Dias.

Similar changes in the brain were seen even in offspring conceived with artificial insemination from the sperm of cherry blossom-fearing fathers.

The sons of trained mouse fathers also had the altered gene expression in their sperm.

"Such information transfer would be an efficient way for parents to 'inform' their offspring about the importance of specific environmental features that they are likely to encounter in their future environments," said Ressler.

Commenting on the findings, British geneticist Marcus Pembrey said they could be useful in the study of phobias, anxiety and post-traumatic stress disorders.

"It is high time public health researchers took human transgenerational responses seriously," he said in a statement issued by the Science Media Centre.

"I suspect we will not understand the rise in neuropsychiatric disorders or obesity, diabetes and metabolic disruptions generally without taking a

multigenerational approach."

Wolf Reik, epigenetics head at the Babraham Institute in England, said such results were "encouraging" as they suggested that transgenerational inheritance does exist, but cannot yet be extrapolated to humans.

More information: Paper: dx.doi.org/10.1038/nn.3594

Press release: phys.org/wire-news/147444296/m … vity-to-a-smell.html