

Yoga Research

The Emerging Neuroscience of the Wandering Mind and Meditation

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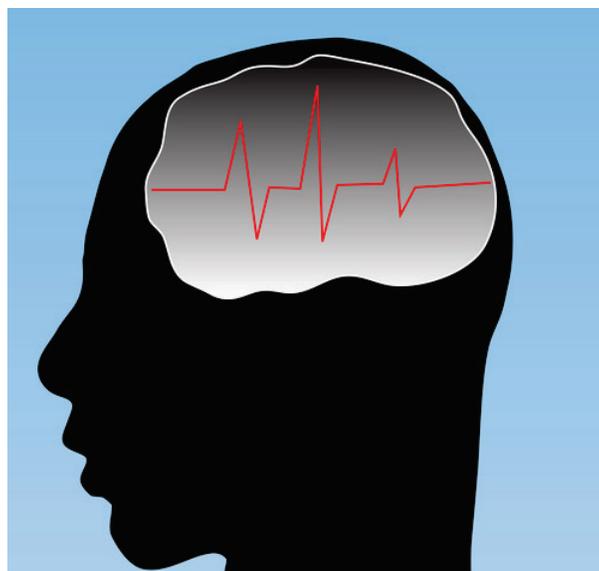
Like an imaginary friend, mind wandering might keep us company when we're waiting for a bus or waiting in the doctor's office. However, it also pays us less welcome visits when we're trying to concentrate on reading or completing a time-sensitive task. This ubiquitous characteristic of the human mind has been well-known for centuries and was described in the ancient Upanishad scriptures: "...this mind of mine is extremely restless" and "It wanders from a cloth to a pot and thence to a big cart. The mind wanders among objects as a monkey does from tree to tree." (Annapurna Upanishad III-5 and

Annapurna Upanishad III-6).

Human beings have a natural propensity for mind wandering. Mind wandering is what occurs when we are contemplating scenarios of our past or future such as last week's argument with the spouse or the outcome of an upcoming business meeting. There are some recent and ongoing studies that show the evolutionary advantages of mind wandering. Creative problem solving, future planning, and as a refresher or relief from tedium are some of the possible benefits. However, it is when we dwell, as we most often do, on more challenging or stressful topics, such as the past argument with the spouse or the upcoming business meeting, that a less friendly form of mind wandering occurs. This may progress further into a more pernicious activity known as rumination, in which there is a persisting continual loop, the chewing of thoughts over and over, and this comes with a price.

Emotionally, it comes at the cost of one's happiness and sense of well-being. The study of mind wandering has now actually become a focus of scientific research to understand its consequences and underlying mechanisms. Most notably, a Harvard study on mind wandering in everyday activities, published in the prestigious journal *Science*, showed that people were less happy when their minds were wandering than when they were not and that, "The ability to think about what is not happening is a cognitive achievement that comes at an emotional cost."

In the brain, mind wandering is primarily associated with a network of interacting brain regions called the default mode network (DMN), although recent research



is suggesting that other brain regions are also involved. Some forms of activity in the DMN have been shown to have a direct link to mood disturbance and psychiatric conditions. The more one ruminates, the more the default mode network is strengthened. This phenomenon is known as brain plasticity and works very much like the way building a muscle might happen. The more time spent exercising the muscle, the more it grows, and the stronger it becomes. The more time spent in mind wandering and rumination, the more the brain is dominated by performing that activity, and the unhappier you become. Over time, too much DMN activation in rumination is associated with risk factors for mental health conditions such as depression, addictive behaviors, attention deficit disorders, and anxiety disorders.

On the flip side, there is a brain activity that is very different than mind wandering or rumination which is associated with task-oriented functions that require focus and control of attention. One of these activities is meditation, the relaxed focus of attention. Instead of the past or future thinking in mind wandering, this activity involves focus on the here-and-now and involves activation of the attention networks in the brain in the frontal lobe. Meditation is a proven mechanism for training the mind and there are two primary meditation forms. One is closed focus or concentrative meditation, in which one focuses attention on a single point or target such as the breath, an image, or a mantra. The other form is referred to as open focus, open monitoring, or mindfulness meditation in which one observes the flow of thought or sensation in consciousness. What is common to both forms of meditation is that mind wandering inevitably intervenes repeatedly, and the task is to redirect the mind to the object of attention in a relaxed manner.

This alternation between focus of attention and mind wandering is a hallmark of the practice of meditation. An elegant neuroimaging research study of meditation in the fMRI brain scanner (functional magnetic resonance imaging) distinguished this pattern of activity during meditation, revealing four distinct phases in a repetitive sequence: mind wandering, awareness of mind wandering, shifting of attention back to the intended focus, and sustained attention or focus. It was the DMN that was observed to become active during the mind-wandering phase, whereas the prefrontal cortex was activated during the focus phase. In longer term meditators, it was noted that these individuals were able to more quickly return to the focus phase of meditation, suggesting that there are lasting changes in brain regions associated with long-term practice of the task-focused attention in meditation. Other research is indicating that activation of the attention networks in the prefrontal cortex has inhibitory effects on the limbic system where emotions are regulated. This is significant, because it means that the minds of meditators, on the whole, are benefiting in a sustainable way.

Research is suggesting that individuals more prone to mind wandering and rumination are potentially more at risk for the development of mood disturbance and even psychiatric conditions. In long-term meditators, regions of the limbic system are actually structurally reduced in size compared with non-meditators and the risk for mood disorders is reduced. There is lowered emotional reactivity and an increased ease in decision-making. Increases in relaxation, improvements in focusing, and higher performance emerges. The more one meditates, the more one spends time activating the attention networks, and the less time one spends in DMN activity, and it is likely that structural changes follow the degree of activity in each network. Ultimately, with long-term meditation, the first known published description of the active control of attention in the act of meditation in the Upanishad scriptures is realized: "... the man who has a discriminating

intellect as his driver, and a controlled-mind as the reins, reaches the end of the path--that supreme state of Vishnu." (Katha Upanishad 1-III-9).



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