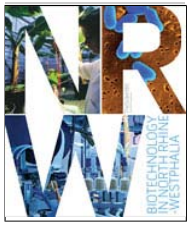

News:

Stressed brains rely on habit

Posted by Jef Akst
[Entry posted at 30th July 2009 07:01 PM GMT]
View comments(3) | Comment on this news story

Exposure to chronic stress causes alterations in brain anatomy that may compel rats to rely too much on routine, even when a change in circumstances calls for a change in behavior, according to a new study published this week in *Science*.


Image: Wikimedia commons, Janet Stephens

The study provides "a really nice animal model for a subtle, important problem with cognition that can be caused by chronic stress in humans," neuroscientist Robert Sapolsky of Stanford University School of Medicine, who was not involved in the work, wrote in an email. "Plus some excellent neurobiology to go along with it."

Habit formation is believed to be a way to conserve cognitive resources and make decisions more efficiently, as habits do not require constant evaluation of potential consequences. Driving home from work, for example, quickly becomes a matter of routine, leaving your mind free to daydream without missing a turn. However, some situations require alterations to such routines, such as stopping by the grocery store on the way home, in which case goal-directed attention is necessary for reaching your destination. In a series of behavioral experiments, neuroscientists Rui Costa of the Champalimaud Foundation in Portugal and the National Institutes of Health (NIH) and colleagues determined that rats that had been stressed repeatedly and unpredictably for three weeks were more likely than unstressed animals to continue performing habitual behaviors, even when it no longer made sense to do so.

"It's certainly a major finding," said neuroscientist Henry Yin of Duke University, who was not involved in the research. "This paper presents the very first evidence that stress can promote habitual behavior [in animals]."

Chronic stress can also result in other behavioral symptoms, such as deficits in memory or spatial navigation. These changes are believed to be triggered by the release of corticosteroids, causing neuronal reorganization, primarily in the hippocampus and medial prefrontal cortex (mPFC). When the researchers measured the volume and density of various brains structures in stressed and unstressed rats, they found several differences. Most notably, the prelimbic cortex (PL) of the mPFC and the dorsomedial striatum (DMS) -- both implicated in goal-directed actions -- were reduced in size in stressed rats, while the dorsolateral striatum (DLS) -- necessary for habit formation -- was enlarged, suggesting a neurological mechanism for how stress affected their behavior.

Previous work showed that habit formation involved the switch between neural circuits associated with goal-directed behavior and those controlling habitual behavior, Yin said, "[but] this is the first piece of evidence showing the structural basis for this kind of switch."

"[It's] an important and novel contribution into the field," agreed neuroscientist Patricia Janak of the University of California, San Francisco, who was not involved in the work. "People typically had been thinking about chronic stress affecting circuits in the frontal cortex and circuits in the hippocampus. To look at the striatum, which controls a lot of our moment-by-moment behavior, is a really new direction."

In the first set of tests, rats were trained to press a lever to receive a reward (either food pellets or sucrose). After two weeks of training, they were given full access to the reward and allowed to consume as much as they desired. When presented with the lever again, control animals stopped pressing the lever, but stressed animals didn't. If you get the dessert for free, Costa said, there's no need to work for it. "That's what control animals do," but stressed animals work anyway.

In a second set of experiments, rats were trained to press one lever for pellets and the other for sucrose. Then, one of these two rewards was provided for free -- i.e., without a lever press. When the rats were given a choice of levers, control animals rightly pressed the lever that still required pressing to receive the reward, while stressed animals showed no preference between the two options.

"It's not that they are stupid and don't understand that there is a difference," Costa said. "It's just that when given a choice, they will do the automatic thing." In fact, he said, these stress-induced changes seem almost adaptive. " When we are under chronic stress, it could be advantageous to use habitual strategies because [it reduces] the amount of cognitive resources that you need." Of course, when circumstances change, such a strategy can backfire.

The findings, researchers say, provide a possible avenue for investigating therapies for stress-related disorders and addictive behavior. "We know stress is very often associated with compulsive drug use -- drugs tend to be used more often when you're stressed out," said Yin. "If we can figure out the molecular details underlying this, then maybe we'll be able to find some treatment for this."

LATEST NEWS
- Newton the gumshoe
- Stressed brains rely on habit
- Top innovations of 2009?
- NIH 2010 budget tweaked
- Alzheimer's clue found
- Curves guide bacterial proteins
- Retracted: stem cell paper
- Butterfly sperm explained
- Food dye lessens spinal injuries
- Synthetic enzyme pioneer dies
- Biolab site choice flawed: report
- Airway cilia taste toxins
- The poetryome
- Factor fixes damaged hearts
- Furloughs for state school profs

More Entries...