The importance of cognitive neuroscience research cannot be overstated. In recent years neuroscience is responsible for some of the most innovative findings and scientific breakthroughs that seek to identify causes and improve treatments for mental health disorders. Among cognitive neuroscience discoveries are links between brain activity and behaviors that play an important role in emotion regulation.

The integration of cognitive neuroscience and mental health research increases the effectiveness of interventions that promote recovery from some of the most challenging psychiatric disorders including bipolar disorder, depression, addiction, anxiety, post-traumatic stress disorder and schizophrenia.

Cognitive Neuroscience Basics
Cognitive neuroscience is an inter-disciplinary subfield of neuroscience, which focuses on the study of fundamental mechanisms that underlie psychiatric diseases and disorders of the brain, such as major depression or anxiety. When we have thoughts and/or behaviors that cause distress or impairment in our lives, as is often the case in mental health disorders, this is the result of the way our brain functions. Cognitive neuroscience can help us to understand what brain circuitry plays a role in mental health- for resilience, for mental illness, and for everything in between. Through cognitive neuroscience we can develop new ways of conceptualizing and diagnosing psychiatric disorders, with the ultimate goal of using this knowledge to develop novel treatments.

Continued on page 2
Neuroscience

Continued from page 1

Brain and Behavior

Neuroimaging technologies are the most commonly used tools in cognitive neuroscience, as a means of visualizing the brain. Neuroimaging allows us to explore the brain, and collect different pieces of information needed to find biomarkers that will help predict the most effective treatment plans for patients.

There are several tools that we can use to do this. One tool is functional magnetic resonance imaging (fMRI), which measures blood flow to different regions of the brain while participants complete tasks that measure cognitive or emotion processes relevant to psychiatric disorders. There are also more cost-effective measures that researchers can use to assess brain-markers implicated in psychiatric disorders, such as electroencephalography (EEG), eye-tracking methods, or psychophysiological tools such as heart rate and respiration.

Over the past few decades, the field has shown that cognitive neuroscience tools can help us to achieve this goal. For example, just as cardiac imaging during a stress test can be used to diagnose coronary artery disease, one can imagine studies in which patterns of brain activation following stimulation may be diagnostic for early mental health detection.

Improving mental health treatment through cognitive neuroscience

Cognitive neuroscience can help us to identify brain and behavioral targets in order to develop better treatments to reduce the suffering of the many individuals with mental health disorders. Importantly, cognitive neuroscience can also help us to identify brain and behavioral risk factors that we can use for targeted prevention efforts, before the development of mental health disorders, in order to prevent the suffering and impairment caused by these disorders.

“By utilizing cognitive neuroscience tools, we can study the underlying mechanisms of depression and also use these methods to identify which individuals are at greatest risk for developing depression. In one example, researchers have consistently documented impairments in emotional reactivity and regulation responses among individuals with depression. Utilizing cognitive neuroscience tools, researchers have been able to detect brain regions and networks that are responsible for these impairments. These studies document abnormal structure, function, and connectivity in brain regions that subserve these aspects of emotion and emotional regulation among individuals with depression. Results from these cognitive neuroscience studies have been used to inform the development of novel treatments for depression,” said Katie L. Burkhouse PhD, Assistant Professor of Psychiatry, UIC Department of Psychiatry.

For instance, real-time fMRI is a form of neurofeedback which can be used to train depressed patients in the self-regulation of brain circuits that are associated with deficits in emotion processing. In another example, researchers have utilized deep brain stimulation to target brain regions that are deficient in patients with treatment-resistant depression, such as the anterior cingulate cortex and ventral striatum, regions implicated in cognitive and emotion processing. This work has shown promise for deep brain stimulation reducing symptoms and future diagnoses of depression.
On March 10, 2021, UIHealth kicked off the first virtual *UIH Emotional Well-being and Recovery Town Hall* with UIH Leadership (VCHA Robert Barish, CEO Mike Zenn, COM Dean Mark Rosenblatt, CNO Shelly Major, and CMO Terry VandenHoek) along with keynote speaker Josh Morganstein, MD, Associate Professor and Assistant Director at the Center for the Study of Traumatic Stress in the Uniformed Services University of the Health Sciences in Bethesda, Maryland. Dr. Morganstein is a recognized expert on stress and trauma and has consulted with several local, national and international organizations to support the well-being of individuals and communities adversely impacted by traumatic events.

Dr. Morganstein described stressors as representing a broad spectrum in both their nature and magnitude, and further described our physiological and psychological responses to stress as also being broad and diverse - and often normal and appropriate responses. Therefore, support and interventions should be customized to individuals and groups based on their special circumstances and preferences as much as possible.

In preparation for the Town Hall, a needs assessment was sent to all UIH staff, trainees and faculty as part of our effort to develop mechanisms and strategies tailored to the emotional needs of UIH staff.

It was apparent from the responses that COVID-19 was the primary stressor over the last 6-12 months. A significant number of respondents indicated difficulty with stress/tension/anxiety, sleep, social support and balancing work-life challenges. With regard to the nature of the support and interventions that they would like to see, respondents expressed preferences for ‘wellness’ based interventions including nutritional education, sleep hygiene, mindfulness, and concentration and meditation exercises. There was also interest in short-term talk therapy.

This Town Hall is the first of what we hope will be a series of conversations and dialogues with the staff and leadership of UIH over the next several months to best meet the identified needs and serve UIH staff, trainees and faculty more effectively in the future.
Neuroscience
Continued from page 2

patients that have not responded to other standard psychosocial or pharmacological treatments of depression.

Cognitive neuroscience methodologies are also used for early detection of people at risk for mental illness, and are the focus of The Families, Affective Neuroscience, and Mood Disorders (FAM) Lab in UIC’s Department of Psychiatry. The lab represents some of the country’s leading researchers at the forefront of cognitive neuroscience and conducts extensive research of preventive interventions for depression, with the ultimate goal of developing reliable, objective tools that can aid in the prevention and diagnosis of child and adolescent depression.

“Specifically, we know that children who have parents with a history of major depressive disorder are at significantly elevated risk for multiple forms of psychiatric disorders across the lifespan. Given this, there is a need to identify specific mechanisms of risk in order to develop targeted, prevention efforts for this population. Our lab utilizes cognitive neuroscience approaches to identify children at greatest risk for developing depression throughout adolescence. For example, utilizing fMRI, we and others in the field have shown that youth at high risk for depression are characterized by enhanced engagement of brain regions responsible for processing negative salient information (e.g., passively viewing sad or threatening faces) and overactivation in brain regions can predict which offspring develop depression in the future. There is also a push in the field to use more cost-effective cognitive neuroscience tools to aid in the early detection of psychiatric disorders in children. For example, researchers have utilized eye-tracking tools to measure task-evoked pupil dilation, a peripheral measure of brain activation during the processing of emotion. Our lab has shown that greater pupillary response to negative stimuli prospectively predicted trajectories of depressive symptoms and diagnoses among children of depressed mothers, representing a potential cost-effective biomarker for depression risk among this high risk population that has the potential to be implemented in clinical settings, such as pediatricians offices,” said Burkhase.

Innovative research advancing neuroscience

The UIC neuroscience labs continue to advance the exploration of behavioral-brain risk phenotypes and preventive interventions for depressive disorders.

Recent studies of note include:
- **How brain reward circuitry may be a risk factor for problematic cannabis use**
- **How social signal contribute to severity of Social Anxiety Disorder**
- **Brain scan before antidepressant therapy may predict response**

“Cognitive neuroscience findings have greatly increased our understanding of the neurobiology of depression and other internalizing psychopathologies, which has important clinical applications though further work is necessary to translate findings to real-world clinical practice.” said Heide Klump PhD, Associate Professor of Psychiatry, UIC Department of Psychiatry.

One major trend in cognitive

Continued on page 5
Neuroscience
Continued from page 4

Neuroscience is using advanced data-driven methods to increase precision in detecting mental health disorders. For instance, large open-source neuroimaging datasets are gaining increasing popularity in our field, making it possible for researchers to apply advanced statistical methods, such as machine learning, to this type of data to predict clinical outcomes. For example, researchers have utilized data-driven approaches that harness whole-brain data to increase precision in classifying major depressive disorder. Other work has shown the promise of combining machine learning approaches and MRI data to improve prediction of treatment response for depression. Although this work is still in its infancy, this type of approach offers great potential to improve our understanding of depression.

“Neuroscience allows us to examine brain structure and function in humans in a way that would otherwise be impossible. Importantly, neuroimaging techniques greatly contribute to our efforts to destigmatize mental health disorders, as they demonstrate how mental health disorders are brain-based disorders, not character flaws or other negative stereotypes that people may have about mental health disorders,” said Natania Crane PhD, Assistant Professor of Psychiatry, UIC Department of Psychiatry and Associate Director of the UIC Recovery Clinic.

Explore more of the pioneering bipolar disorder research and cutting-edge treatment at UIC clinics:

The Families, Affective Neuroscience, and Mood Disorders (FAM) Lab
The Families, Affective Neuroscience, and Mood Disorders Lab seeks to identify behavioral-brain risk markers and preventive interventions for child and adolescent depression. By combining multiple units of analysis, (i.e., behavioral, EEG, pupil dilation, fMRI), we explore cognitive-affective processing styles involved in the development of depression in youth and also in the transmission of depression from parents to their offspring. The ultimate goal of this research is to develop reliable, objective tools that can aid in the prevention and diagnosis of youth depression.

Katie L. Burkhouse PhD
• Assistant Professor of Psychiatry

REWARD Lab
The REWARD lab, led by Dr. Natania Crane, PhD, performs Research Examining What drives Addiction Risk and comorbid Depression. We seek to better understand the brain and behavioral risk factors for Substance Use Disorder and co-occurring mental health disorders (e.g., depression, anxiety). Our lab uses multi-modal imaging techniques (fMRI and EEG), neuropsychological measures, self-report measures, and acute drug administration studies. The goal of our studies is to identify neurobehavioral risk factors that can be targeted for prevention strategies among individuals at risk for Substance Use Disorders and for treatment strategies among individuals diagnosed with Substance Use Disorders.

Natania Crane PhD
• Assistant Professor of Psychiatry
• Associate Director of the UIC Recovery Clinic

Clinical Cognitive Affective Neuroscience Lab
The overarching goal of the Clinical Cognitive Affective Neuroscience (CCAN) lab is to increase our understanding of anxiety, depression, and mechanisms of treatment (e.g., Cognitive Behavioral Therapy) to reduce the suffering associated with these and other debilitating internalizing psychopathologies (e.g., stress-related disorders). Our methods include functional magnetic resonance imaging (fMRI), psychophysiological measures such as electroencephalogram (EEG), behavioral and subjective measures (e.g., neuropsychological, actigraphy, self-report) to advance our understanding of several interrelated themes.

Heide Klumpp PhD
• Associate Professor of Psychiatry

UICDR NEWSLETTER SPRING 2021 5