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PRESS-RELEASE
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EPIGENETICS: TRACES OF TRAUMA AND ACQUIRED CHARACTERISTICS ARE DETECTABLE OVER GENERATIONS

Traumatic experiences leave traces in the activity of genes, cause changes in behaviour and mental disorders and are also passed on to future generations. But a positive and stimulating environment for the offspring can eliminate these traces. This is shown by studies on mice by **Professor Isabelle Mansuy** of the University and ETH Zurich. As Professor Mansuy reported today (9 July) at the FENS Forum 2018 in Berlin, these epigenetic changes, which do not alter the code of the genes themselves but their activity, are detectable not only in the nerve cells of the brain, but also in blood and germ cells - which might have an effect on the function of organs.

Isabelle Mansuy's studies show the long lasting consequences of trauma in succesive generations. Both male and female animals traumatised in early postnatal life by long-term and unpredictable separation from their mothers have epigenetic changes in their genetic material which they pass on to their offspring. The consequences of these changes are antisocial behaviours, depressive-like symptoms, cognitive deficits and dysregulated metabolism and also altered bone and skin functions. "We've examined four generations and are testing the fifth," sayd Professor Mansuy. "The symptoms are similar across generations. Some of those observed in the first generation are still detectable in all generations we have studied so far."

In epigenetic changes, small chemical modifications, so-called methyl groups, are attached to individual DNA building blocks. Other modifications are added to proteins known as histones associated to the DNA. These proteins package the DNA into ordered structural units.
These epigenetic factors affect gene activity without altering the genetic code itself. Professor Mansuy's team was able to detect such changes in mice as well as in the amount of non-coding ribonucleic acid (RNA) produced from DNA which influence the activity of genes, too.

However, these changes are not limited to the genetic material in the cells of the brain. Traumas probably leave their mark on all body cells. Professor Mansuy has also been able to detect epigenetic changes in blood and germ cells. "Specific genes in these cells are affected," says Mansuy, "which may also have an effect on the function of the affected organ system", she said.

The epigeneticist's investigations also show that the traces of trauma can be eradicated. In a pilot study, the researchers showed that a positive and stimulating environment after trauma leads to the correction of the epigenetic alterations and with them, the disappearance of trauma-related behavioural symptoms in adult mice. The offspring is also preserved from the effects of trauma.

Recently, a research group reported that it could detect alterations in specific non-coding RNAs in the sperm of both traumatised mice and traumatised men. Professor Mansuy's team is also currently examining cohorts of children and adults who had traumatic experiences for epigenetic changes and comparing the results with those of control groups who have grown up or lived with no trauma. "The results look very promising," says Professor Mansuy.

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Epigenetics also plays a role in the domestication of animals, as studies by **Professor Per Jensen** from the University of Linköping (Sweden) show. "In a period of only 10-15000 years, animals that lived with humans and became pets have changed their appearance, their physiology and their behaviour to such an extent that, for example, the dog can be regarded as a new species," says Professor Jensen. Such changes can occur as a result of life experiences and change behaviour and stress reactions.

In chicken research, Jensen's team found that epigenetic changes can be caused by stressful events, last long and can be passed on to the next generation with the associated behavioural effects. The scientists were able to detect large differences in the pattern of DNA methylation in the brain of domestic and wild chickens as well as domestic and wild dogs.

The team simulated the process of domestication and its consequences with animals of the native form of the domesticated chicken, the Red Junglefowl (Gallus gallus), which lives in Southeast Asia. The scientists selected animals that were less afraid of humans than their contemporaries and had them multiplied over five generations. In these animals, too, the researchers were able to demonstrate both specific epigenetic effects in the brain and a change in behaviour over generations.

END

Symposium S40: *Epigenetic inheritance: from chromatin to behaviour across species*

Abstract Reference
Molecular mechanisms of germline-dependent transgenerational epigenetic inheritance, Isabelle Mansuy
Epigenetic basis of behavioural expression and transmission in domesticated species, Per Jensen

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NOTES TO EDITORS
Prof. Dr. Isabelle Mansuy University and ETH Zurich
https://www.hest.ethz.ch/studium/gesundheitswissenschaften-technologie/master-hst/vertiefungen/tutors/tutors-a-z/isabelle-mansuy.html
Per Jensen from the University of Linköping
https://liu.se/en/employee/perje15

The 11th FENS Forum of Neuroscience, the largest basic neuroscience meeting in Europe, organised by FENS and hosted by the German Neuroscience Society will attract more than 7,000 international delegates. The Federation of European Neuroscience Societies (FENS) was founded in 1998. With 43 neuroscience member societies across 33 European countries, FENS as an organisation represents 24,000 European neuroscientists with a mission to advance European neuroscience education and research. https://forum2018.fens.org/

Further Reading
Jensen: Adding ‘epi-’ to behaviour genetics: implications for animal domestication
The Journal of Experimental Biology (2015) doi:10.1242/jeb.106799