Masked fears

Simulations of fear processes can explain their origin in the brain – and why it is so difficult to overcome them

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One group of nerve cells in the brain controls the fear behaviour (right). This can be suppressed by a second group of nerve cells (left) – but the fear is only masked, and has not disappeared completely (Carlos Toledo/Bernstein Center Freiburg)

Fear is a natural part of our emotional life and acts as a necessary protection mechanism. However, fears sometimes grow beyond proportions and become difficult to shed. Scientists from Freiburg, Basel and Bordeaux have used computer simulations to understand the processes within the brain during the formation and extinction of fears. In the current issue of the scientific journal “PLoS Computational Biology”, **Ioannis Vlachos** from the Bernstein Center Freiburg and colleagues propose for the first time an explanation for how fears that were seemingly overcome are in reality only hidden.
The reason for the persistency of fears is that, literally, their roots run deep: Far below the cerebral cortex lies the “amygdala”, which plays a crucial role in fear processes. Fear is commonly investigated

in mice by exposing them simultaneously to a neutral stimulus – a certain sound, for example – and an unpleasant one. This leads to the animals being frightened of the sound as well. Context plays an important role in this case: If the scaring sound is played repeatedly in a new context without anything bad happening, the mice shed their fear again. It returns immediately, however, if the sound is presented in the original, or even a completely novel context. Had the mice not unlearned to be frightened after all? The fact that fears can be "masked" has been known for some time. Recently, two co-authors of the present study discovered that two groups of nerve cells within the amygdala are involved in this process. By creating a model of the amygdala's neuronal network, Ioannis Vlachos and colleagues were now able to find an explanation for how such a masking of fears is implemented in the brain: One group of cells is responsible for the fear response, the second for its suppression. Activity of the latter inhibits the former and, thus, prevents fear signals to be transmitted to other parts of the brain. Nevertheless, the change in their connections that resulted in an increased activity in the fear-coding neurons in the first place, is still present. As soon as the masking by the fear-suppressing neurons disappears, for example by changing the context, these connections come into action again – the fear returns. According to the scientists, these insights can be transferred to us humans, helping to treat fears more successfully in the future.

Vlachos I, Herry C, Lüthi A, Aertsen A and Kumar A (2011) **Context-Dependent Encoding of Fear and Extinction Memories in a Large-Scale Network Model of the Basal Amygdala**. PLoS Comput Biol 7(3): e1001104. doi:10.1371/journal.pcbi.1001104

Contact:
Ioannis Vlachos
Bernstein Center Freiburg / University of Freiburg
ph: +49 761 203 9569
fax: +49 761 203 9559

vlachos@bcf.uni-freiburg.de