

Sex differences in cognitive regulation of stress

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Credit: George Hodan/public domain

While it is true that women and men respond differently to stress, current neuroscientific research only partially confirms traditional gender stereotypes. Other factors heavily contribute to the stress response such as self-esteem, hormones and stress regulation, as has been demonstrated by a project funded by the Austrian Science Fund FWF.

How people react to stress is subjective. Gender also plays a fundamental role. Scientific studies have shown that the [stress hormone cortisol](#) is activated in different ways in men and women. "Stress is influenced by many factors," emphasises Birgit Derntl from the Eberhard Karls Universität in Tübingen. In order to derive a better understanding of the related factors, the clinical psychologist and professor at the Centre for Integrative Neurosciences investigated stress reactions among men and women from a subjective, hormonal and neuronal standpoint.

Subjective feeling versus hormonal reaction

That the subjective experience of stress does not necessarily correspond to bodily reactions is one of several insights the team of principal investigator Derntl gained in a project funded by the Austrian Science Fund FWF. Their study participants were given two tasks. The first addressed achievement stress through solving maths problems – but it should be noted that the answers given were not socially evaluated. In a second step, all individuals were asked to play the so-called cyberball task, a virtual ball-tossing game. This task involved a ball-toss game and addressed the stress factor of 'social exclusion'. "Both sexes experienced the tasks as stressful no matter how well they performed the task," Derntl comments regarding their subjective feeling. Cortisol levels, however, rose only in the male subjects, not in the women. Researchers have meanwhile found increasing evidence that perceiving stress does not inevitably lead to a rise in [cortisol levels](#). "But a lot of things still need to be clarified before we know why that is so," emphasises Derntl.

Neuronal stress correlations

An important step towards finding an answer led the researchers to address the question as to how the brain responds to stress and to a rise

in hormonal levels – and how these processes interconnect. Birgit Derntl is one of the first scientists who not only measured hormone levels but also took a gender perspective when examining activity in the brain while coping with stress. In line with their increased cortisol levels, the brain scans of men showed a greater activation of the regions linked to attention, while those areas were hardly active in women. "This suggests that we have different ways of processing these tasks," notes the psychologist. "In the social exclusion stress test women showed increased levels of progesterone, men of testosterone," comments Derntl on the results of the project. There are indications that the hormone progesterone is important for group affiliation. "The increase could signal that women become insecure," says Derntl.

The impact of self-esteem

Another factor the researchers focused on was self-esteem. At the outset, they determined the test subjects' self-esteem by means of a questionnaire. The result: self-esteem plays an important role in stress handling. It leads to different responses in men and women. Women with low self-esteem showed increased activation in areas of the brain involved in cognitive control, meaning that their main objective was to fulfil the task as well as possible. Men with low self-esteem revealed stronger activation of brain regions involved in self-reference and emotions.

Coping with stress

In a follow-up study, the team from the Universitätsklinikum Tübingen has already gained further insights into individual stress coping strategies. Again, the test subjects had to perform achievement tasks. This time they were then also evaluated in a socially negative way. The subjects were simultaneously asked not to let themselves be distracted by

negative feelings that came up while they performed the task. In women, this led to a higher subjective stress reaction than in men. These findings were also reflected by the brain regions associated with attention, emotions and rewards. "Contrary to our expectations, [women](#) did not cope so well with the task of controlling their emotions," notes Birgit Derntl.

The findings indicate at any rate that the connection between stress hormones and brain activity is subject to gender effects which can be vital for [stress response](#) and stress coping skills. The stress researcher also points out that one should challenge the almost exclusively negative connotations of 'stress'. As long as it does not become chronic, [stress](#) can also have a very positive and motivating impact, as was corroborated by Birgit Derntl's empirical investigations.

More information: Lydia Kogler et al. Sex differences in the functional connectivity of the amygdalae in association with cortisol, *NeuroImage* (2016). [DOI: 10.1016/j.neuroimage.2016.03.064](https://doi.org/10.1016/j.neuroimage.2016.03.064)

Lydia Kogler et al. Sex differences in cognitive regulation of psychosocial achievement stress: Brain and behavior, *Human Brain Mapping* (2015). [DOI: 10.1002/hbm.22683](https://doi.org/10.1002/hbm.22683)

E.M. Seidel et al. The impact of social exclusion vs. inclusion on subjective and hormonal reactions in females and males, *Psychoneuroendocrinology* (2013). [DOI: 10.1016/j.psyneuen.2013.07.021](https://doi.org/10.1016/j.psyneuen.2013.07.021)

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