The Relationship Between Adolescents' Coping Mechanisms and Behavioral Brain Functions Under Academic Stress

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Abstract

Background: The majority of adolescents do not employ coping mechanisms in face of stressful situations. This in turn leads to a decrease in hippocampal responses to subsequent presentations of emotional stimuli among other consequences related to emotional functions of the brain.

Objectives: The purpose of this paper is to analyze and synthesize the relationship between lack of coping mechanisms and its effect on the emotional functions of the brain, more particularly fluctuations in behavior. By recognizing these key components, effective strategies and awareness can be fostered to elevate the incorporation of coping skills.

Methods: Participants were recruited via systematic random sampling at Adlai E. Stevenson High School, where every third person entering the library was invited to participate. A total of 63 students participated, including 25 from the 11th and 12th grades and 5 from the 10th grade. Informed consent was obtained, and interviews were transcribed verbatim. Thematic analysis was conducted to identify common themes related to coping strategies and emotional outcomes, providing insights into adolescents' personal coping experiences with academic stress. This review was conducted by the use of PubMed, American Heart Association Journals, the Center for Disease Control and Prevention, and other scholarly sources relevant to the keywords.

Results: Based on the results, adolescents experience academic stress from test anxiety, homework burdens, and societal and family expectations. To manage stress, they employ coping mechanisms such as seeking social support from friends and family, engaging in self-care activities like reading and exercising, and actively addressing academic challenges. While some resort to avoidance strategies like procrastination, these are less effective. The

efficacy of coping strategies varies with individual and situational factors, with adaptive strategies improving emotional well-being over time. Cultural influences play a significant role, highlighting the need for culturally tailored interventions to support adolescents in managing academic stress effectively.

Conclusions: The literature analysis and experimental results reveal intricate relationships between coping strategies, academic stress, and adolescents' emotional outcomes. Common stressors include homework and testing, exacerbated by family and cultural expectations. Identified coping mechanisms include active participation, seeking social support, self-care, and sometimes avoidance. The effectiveness of these strategies varies, with adaptive techniques enhancing resilience and emotional health. The findings underscore the need for tailored interventions promoting useful coping strategies, bolstering social support networks, and encouraging self-care. There are gaps in understanding the interplay between coping mechanisms and cultural factors, necessitating further research across diverse backgrounds to develop culturally aware and effective support interventions for adolescents.

Keywords: Stress, Coping Mechanisms, Emotional Brain Growth, Adolescent

Introduction:

The biological stress responses contain numerous interconnections among the immune and nervous system. Stress not only impacts one's physical health, but consumes their social and mental life. As evolution occurred over generations, the stress people experience also evolved. Instead of worrying over whether they would get eaten by a predator, the majority of the human population focused on the financial, social and academic struggles. Currently, 10–30% of students experience academic stress [1] with a staggering 77% resorting to unhealthy coping mechanisms [2]. This surge in stress levels, coupled with detrimental coping methods, creates an imbalance in neural circuitry governing cognition, potentially influencing the expression of behaviors and behavioral states associated with anxiety .

This study hypothesizes that adolescents using effective coping mechanisms have enhanced emotional resilience and functional behavioral responses, contributing significantly to the existing literature. First, it validates the correlation between coping mechanisms and the emotional state of the brain. Despite the separate discussions on these topics, their direct relationship has ultimately received limited research attention. Second, the findings suggest potential avenues for future research, specifically focusing on the emotional changes within the brains of teenagers, crafting a clear platform for interventions and preventative measures to be implemented.

Methods:

To investigate the coping mechanisms employed by adolescents in response to academic stress and their impact on emotional functions, we conducted a study utilizing a mixed-methods

approach, focusing solely on semi-structured interviews. The study was conducted at the library of Adlai E. Stevenson High School, which provided a conducive environment for data collection and ensured a diverse sample of participants. The study participants were recruited using a systematic random sampling method. Specifically, we approached every third person entering the library to invite them to participate in the study. We surveyed a total of 63 individuals. There were 25 students per 11th and 12th grade, and a total of 5 students involved in the study that were 10th graders. The sampling strategy was purposefully designed to capture a range of experiences across different stages of adolescence. We selected specific grades to reflect varying levels of academic and social pressures, which often differ significantly as students advance through high school. Grades 11 and 12 were prioritized due to the heightened academic and career-related pressures associated with the later years of high school. However, we included a smaller group from the 10th grade—five students—in order to represent the perspectives of younger students without over-representing a cohort that may experience different stressors. By structuring the sample in this way, we aimed to balance depth and breadth in understanding coping mechanisms at different developmental stages. Informed consent was obtained from the participants prior to conducting the interviews. The semi-structured interviews were conducted with each participant individually, allowing for in-depth exploration of their experiences with academic stress and coping mechanisms. The interview protocol included open-ended questions about participants' perceptions of academic stress, the coping strategies they employed in response to stressors, and the perceived impact of these strategies on their emotional well-being. Participants were encouraged to elaborate on their responses and share personal anecdotes or examples to provide richer insights. All interviews were with the participants' consent and transcribed verbatim for analysis. Thematic

analysis was conducted to identify recurring themes and patterns related to coping mechanisms and emotional outcomes among adolescents facing academic stress. Data analysis involved coding the interview transcripts to identify common themes and categories related to coping strategies and emotional functions. The coding process was iterative, with codes being refined and revised as new themes emerged from the data. By focusing solely on semi-structured interviews and utilizing a systematic random sampling method, this study aimed to provide an in-depth exploration of adolescents' coping mechanisms in response to academic stress. This study employed a qualitative design, focusing on semi-structured interviews with high school students to explore coping mechanisms and behavioral responses to academic stress. Although a mixed-methods approach was initially considered, we opted for a qualitative focus to gain in-depth insights into participants' personal coping experiences, allowing us to examine nuanced themes such as stress management strategies, perceived effectiveness, and emotional responses. No quantitative data was collected, as our research aimed to uncover subjective, complex perspectives rather than generalizable patterns. This approach aligns with the study's goals, enabling a rich thematic analysis based on participants' narratives.

Theoretical Framework:

Initially, to foster understanding of existing theories in relation to stress and coping mechanisms, we must provide a theoretical framework. Adolescence remains a pivotal time period for cognitive and socio-emotional changes. Therefore, a theoretical framework can guide the exploration of interactions and advocate for the development of interventions. In this paper, we are going to focus on Lazarus and Folkman's Transactional Model of Stress and Coping and the Biopsychosocial Model.

The Lazarus and Folkman's model defines stress as a dynamic process involving continuous transactions between individuals and their environment. This model posits that stress is a result of an individual's appraisal of environmental demands and their perceived capacity to manage those demands. Adolescents facing academic stress frequently evaluate their workload, test performance, and time management as part of this transactional process, assessing whether they have the necessary resources—emotional, cognitive, or behavioral—to cope effectively. The model is particularly relevant to adolescents in high-stakes educational environments, where academic stress can be a constant, and individual responses to stress vary based on personal and situational factors. The model emphasizes the importance of stress appraisal and coping mechanisms and highlights the bidirectional nature of it [3]. The model then takes a step forward to mention how there are two primary coping mechanisms: problem solving and emotion focused coping [3]. Categorizing strategies into these two broad topics allows for relevant understanding of different stresses, (ex: academic), and their perception of control over them. In essence, the model aims to help people cope with these stressful situations by using objective appraisal [4]. By applying this model, we aim to understand how adolescents actively interpret and manage their academic challenges through various coping mechanisms, which may be adaptive or maladaptive.

On the other hand, The Biopsychosocial Model makes an effort to cultivate understanding of well-being by integrating social and biological factors to emphasize the direct relationship between them in shaping an individual's experience and outcome [5]. By considering these factors together, it allows the model to provide a holistic understanding of these elements' impacts. For example, academic stress can leave an impending impact on the physiological effects on adolescents: it could alter the neuronal circuits [6], or the neurotransmitter levels [7].

These biological factors can therefore contribute to how adolescents respond. Additionally, social factors—like peer relationships and parental expectations—impact how adolescents perceive and react to academic stress.

The transactional and biopsychosocial models complement each other by providing a multi-layered perspective on stress. While the transactional model focuses on cognitive appraisal and coping responses, the biopsychosocial model broadens the scope, illustrating how physical and social environments contribute to an adolescent's overall stress experience. Together, these models help explain the complex ways in which adolescents process and cope with academic demands, recognizing that stress management is not just an individual cognitive process but also one influenced by broader biological and social contexts.

Coping Mechanisms and Academic Stress:

For adolescents, the major stress seems to be academic stress. This stress can arise from various sources such as fear of failure, workload, academic expectations, and balancing academic demands with other responsibilities. Academic stress is known to have significant effects on the mental health and academic performance of adolescents [8]. However, by incorporating certain coping mechanisms, adolescents can manage these difficulties. Coping mechanisms typically refer to the strategies individuals use to manage stress, or challenging situations. These mechanisms can be both conscious and unconscious and can vary widely from person to person [8]. Coping mechanisms can be adaptive, helping individuals effectively deal with stressors, or maladaptive where they potentially exacerbate stress or cause other problems [9].

A variety of coping strategies and techniques are employed in the process of dealing with academic stress. For instance, adolescents may use problem-focused coping strategies to address the academic stressors directly by taking action to solve the underlying problems. They may engage in behaviors such as seeking additional help from teachers, or joining study groups to improve their academic performance. Studies have shown that problem-focused coping is associated with better academic outcomes and psychological well-being among adolescents [10]. Emotion-focused coping strategies involve regulating distressing emotions associated with academic stress without necessarily addressing the underlying problems directly. Adolescents may also use techniques such as seeking emotional support from friends or engaging in relaxation exercises to manage their stress levels. Research suggests that emotion-focused coping can help adolescents alleviate emotional distress and maintain psychological well-being, even if it doesn't necessarily improve academic performance directly [11]. Avoidance coping can be inferred as a form of disengagement coping, where individuals attempt to distance themselves from the stressor. Adolescents also tend to use avoidance coping strategies such as procrastination, denial, or social withdrawal to avoid confronting the academic stressors directly. However, studies have indicated that avoidance coping tends to be associated with poorer academic outcomes and psychological well-being among adolescents [12].

Coping mechanisms mainly vary significantly based on individual characteristics such as gender, socioeconomic status (SES), and cultural factors. Research suggests that women tend to utilize more emotion-focused coping strategies compared to men. They may be more likely to seek social support, engage in emotional expression, and use cognitive reappraisal techniques to manage stressors. This trend may be influenced by societal norms that encourage women to express emotions openly and seek support from others [13]. On the other hand, men may be

more inclined to use problem-focused coping strategies, such as seeking solutions to stressors or engaging in instrumental actions to address challenges. This may be influenced by traditional masculine norms that emphasize self-reliance and problem-solving abilities [14]. Interestingly, individuals from higher socioeconomic backgrounds may have access to more resources, and as a result, they may be more likely to use problem-focused coping strategies and seek professional help when facing stressors [15]. Conversely, individuals from lower socioeconomic backgrounds may have fewer resources and face more chronic stressors related to poverty, and may be more inclined to use emotion-focused coping strategies, such as seeking social support from family and friends, or avoidant coping strategies, such as denial or substance use, due to limited resources for problem-solving [16]. Similarly, in cultures that emphasize individualism, such as Western societies, coping strategies may focus more on individual autonomy and assertiveness. Problem-focused coping and emotion-focused coping may be commonly used, depending on the nature of the stressor and personal preferences [17]. In contrast, cultures that prioritize collectivism, such as Asian or African societies, may emphasize the importance of interdependence, and family support. Coping strategies may involve seeking guidance from elders, maintaining group cohesion, and prioritizing the well-being of the community over individual needs [17]. It's important to recognize that individuals possess multiple intersecting identities [19], and coping mechanisms may be shaped by the interplay of these factors. For example, a woman from a lower SES background may face unique stressors related to gender discrimination and socioeconomic disadvantage, leading to a complex array of coping strategies that reflect both her gender and socioeconomic status.

Emotional Functions of the Brain:

The limbic structure oversees and micromanages one's emotions. While research fails to provide full detail regarding the structures, the known ones are the amygdala, hippocampus, limbic cortex, and hypothalamus [20] The feeling of chronic stress can therefore impair these structures significantly. For instance, it would significantly reduce the volume of hippocampus [21], leaving the body to have fluctuated temperature, growth, weight, etc. [22]. Furthermore, different types of stresses activate different types of neuronal circuits that are life threatening In contrast, psychological stressors, such as academic stress, activate higher-order brain structures for further perceived endangerment. [23]]. For instance, when someone is experiencing a stressful event, the amygdala, a structure that facilitates emotional processing, sends a signal of discomfort to the hypothalamus [24], a structure that keeps your body stable. ("Hypothalamus"). However, long term stress often overactives the limbic system and the over release of epinephrine can damage blood vessels, and cause high blood pressure [25].

These key structures play crucial roles with regulation and expression of emotions, while neurotransmitters act as chemical messages to facilitate the communication between the vast regions of the brain [26]. For instance, the major neurotransmitters related to stress are dopamine and norepinephrine (NE). These chemical messages are very sensitive to stress, so much so that it depletes critical neurotransmitters; these low levels can therefore leave one to be depressed and prone to addiction [27] affecting students' performance at school and their relationships with people around them.

To further advance the relationship of the brain to emotional function, it is utmost clear that stress, especially during developing states such as adolescentes, causes functional and morphological changes to the amygdala and PFC at a substrate and circuit level, which may

have behavioral implications for emotion regulation [28]. More specifically, when analyzing behavioral changes, there seems to be a pattern of cloudy thinking, increased alcohol or drug use and a change in emotional responses to others [29]. In particular, when observing anhedonia with its coupled association with chronic stress and prevalence in adolescence [30], there seems to be a strong association with depression that arises when POMC neurons in the arcuate nucleus of the hypothalamus become hyperactive [31]. When observing human studies, anhedonia seems to be characterized by dysregulation of circuits involving the PFC and amygdala, regions that are notably affected by chronic stress.

Results:

Adolescent interviewees highlighted several prevalent academic stressors, including test anxiety, the overwhelming burden of homework, and the fear of being unprepared. These stressors are often exacerbated by societal and familial expectations to achieve high academic performance. To navigate these challenges, teenagers reported employing various coping strategies, reflecting their need to manage stress effectively in an increasingly demanding environment. One significant coping mechanism is social support, which serves as a vital resource during difficult times. Many adolescents rely on friends and family for emotional comfort and practical advice. These relationships provide a sense of stability and reassurance that helps them cope with academic pressures. Additionally, self-care practices have proven beneficial for many teenagers. Engaging in activities such as reading, exercising, and listening to music allows them to alleviate stress and restore emotional balance, offering a moment of reprieve from their demanding routines. Nevertheless, some teenagers acknowledged that avoidance coping mechanisms, such as procrastination, were only partially successful.

Individual preferences and situational factors affected each coping strategy's efficacy differently. There were long-term impacts, with dependence on poor coping mechanisms prolonging stress and regular application of adaptive strategies improving emotional well-being. Cultural backgrounds played a big role in how teenagers coped with academic stress, influencing both short-term and long-term outcomes. For teens from collectivistic cultures, family and community support were often the go-to strategies. Sharing their struggles with loved ones and leaning on a close-knit network not only helped them feel less alone but also gave them emotional strength during tough times. On the other hand, teens from individualistic cultures tended to rely more on themselves, using strategies like setting personal goals or working independently to deal with stress. These approaches had lasting effects. Relying on unhelpful habits, like avoidance or self-criticism, often made stress stick around longer. But when teens consistently used healthy strategies—whether that meant seeking support from others or solving problems on their own—they saw big improvements in their emotional well-being.

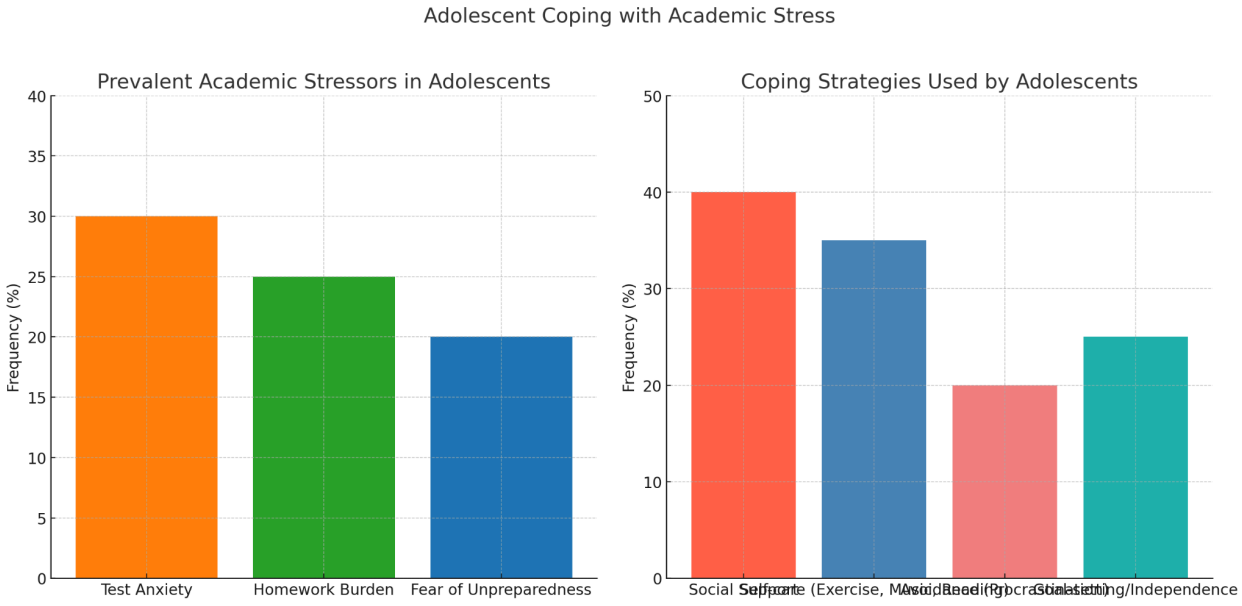

Figure 1: Results

Conclusion and Discussion:

The literature analysis and experimental results reveal the varied relationships between coping strategies, academic stress, and their emotional consequences for adolescents. Stress stemming from academic pressures, such as homework, tests, and the fear of falling short, is a universal challenge. This stress is often amplified by cultural norms and family expectations, creating a complex dynamic that shapes how teens experience and manage their emotional well-being. For example, one participant shared, *"I always feel like I can't take a break because my parents expect me to score top grades, and if I don't, it's like I've let them down."* This quote highlights how external expectations can intensify stress, pushing some teens toward unhealthy coping mechanisms like avoidance or overworking. On the flip side, another participant noted, *"When things get overwhelming, I like to talk to my friends. It's like they remind me that I'm not alone, and that helps a lot."* This scenario reflects how leaning on social support—whether from friends or family—can buffer stress and foster resilience. The findings also revealed that cultural context plays a significant role. Adolescents from collectivistic backgrounds often relied on family and community for support, while those from individualistic cultures were more likely to adopt self-reliant approaches like personal goal-setting or mindfulness practices. Both strategies had their benefits, but consistent use of adaptive strategies like seeking social support or engaging in self-care was linked to improved emotional well-being.

Several coping mechanisms have been identified to help adolescents manage stress, including actively engaging in tasks, seeking social support, practicing self-care, and sometimes relying on avoidance strategies. The effectiveness of these methods, however, varies significantly among individuals. Understanding these dynamics is important because effective coping not

only helps teens handle immediate stressors but also builds resilience, which can protect against negative emotional outcomes in the face of academic challenges. The literature suggests the need for interventions that promote healthy coping strategies tailored to each adolescent's unique needs.

Strengthening social support networks in schools and communities is one key way to provide emotional validation and foster resilience during tough academic times. Encouraging self-care practices and active participation in school activities can also help teens manage stress more effectively. For teens facing academic struggles, targeted therapy designed to meet these needs can lead to improvements in overall mental health. Despite progress in this area, gaps remain in understanding how cultural factors influence coping strategies. Future research should explore how these strategies vary across cultural backgrounds and how family expectations shape how teens manage stress. Additionally, investigating the potential role of digital mental health tools in supporting coping mechanisms, particularly among teens from different cultural contexts, could offer valuable insights. Further qualitative studies could also explore teens' personal experiences with stress and coping, providing a more nuanced understanding of their challenges. These findings could inform the development of culturally sensitive interventions, ensuring they are appropriate for diverse adolescent populations.

References:

1. “77% of Americans Have Used Addictive Behaviors or Unhealthy Coping Mechanisms to Manage Their Mental Health, according to Myriad Genetics Nationwide Survey.” *GeneSight*, 19 Apr. 2023, https://genesight.com/news-and-press/77-of-americans-have-used-addictive-behaviors-or

-unhealthy-coping-mechanisms-to-manage-their-mental-health-according-to-myriad-genetics-nationwide-survey/.

2. Aldridge, Arianna A., and Scott C. Roesch. “Developing Coping Typologies of Minority Adolescents: A Latent Profile Analysis.” *Journal of Adolescence*, vol. 31, no. 4, Sept. 2007, p. 499.
3. Algorani, Emad B., and Vikas Gupta. “Coping Mechanisms.” *StatPearls [Internet]*, StatPearls Publishing, 2023.
4. Alsulami, Saleh, et al. “Perception of Academic Stress among Health Science Preparatory Program Students in Two Saudi Universities.” *Advances in Medical Education and Practice*, vol. 9, 2018, p. 159.
5. Ayada, C., et al. “The Relationship of Stress and Blood Pressure Effectors.” *Hippokratia*, vol. 19, no. 2, Apr. 2015, p. 99.
6. Barbayannis, Georgia, et al. “Academic Stress and Mental Well-Being in College Students: Correlations, Affected Groups, and COVID-19.” *Frontiers in Psychology*, vol. 13, May 2022, p. 886344.
7. Barnett, Phoebe, et al. “The Association between Social Class and the Impact of Treatment for Mental Health Problems: A Systematic Review and Narrative Synthesis.” *Social Psychiatry and Psychiatric Epidemiology*, vol. 58, no. 4, Nov. 2022, p. 581.
8. Berjot, Sophie, and Nicolas Gillet. “Stress and Coping with Discrimination and Stigmatization.” *Frontiers in Psychology*, vol. 2, 2011, https://doi.org/10.3389/fpsyg.2011.00033.
9. Borrell-Carrió, Francesc, et al. “The Biopsychosocial Model 25 Years Later: Principles, Practice, and Scientific Inquiry.” *Annals of Family Medicine*, vol. 2, no. 6, Nov. 2004, p.

576.

10. Cheng, Xiaochun, and Huiling Lin. “Mechanisms from Academic Stress to Subjective Well-Being of Chinese Adolescents: The Roles of Academic Burnout and Internet Addiction.” *Psychology Research and Behavior Management*, vol. 16, Oct. 2023, p. 4183.
11. “Chronic Stress.” *Yale Medicine*, 6 Aug. 2022, https://www.yalemedicine.org/conditions/stress-disorder.
12. Fuchs, E., and G. Flügge. “Chronic Social Stress: Effects on Limbic Brain Structures.” *Physiology & Behavior*, vol. 79, no. 3, Aug. 2003, https://doi.org/10.1016/s0031-9384(03)00161-6.
13. Herres, Joanna, and Christine Mccauley Ohannessian. “Adolescent Coping Profiles Differentiate Reports of Depression and Anxiety Symptoms.” *Journal of Affective Disorders*, vol. 186, Aug. 2015, p. 312.
14. “Hypothalamus.” *Cleveland Clinic*, https://my.clevelandclinic.org/health/body/22566-hypothalamus. Accessed 1 Mar. 2024.
15. Lupien, S. J., et al. “The Effects of Chronic Stress on the Human Brain: From Neurotoxicity, to Vulnerability, to Opportunity.” *Frontiers in Neuroendocrinology*, vol. 49, Apr. 2018, https://doi.org/10.1016/j.yfrne.2018.02.001.
16. Milner, Allison, et al. “The Influence of Masculine Norms and Mental Health on Health Literacy Among Men: Evidence From the Ten to Men Study.” *American Journal of Men’s Health*, vol. 13, no. 5, Sept. 2019, p. 1557988319873532.
17. Neuroscience News. “When Chronic Stress Activates These Neurons, Behavioral Problems Like Loss of Pleasure and Depression Result.” *Neuroscience News*, 24 Jan. 2023, https://neurosciencenews.com/pomc-neurons-depression-stress-22343/.

18. *[No Title]*. https://paperpile.com/c/QAEU5k/LAuWM. Accessed 5 Jan. 2025.
19. Pampel, Fred C., et al. “Socioeconomic Disparities in Health Behaviors.” *Annual Review of Sociology*, vol. 36, Aug. 2010, p. 349.
20. *Regulating Stress*. https://courses.lumenlearning.com/waymaker-psychology/chapter/regulation-of-stress/. Accessed 5 Jan. 2025.
21. Research leaders. *The Limbic System*. 10 Nov. 2017, https://qbi.uq.edu.au/brain/brain-anatomy/limbic-system.
22. Sanchez Jimenez, Jose G., and Orlando De Jesus. “Hypothalamic Dysfunction.” *StatPearls [Internet]*, StatPearls Publishing, 2023.
23. Schoenmakers, Eric C., et al. “Problem-Focused and Emotion-Focused Coping Options and Loneliness: How Are They Related?” *European Journal of Ageing*, vol. 12, no. 2, Feb. 2015, p. 153.
24. Sheffler, Zachary M., et al. “Physiology, Neurotransmitters.” *StatPearls [Internet]*, StatPearls Publishing, 2023.
25. Sheth, Chandni, et al. “Chronic Stress in Adolescents and Its Neurobiological and Psychopathological Consequences: An RDoC Perspective.” *Chronic Stress*, vol. 1, 2017, https://doi.org/10.1177/2470547017715645.
26. Stanisławski, Krzysztof. “The Coping Circumplex Model: An Integrative Model of the Structure of Coping With Stress.” *Frontiers in Psychology*, vol. 10, Apr. 2019, p. 694.
27. Tottenham, Nim, and Adriana Galván. “Stress and the Adolescent Brain: Amygdala-Prefrontal Cortex Circuitry and Ventral Striatum as Developmental Targets.” *Neuroscience and Biobehavioral Reviews*, vol. 70, July 2016, p. 217.

28. “Understanding the Stress Response.” *Harvard Health*, 6 July 2020, https://www.health.harvard.edu/staying-healthy/understanding-the-stress-response.
29. Wand, Gary. “The Influence of Stress on the Transition From Drug Use to Addiction.” *Alcohol Research & Health*, vol. 31, no. 2, 2008, p. 119.
30. *Website*. https://www.researchgate.net/publication/41824842_Maladaptive_coping_adaptive_coping_and_depressive_symptoms_Variations_across_age_and_depressive_state.
31. ---. https://psycnet.apa.org/record/2020-27719-001.