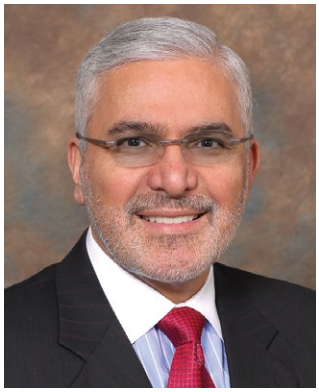

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Is the contemporary mental health crisis among youth due to DMN disruption?

The advent of unprecedented technologies drastically altering the behavior of children and adolescents, compounded by prolonged isolation from a once-in-a-century pandemic, may have negatively impacted the normal connectivity of the human brain among youth, leading to the current alarming increase of depression, anxiety, and suicidality among this population.

DMN deactivation by excessive use of social media may explain the mental health decline in youth

The human brain is comprised of multiple large-scale networks that are functionally connected and control feelings, thoughts, and behaviors. As clinical neuroscientists, psychiatrists must consider the profound impact of a massive societal shift in human behavior on the functional connectivity of brain networks in health and disease. The advent of smartphones, social media, and video game addiction may have disrupted the developing brain networks in children and adolescents, leading to the current escalating epidemic of mental disorders in youth.

The major networks in the human brain include the default mode network (DMN), the salience network, the limbic system, the dorsal attention network, the central executive network, and the visual system.[1] Each network connects several brain regions. Researchers can use functional MRI to detect the connectivity of those networks. When blood flow increases concurrently across 2 or 3 networks, this indicates those networks are functionally connected.

There was an old "dogma" that brain regions use energy only when activated and being used. Hans Berger, who developed the EEG in 1929, noticed electrical activity at rest and proposed that the brain is constantly busy, but his neurology peers did not take him seriously.[2] In the 1950s, Louis Sokoloff noticed that brain metabolism was the same whether a person is at rest or doing math. In the 1970s, David Ingvar discovered that the highest blood flow in the frontal lobe occurred when a person was at rest.[3] Finally, in 2007, Raichle et al[4] used positron emission tomography scans to confirm that the frontal lobe is most active when a person is not doing anything. He labeled this phenomenon the DMN, comprising the medial fronto-parietal cortex, the posterior cingulate gyrus, the precuneus, and the angular gyrus. Interestingly, the number of publications about the DMN has skyrocketed since 2007.

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The many roles of the DMN

Ongoing research has revealed that the DMN is most active at rest, and its anatomical hubs mediate several key functions[5]:

- *Posterior cingulate gyrus* (the central core of the DMN): remembering the past and thinking about the future
- *Medial prefrontal cortex*: autobiographical memories, future goals and events, reflecting on one's emotional self, and considering decisions about family members
- *Dorsal medial subsystem*: thinking about others, determining and inferring the purpose of other people's actions
- *Temporo-parietal junction*: reflecting on the beliefs and emotions of others (known as "theory of mind"[6])
- *Lateral parietal junction:* retrieval of social and conceptual knowledge
- *Hippocampus:* forming new memories, remembering the past, imagining the future
- *Posterior-inferior parietal lobe:* junction of auditory, visual, and somatic sensory information and attention
- *Precuneus*: Visual, sensory-motor, and attention.

Many terms have been used to describe the function of the DMN, including "daydreaming," "auto-pilot," "mind-wondering," "reminiscing," "contemplating," "self-reflection," "the neurological basis of the self," and "seat of literary creativity."

Psychiatric consequences of DMN deactivation

When another brain network, the *attention network* (which is also referred to as the *task-positive network),* is activated consciously and volitionally to perform a task that demands focus (such as text messaging, playing video games, or continuously interacting with social media sites), DMN activity declines.

The DMN does not exist in infants, but starts to develop in childhood.[7] It is enhanced by exercise, daydreaming, and sleep, activities that are common in childhood but have declined drastically with the widespread use of smartphones, video games, and social media, which for many youth occupy the bulk of their waking hours. Those tasks, which require continuous attention, deactivate the DMN. In fact, research has shown that addictive behavior decreases the connectivity of the DMN and suppresses its activity.[8] Most children and adolescents can be regarded as essentially addicted to social media, text messaging, and video games. Unsurprisingly, serious psychiatric consequences follow.[9]

DMN dysfunction has been reported in several psychiatric conditions, including depression, posttraumatic stress disorder, autism, schizophrenia, anxiety, obsessive-compulsive disorder, and substance use.[10-12] Impaired social interactions and communications, negative ruminations, suicidal ideas, and impaired encoding of long-term memories are some of the adverse effects of DMN dysfunction. The good news is that the DMN's connectivity and functioning can be modulated and restored by meditation, mentalizing, exercise, psychotherapy, antidepressants, and psychedelics.[13,14]

The lockdown and stress of the COVID-19 pandemic added insult to injury and exacerbated mental illness in children by isolating them from each other and intensifying their technological addiction to fill the void of isolation. This crisis in youth mental health continues unabated, and calls for action to prevent grim outcomes. DMN dysfunction in youth can be reversed with treatment, but access to mental health care has become more challenging due to workforce shortages and insurance restrictions. Psychiatrists and parents must work diligently to treat psychiatrically

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affected youth, which has become a DaMN serious problem…

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The good news is that the DMN's connectivity and functioning can be modulated and restored