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A Cogniceptive Model of Trauma Fixation

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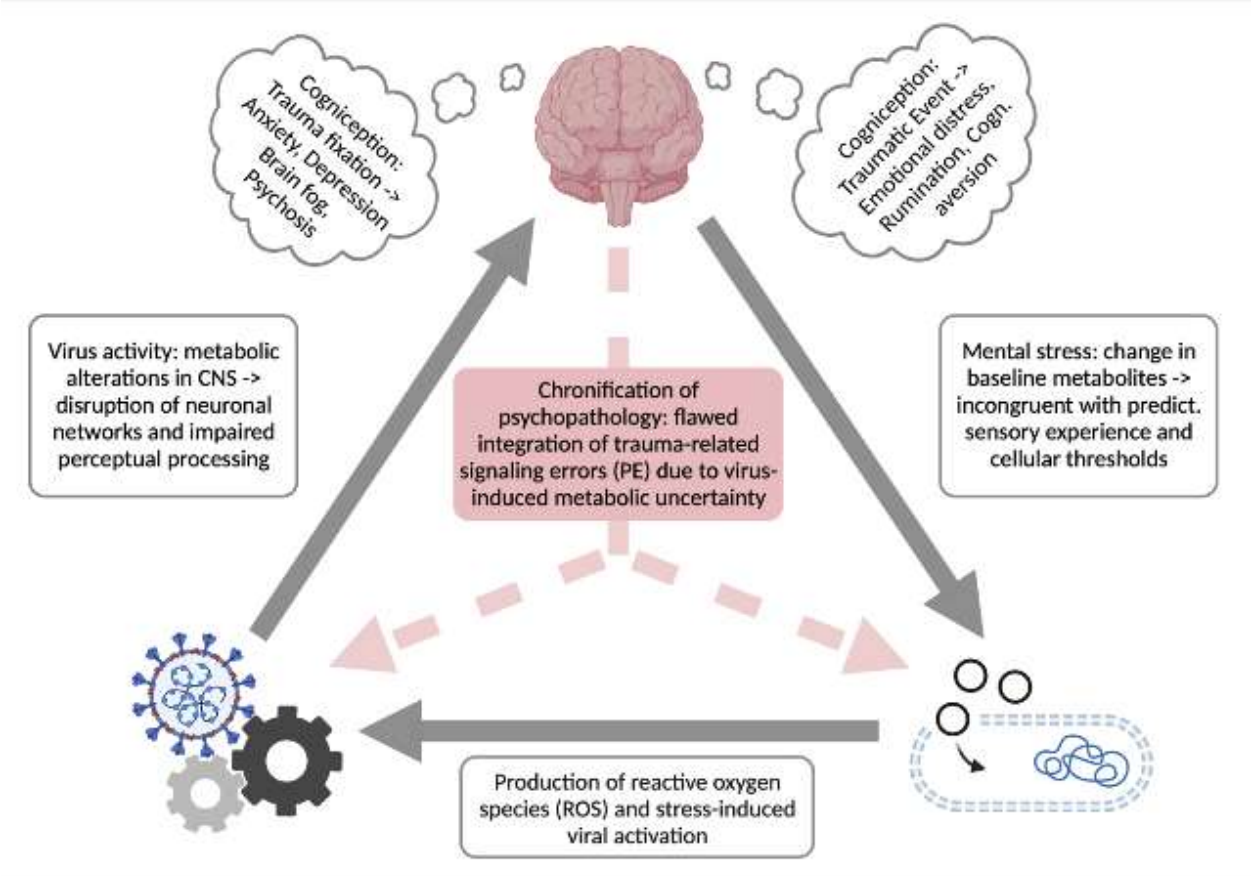
Stress may be defined as a stimulus above or below the expected threshold in a given momentum and environment (Saintigny et al., 2016; Schulz & Vogele, 2015). Stress is a universal part of life and the foundation for change and, thus, evolutionary adaptation (Hoffmann & Hercus, 2000). On a molecular level, environmental stress was reported to induce oxidative stress, which is a cellular condition characterized by an imbalance between the production of reactive oxygen species (ROS) and the ability of cells to detoxify them (Pizzino et al., 2017). Oxidative stress is implicated in various physiological and pathological processes, including aging, neurodegenerative diseases, and psychiatric disorders (Chen et al., 2012; Wu et al., 2013). In animals and humans, cellular stress may be induced through muscle tone or tension (i.e., proprioception), visual and other body-external sensory experiences (i.e., exteroception), or sensations of the internal milieu (i.e., interoception), such as increased heart rate, inflammation of the bowel, and other body-internal sensations (Buttiker et al., 2021; Schulz & Vogele, 2015). Importantly, whether a stimulus will be experienced as stressful depends on the expectation (i.e., prior probability) of a stimulus to occur in the given moment and environment (Harris et al., 2023). In a predictive processing model, a mismatch between the expected (i.e., predicted) stimulus and the actual sensory input leads to errors (i.e., prediction errors [PE]), which play an important role in updating the body's sensory expectation (i.e., internal concepts) according to the incoming information (Barrett, 2017; Clark, 2013; Seth, 2013). This is a form of learning, which the brain implements to adapt to newly encountered situations (Buttiker et al., 2021; Raymond et al., 2017).

How these sensations are being perceived and processed on a cognitive level, however, depends on the previously learned, internal concepts and one's awareness of associated stimuli (Barrett, 2017). The ability to reflect on cognitive states of emotions and thoughts in a given momentum and environment is called *cogniception*. Cogniception is involved in the generation of sensory predictions and subsequent integration of PEs into internal concepts, allowing psychological adaptation to a constantly changing environment. Stimuli that greatly exceed the expected thresholds may be perceived as traumatic, leading to acute stress and the generation and integration of aversive PEs into initially healthy internal concepts (Linson et al., 2020). Examples for this could be sports accidents, interpersonal conflicts, such as breakups, becoming the victim of a crime, etc., which may lead to temporary uncertainty due to the overflow of unexpected, aversion-connected information (i.e., PEs) and feelings of anxiety (Grupe & Nitschke, 2011, 2013). Unsuccessful integration of these PEs over time may then lead to chronic distress and, in a cognitive model, to the integration of traumatic sensory information into other initially healthy concepts increasingly leading to the unconscious fixation of trauma and, for example, trait anxiety (Buttiker et al., 2021; Linson et al., 2020; Raymond et al., 2017). Notably, psychosocial stress, which may involve rumination over distressing thoughts, has been reported to increase the production of ROS (Kim et al., 2021). Hence, if chronic stress, which comprises repeated PEs in the context of cognitive processing, is not effectively managed,

it could potentially contribute to oxidative stress. Chronic activation of the stress response system with an increase in intra- and extra-cellular ROS can lead to oxidative damage to cells causing important changes in the DNA, protein expression and molecular signaling (Chen et al., 2012; Pizzino et al., 2017).

Furthermore, a disbalance in the mechanisms underlying oxidative stress can lead to a stress-induced activation of persistent infections of neurotropic viruses (Buttiker, Stefano, et al., 2022). Their reactivation causes metabolic changes, for example, in infected glial cells, neurons and mitochondria additionally compromising the neuronal energy landscape and functional integrity of brain networks (Buttiker, Weissenberger, et al., 2022; Stefano et al., 2021; Stefano et al., 2020). In a predictive coding model, such virus-induced metabolic alterations in the central nervous system (CNS) may reinforce the existing sensory uncertainty of traumatic stimuli, furthermore compromising the healthy processing and integration of associated PEs. Hence, it is suggested that traumatic events and chronic distress (e.g., rumination over such) can reactivate neurotropic viruses, which may reinforce the present uncertainty in the minimization of PEs via immune-modulatory effects leading to altered cogniceptive states and a flawed perception of the world and self in an acute (e.g., psychosis, anxiety) and chronic (e.g., brain fog, depression, trait anxiety) manner. The potential involvement of cogniception in traumatic experiences, stress-induced activation of neurotropic viruses and subsequent chronification of cognitive disruption and trauma fixation is presented in Figure 1 in the form of a positive feedback-loop. Importantly, an understanding of these mechanisms can lead to better therapeutic strategies.



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