

Survival vs. Cognition: Stress Mechanisms in Humans vs. Animals



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Introduction to Stress Mechanisms

Stress is defined as the physiological and psychological reaction to perceived threats or demands that activates a cascade of neurobiological processes that help maintain homeostasis (McEwen, 2007). The hypothalamic-pituitary-adrenal axis (The HPA Axis) plays the primary role in regulating stress and the release of stress hormones such as cortisol and corticosterone. These hormones are used to regulate the physiological and behavioral responses in several species (Sapolsky, Romero, & Munck, 2000). Additionally, neurotransmitters play an equally important role in the regulation of stress and emotion. Specifically, dopamine and norepinephrine influence stress-related cognitive and emotional regulation (Joëls & Baram, 2009). Even with similar processes of regulating stress, animals and humans tend to respond to and process stress differently. Animals are primarily concerned with acute survival-linked stressors, such as predation or resource deficiency. Whereas, humans experience complex cognitive appraisal, differentiating between immediate threats and external concerns like societal or financial pressures. It is crucial to highlight and study these differences between human and animal stress responses as it allows us to improve the understanding of chronic stress disorders and coping strategies in humans while also enhancing animal stress research.

Fight-or-Flight Response in Humans vs. Animals

Animals and humans both respond differently to perceived threats; however, one mechanism that allows both to respond rapidly is the fight-or-flight response. This response is quite instinctive in animals and is triggered by the autonomic nervous system, especially in the sympathetic branch. This area is known to initiate rapid physiological changes like increased heart rate, energy mobilization and pupil dilation (Cleveland Clinic, 2022). In animals, these reactions and changes are crucial for survival during acute stressors. These stressors entail predator-prey encounters, where quick action is needed and can determine life or death. The HPA axis releases glucocorticoids that help maintain energy levels and modulate inflammation during high-stress periods such as these (Wingfield & Romero, 2001). However, in humans, physiological responses also have an added cognitive aspect. Humans tend to interpret stress through fear and anxiety and this is based on whether the stress is a direct and immediate stressor or an anticipated one. Since humans can overthink problems, it is common for humans to stay stressed even after the direct stressor has left. Unlike animals, we continue to worry about things that have not even occurred or happened in our work and social lives. This tendency makes it more difficult for humans to recover and overtime leads to issues such as anxiety and burnout (Harvard Health Publishing, 2018).

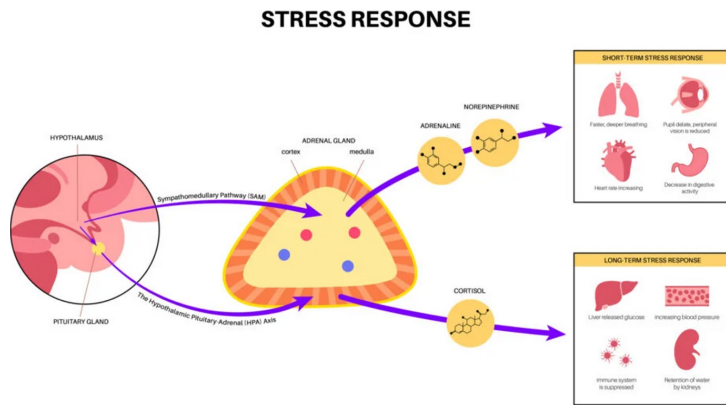


Figure 1. Diagram showing the human stress response pathways. The SAM pathway triggers immediate release of adrenaline and norepinephrine (fight-or-flight), while the HPA axis leads to cortisol release during prolonged stress. *Simply Psychology, "What is the HPA Axis?"*

Survival-Based Stress Response in Humans vs. Animals

Stress in animals is highly survival-driven and is elicited by immediate threats by predators, famine or weather. These acute stressors can trigger fast physiological adjustments that enable them to hide, fight or even run away. These reactions have been perfected over the course of evolution to maximize survival (Wingfield & Romero, 2001). As the danger leaves, the stress response switches off, and the animal can recover by returning to rest and conserving energy. Figure 2 illustrates this process, showing how animals pass through an ordered cascade of physiological and behavioral responses to perceived danger, and recovery or chronic stress outcome in relation to their capacity to recover homeostasis. The way that animals are able to recover so quickly is a significant evolutionary adaptation that saves animals from experiencing effects of chronic stress. On the other hand, humans perceive stress in addition to physical danger. Some examples could include public speaking, issues at work and in relationships. This difference between humans and animals is because humans have an advanced cognitive ability to imagine, evaluate and magnify risks (Ohman, 2005.) Due to this, humans often feel stressed in response to psychological or social problems in the absence of any real life-threatening situation. This is beneficial as humans can adapt their actions allowing them to prepare and evade threats, but it also leads to chronic disease (Harvard Health Publishing, 2018).

Long-Term Stress: Chronic Stress in Animals and Humans

Animals in the wild are oftentimes subjected to brief, severe stressors like predators or harsh weather. These difficulties trigger quick physiological reactions, such as the release of glucocorticoids, which minimize long-term harm by rapidly returning to baseline after the threat has passed (Wingfield and Romero, 2001). However, some animals are kept in

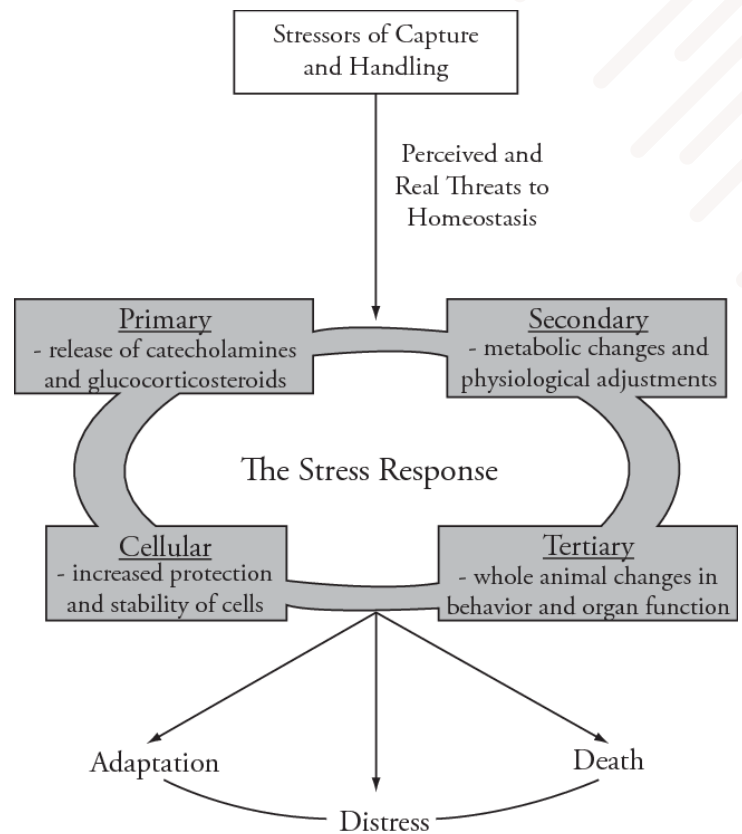


Figure 2. Powell, Roger A., et al. "Diagram illustrating the stress response that follows when an animal perceives a threat to homeostasis." *ResearchGate*, 2012

captivity which can lead to ongoing stress. This is due to confinement, lack of stimulation, and abnormal social structures. This is due to confinement, lack of stimulation, and abnormal social structures. According to Morgan and Tromborg, these disorders may cause a persistent increase in stress hormones, which can have a detrimental effect on immune system performance, reproductive success, and general animal behavior. Long-term exposure to glucocorticoids in captive animals has led to chronic stress. Behaviors such as disruption in circadian rhythms, and impairment of hippocampus function are just some signs (McEwen, 2007). In people, psychological and social triggers like employment obligations, interpersonal issues, and unstable finances are more frequently the cause of chronic stress. Given that humans have a more developed prefrontal cortex as opposed to animals, they are able to predict, consider, and magnify stressors, triggering the hypothalamic-pituitary-adrenal (HPA) axis to continuously activate (Joëls and Baram, 2009). Eventually, this imbalance leads to a variety of illnesses, such as diminished immune system, anxiety, depression, and cardiovascular disease (McEwen; Chrousos and Gold, 1998). The frequency of exposure can lead to long-term physiological damage is explained by the idea of allostatic load, which is the overall deterioration on the body brought on by chronic stress (McEwen and Seeman, 1999). These consequences highlight the importance of resilience-building techniques and stress-reduction tactics in human health care and lifestyle.

Support Systems and Growth Mindsets

Though its structure and purpose vary among different species, social support is crucial for controlling stress in both people and animals. Stress levels in animal communities can be very much influenced by social hierarchies and group dynamics. For instance, constant social stress—especially in captivity—allows subordinate animals within rigid hierarchies to have higher glucocorticoid levels. On the other hand, animals that create stable social ties—such as grooming-engaging primates—often have reduced levels of stress hormones, underscoring the protective effect of positive social interactions (Wingfield and Romero, 2001). In humans, networks of social support—including family, friends, and community members—act as shielding buffers against ongoing psychological stress. These interactions help to downregulate the activity of the sympathetic nervous system and the HPA axis, thus reducing the physiological consequences of stress (McEwen, 2007). Besides, resilience against stress depends on a person's psychological viewpoint.

“ The ability to reframe stress through a growth mindset helps humans to see obstacles as opportunities rather than hazards. ”

This cognitive assessment modulates the stress reaction by influencing the way the brain understands threats and their consequent physiological effects (Joëls and Baram, 2009). Using adaptive coping techniques that support emotional control and lower allostatic load—cognitive reappraisal, mindfulness, and goal-setting—helps one to reduce persistent stress (McEwen and Seeman, 1999). Consequently, how different animals react to and recover from stress depends much on both internal mental frameworks and outside social settings.

Implications for Behavioral Models and Future Research:

This paper looked into how human and animal stress mechanisms differ, emphasizing how humans frequently experience cognitively driven, chronic stress while animals depend on acute, survival-based reactions. Both make use of comparable biological systems, such as the HPA axis and the sympathetic nervous system, but because of our superior cognitive abilities, humans are exposed to stress for longer

periods of time and experience more complicated effects. Important differences have been observed in the influence of social and psychological factors, long-term stress development, and fight-or-flight reactions. Behavioral psychology greatly benefits from the research of stress processes in human-animal relationships. Stress reactions have a direct impact on behavior, decision-making, and emotional regulation since they are based on common neurobiological systems such as the sympathetic nervous system and the HPA axis (Joëls and Baram, 2009). More specialized behavioral models, like those for anxiety, depression, and post-traumatic stress disorder (PTSD), can be guided by knowledge of how long-term stress changes the brain circuits involved in cognition and emotion. For instance, knowledge gained from research on animals has influenced pharmacological and exposure-based therapies to control the release of stress hormones and brain plasticity (McEwen, 2007). But the primary issue is the morality of using animals in stress studies. In order to protect animal welfare while advancing science, researchers must provide humane conditions, reduce suffering, and use alternatives when possible (Morgan and Tromborg, 2005). The relationship between stress resilience, neuroplasticity, and specialized treatment approaches must be further investigated in future studies. To better understand how early life stress, social context, and psychological state interact to influence long-term health outcomes, more longitudinal research in humans is needed. Public health and tailored treatment can also benefit from studying how stress appears in other animals and social groups. Combining psychological ideas with neurobiological facts may also improve our capacity to anticipate stress vulnerability and stop it from happening. Future research can better understand stress problems and inform more efficient, moral, and focused treatments by integrating insights from animal studies into human behavioral science.

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About the Author

Pravika Srivastava is a rising junior at the University of Illinois Urbana-Champaign majoring in neuroscience with a minor in psychology on the pre-medical track. She is passionate about brain health, mental well-being, and hopes to pursue a career in psychiatry. As a writer and new Social Media Co-Chair for Brain Matters, she enjoys writing about neuroscience-related topics while eager in helping expand the journal's outreach. On campus, Pravika volunteers in the Pediatric ICU at Carle Foundation Hospital, conducts research at the CONNECTlab and Rudolph Lab, and serves on the Speaker Committee for Alpha Epsilon Delta. Pravika is excited to share her research and writing as part of her ongoing commitment to advancing understanding of the brain and mental health.

