Depression and Mental Health of Students, and possibilities offered by Cognitive Neuroscience

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Did you know that mental illnesses such as schizophrenia, depression, epilepsy, dementia, and substance abuse disorders constitute about 13% of the global burden of disease worldwide, surpassing both cancer and cardiovascular disease. These figures are likely to have been further exacerbated in Covid 19 and due to the proliferation of social media platforms, particularly in the younger generation. The lack of cures and dearth of preventive interventions for such disorders is in part also due to the limited understanding of the brain, and its molecular and cellular mechanisms.

Exposure to stress events is a well-established risk factor for mental illnesses such as depression. However, it is still difficult today to prospectively identify individuals from the general population under stress, who will respond poorly to stressors and are therefore more likely to face depression. Creating biomarkers to identify stress susceptibility has therefore become one of the key research areas for early identification of such mental illnesses.

Challenges faced by Students

The transition from high school to university is a major life stressor for teenagers that poses several challenges. Navigating their role to adulthood, increasing academic and financial responsibilities, adjusting to new living conditions, and separating from the traditional support network of family are all stressors that occur within a very short period. Moreover, all these events happen during the ages of 16-20 years, a developmental period characterized by increased stress susceptibility. Aside from parental history and temperament, greater stress in this transition has also been linked to poor academic outcomes, higher rate of attrition and increased suicidal behavior. It is estimated that approximately 7% of adolescents will develop a mental illness by the time they are in the first year of university and develop depression for the first time.

The Advent of Cognitive Neuroscience

The brain is broadly made up of grey matter, which is responsible for social cognitive abilities, self-awareness, moral reasoning, language, and voluntary movement; white matter, which is located deeper in the brain and connects different areas of grey matter, and cerebrospinal fluid which cushions the brain.

Neurology and neuroscience have long examined the connection of the brain and the nervous system to the body and explored treatment for nervous system disorders. Mental health issues and the study of mind and behavior have however been studies by psychology. However, neither neuroscience nor psychology can alone provide the comprehensive lens to correlate the mind with neural responses. Neuropsychiatry along with cognitive neuroscience have become the fields that combine the causes of disorders related to neuropathology and those related to the mind and environment.

Cognitive neuroscience studies the neurobiological mechanisms that underlie mental processes and behaviors. Magnetic Resonance Imaging (MRI) is a neuroimaging technique that produces high resolution images of brain anatomy and allows assessment of brain structure. Functional MRI (fMRI) measures the blood oxygenation level dependent (BOLD) signal and reflects changes in blood flow that correspond to a brain activity, while the participant is performing a cognitive task in the scanner. Diffusion tensor imaging (DTI) is used to examine structural connectivity, which is a measure of how well white matter connects with grey matter. Together, these imaging techniques have allowed to us to understand how the brain is organized, how it functions when processing information and how various regions communicate to support cognition and behavior.

Neuroplasticity

Several studies have confirmed the plasticity of the human brain – the ability of the brain to adapt and change, suggesting that the adult human brain does have the capacity to strengthen and generate new neural connections to enhance daily function, especially in response to injury or learning.

For example, constraint-induced movement therapy is a technique used to rehabilitate patients to manage daily tasks after a stroke. Individuals under this treatment, practice movements using the impacted limb by constraining the unimpacted limb, thereby forcing the reorganization of neural connections, often motor neurons, in the brain area damaged by the stroke. Similarly, experiencing chronic stress contributes to abnormal brain functioning and grey matter loss, which can lead to cognitive impairment in people with depression, schizophrenia, and autism. Supportive and enriched social environments however can facilitate brain plasticity by strengthening neural connections, reflected by increase in grey matter. These principles of neuroplasticity have become the driving force for cognitive remediation intervention and have the potential to increase the effectiveness of interventions that promote recovery from a mental illness.

Biomarkers and improving Mental Health Treatment

Current practice diagnoses a mental health condition after the onset of behavioral symptoms that meet a specific criterion. However neural signs of mental health symptoms are often present years before the manifestation of the condition. These neural signs, or biomarkers, open the possibility of a window where intervention or possible prevention of mental illness may be possible. In the context of cognitive neuroscience, a biomarker is a measurable neurobiological feature which indicates that the person is at risk of developing a mental illness. While reliable biomarkers for diagnosis of mental illnesses do not exist yet, there is exciting potential based on the imaging and analysis techniques that make this a real possibility in the near future.

Biomarkers can also be used to identify the signatures which mark brain resiliency. Study of neural substrates in people exposed to an adverse social environment, and not developing mental health issues, can help us learn how the brain protects itself. Early results indicate that better organized neural networks for reward processing, emotion regulation and stress management may be features of sustained mental health, even in the face of stress and trauma.

Youth Vulnerability to Depression

The role of social factors in the development and treatment of depression has long been recognized. However, it is only recently that this work has been extended to examine how individual differences in neural processing of social interactions relate to risk. Vulnerability models of depression have proposed that altered responses to both positive and negative emotional stimuli, are traits which correlate with increased risk of later depression. Initial results indicate that increased reactivity to negative social feedback and blunted response to social reward are characteristics of high vulnerability. An important conclusion is that a reduction in positive reinforcement in the environment increase risk of depression later.

Though additional research is needed in factors that contribute to risk of depression, studies support the possibility that these measures can be used to predict which children and adolescents are likely to develop depression. This potential of informing early intervention both from a clinical and social perspective can lead to improving long term outcomes for youth at risk of depression.

Diagnosis and treatment aside, its clear that mental health, particularly in adolescents, is a significant epidemic which we all need to recognize, both at our institutions as schools and universities, and as mentors, teachers and friends. Awareness of the social factors that exacerbate the risk of mental illness for those around us, can be the first and foremost preventive measure that we can introduce ourselves, while science catches up with the challenges and reality of human society.

References

Collins PY, Patel V, Joestl SS, March D, Insel TR, Daar AS; Grand challenges in global mental health. Nature. 2011 Jul 6;475(7354):27-30. doi: 10.1038/475027a. PMID: 21734685; PMCID: PMC3173804.

Kujawa A, Burkhouse KL. Vulnerability to Depression in Youth: Advances from Affective Neuroscience. Biol Psychiatry Cogn Neurosci Neuroimaging. 2017 Jan;2(1):28-37. doi: 10.1016/j.bpsc.2016.09.006. PMID: 28497126; PMCID: PMC5421558.

Sandre A, Bagot RC, Weinberg A. Blunted neural response to appetitive images prospectively predicts symptoms of depression, and not anxiety, during the transition to university. Biol Psychol. 2019 Jul;145:31-41. doi: 10.1016/j.biopsycho.2019.04.001. Epub 2019 Apr 8. PMID: 30974147.

Wojtalik JA, Eack SM, Smith MJ, Keshavan MS. Using Cognitive Neuroscience to Improve Mental Health Treatment: A Comprehensive Review. J Soc Social Work Res. 2018 Summer;9(2):223-260. doi: 10.1086/697566. Epub 2018 Apr 27. PMID: 30505392; PMCID: PMC6258037.