The Undermind

Frank J. McNamara
Bureau of Study Counsel, Harvard University

The Wandering Mind

A common assumption about learning is that the more successfully we sustain periods of narrowly focused attention the more effectively we will grasp the material. The mental state that characterizes this ideal laser-like penetration is called the *focused mode*.[1] When our ability to engage the focused mode is maximized, we might feel we are "in the zone," a state that psychologist Mihalyi Csikszentmihalyi refers to as *flow*.[2] In the flow state, absorption in a task is so complete that awareness of one's surroundings fades, time passes without notice, and concerns of the self recede into the background.

More often than not, however, our mind naturally wanders from the intended subject of our attention to unrelated matters, casting a wide beam over whatever is happening outside of our narrowly defined focus. The reason for this susceptibility can be understood in terms of the brain's hard wiring, installed over the course of millions of years of evolution. If our ancestors were so focused on a particular task that they didn't notice what was happening around them, they might not have noticed sudden threats that would emerge, or they might have missed important opportunities that would arise. Consequently, the human brain seems to have adapted to alternate automatically between the focused mode and attending to peripheral matters.

The threshold for shifting out of the focused mode (i.e. getting distracted) varies depending on the difficulty of the task, degree of interest, one's familiarity with the topic, one's physical state, other concerns on one's mind, etc. But even if one is facing a manageable task, deeply interested in the subject, physically comfortable, and free of immediate worries, sustaining one's focus of attention can be difficult. Psychologist and Nobel Prize recipient Daniel Kahneman describes the challenge:

> Maintaining a coherent train of thought requires discipline. An observer of the number of times I look at email or investigate the refrigerator during an hour of writing could reasonably infer an urge to escape and conclude that keeping at it requires more self-control than I can readily muster.[3]

The psychiatrist Iain McGilchrist points out that we are not necessarily active choosers of what draws our attention. He notes that "often what engages our attention comes to us pre-consciously, and by-passes any willed action..."[4] McGilchrist believes that the brain's

[1] For example, Oakley (2014).
[2] Csikszentmihalyi (2008).
[3] Kahneman (2013). p. 40.
[4] McGilchrist (2012) p. 162

automatic shifts in attention are largely a function of the right hemisphere, an area of the brain that is that is drawn to "vitality, life, and movement."[5]

> The figure of someone walking by distracts us, it is hard not to succumb to the television if a set is switched on anywhere in the room, because it portrays life and movement. In a room with fire, we are drawn to looking at it.[6]

Given our susceptibility to distraction, it can be helpful to use strategies that increase our ability to focus – for example, overviewing a text, identifying a specific step towards a larger goal, contextualizing the topic, articulating questions, and so on.

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On the other hand, researchers in cognitive neuroscience have been accumulating evidence that effective learning may actually be enhanced by stepping back from your work. The explanation for this is that very focused, effortful attention restricts us to a narrow range of thinking that may actually impede the processing of new information. Barbara Oakley, a professor of engineering at Oakland University and author of *A Mind for Numbers: How to Excel at Math and Science (Even If You Flunked Algebra),* explains, "Focused attention…can often help solve problems, but it can also create problems by blocking our ability to see new solutions."[7]

A well-known experiment by Simons and Chabris, known as *The Invisible Gorilla* test,[8] demonstrates the point:

> Imagine you are asked to watch a short video…in which six people - three in white shirts and three in black shirts - pass basketballs around. While you watch, you must keep a silent count of the number of passes made by the people in white shirts. At some point, a gorilla strolls into the middle of the action, faces the camera and thumps its chest, and then leaves, spending nine seconds on screen. Would you see the gorilla?
>
> Almost everyone has the intuition that the answer is "yes, of course I would." How could something so obvious go completely unnoticed? But when we did this experiment at Harvard University several years ago, we found that **half of the people who watched the video and counted the passes missed the gorilla.** It was as though the gorilla was invisible.[9]

You might think that an individual in a gorilla suit who is gesturing for attention directly in your line of vision is exactly the type of activity that your right hemisphere is programmed to notice. And usually it is. But this experiment vividly demonstrates that when we are most deeply engaged in a task, we can be effectively blind to any stimuli outside of our narrowly focused attention. In other words, while the focused mode is an important step in the process of learning, it also may lock us into a limited ability to connect with new (or old) information. On the other hand, when we relax and let go of conscious deliberation, we are in a position to allow rich, unbidden observations and associations to arise, connecting seemingly unrelated

[5] Ibid., p. 162.
[6] Ibid., p. 162.
[7] Oakley (2014). p. 52.
[8] Simons, D.J. and Chabris, C.F. (1999).
[9] Chabris, C.F. and Simons, D.J. (2010).

elements that are only available to a less focused mode of processing. We see what otherwise may remain invisible.

The Undermind

Researchers call this alternate mindset the *diffuse mode*, or the *default mode network*,[10] an unconscious network of interacting brain systems that is activated automatically when we step out of the focused mode and into a more relaxed, non-goal-directed state. This more relaxed state is thought to be a rich source of information processing and creativity. Guy Claxton, Emeritus Professor of Learning Sciences at Winchester University and author of *Hare Brain, Tortoise Mind: Why Intelligence Increases When You Think Less,* refers to this mode of intelligence as the *undermind*.[11] It is important to understand that the undermind is not necessarily characterized by thinking as we usually think of it. Iain McGilchrist, who reviewed decades of neuroscientific literature, explains it this way:

The undermind is not characterized by thinking as we usually think of it.

> We carry out most mental processes that would normally constitute what we mean by thinking without doing anything consciously, or in language, at all. Many examples exist of famous scientific problems that were solved without language. After much cogitation, Kekulé seized the shape of the benzene ring, the foundation of organic chemistry, when the image of a snake biting its tail arose from the embers of his fire. Poincaré, having spent 15 days trying to disprove Fuchsian functions, suddenly saw their reality, as, after a cup of black coffee, "ideas arose in crowds – I felt them collide until pairs interlocked"; later their relation to non-Euclidian geometry occurred to him at the moment he put his foot on a bus, though he was in the middle of a completely unrelated conversation…. The structure of the periodic table of the elements came to Mendeleyev in a dream. Einstein wrote that "the words or the language, as they are written or spoken, do not seem to play any role in the mechanism of my thought."[12] [citations within text omitted]

McGilchrist argues that we can be misled by our tendency to associate thinking with words:

> The fact that we are more aware of those times when we do think explicitly to ourselves in words…should not deceive us into believing that language is necessary for thought. It could even be an impediment to it. Most forms of imagination, for example, or of innovation, intuitive problem solving, spiritual thinking, or artistic creativity require us to transcend language, at least language in the accepted sense of a referential code. Most thinking, like most communication, goes on without language.[13]

Barbara Oakley would agree. Oakley's understanding straddles both the personal and the professional. She tells of how she herself "flunked my way through high school math and science courses,"[14] only later to realize that her difficulties had little to do with innate ability,

[10] For example, Immordino-Yang et al. (2012).
[11] Claxton, G. (1998).
[12] McGilchrist, I. (2012). p.107.
[13] Ibid., pp. 106-107.
[14] Oakley, B. (2014). p. 1.

and everything to do with her approach to studying. Today Oakley is a professor of engineering. One of the most important things she learned? Take a break!

> Diffuse-mode thinking is what happens when you relax your attention and just let your mind wander. This relaxation can allow different areas of the brain to hook up and return valuable insights. Unlike the focused mode, the diffuse mode seems less affiliated with any one area of the brain – you can think of it as being "diffused" throughout the brain. Diffuse-mode insights often flow from preliminary thinking that's been done in the focused mode.[15]

The diffuse mode of relaxed learning may sound mysterious but it should not be foreign to anyone's experience. Have you ever awakened during the night, aware that your brain has been deeply processing information, all on its own? In an interview with *Harvard Magazine*, Robert Stickgold, a sleep researcher at Harvard Medical School, suggests that there is a reason why, when confronted with certain types of problems, a person says "Let me sleep on it." Stickgold notes that "we understand at a gut level that the brain is doing this integration of information as we sleep, all by itself."[16] Stickgold's conclusion about the value of rest in processing information is consistent with the work of Eric Kandel, recipient of the Nobel Prize for his research on the biology of memory. Kandel's research subjects were *Aplysia* -- sea slugs -- who only have about 20,000 neurons, compared to the hundred billion or so in the human brain. In studying the biology of memory, Kandel's findings provide further evidence that effective learning is not simply a function of sustained attention:

> Long-term memory in *Aplysia* [sea slugs], as in people, requires repeated training interspersed with *periods of rest*. Practice makes perfect, even in snails. Thus, forty stimuli administered consecutively result in habituation…that lasts only one day, but ten stimuli every day for four days produce habituation that lasts for weeks. *Spacing the training with periods of rest enhances the ability of an Aplysia to establish long-term memory.*[17] [emphasis added]

Although the neuropathways of the human brain are vastly more complicated than the neuropathways of sea slugs, Kandel believes that the conditions that maximize learning are the same. Compared to sustained, uninterrupted periods of exposure, alternating engagement in new learning with periods of rest more effectively modifies synaptic connections in the brain and improves consolidation of new information into memory.

Of course, the ultimate period of rest is sleep. As Stickgold's research demonstrates, sleep is not to be confused with passivity. When the body is asleep, the mind actively processes information via the diffuse mode network. In fact, Oakley suggests that "Sleep is probably the most effective and important factor in allowing your diffuse mode to tackle a difficult problem."[18]

Beyond sleep, rest in the form of downtime is essential. Downtime – periods of unstructured, underscheduled time for seemingly aimless walking, musing, puttering - allows for the thorough processing that promotes optimal learning. Daniel Kahneman relates this notion to his own experience, suggesting that "… not all slow thinking requires that form of intense

[15] Ibid., p. 12.
[16] Lambert, C. (2005).
[17] Kandel, E. (2006). pp. 191-192.
[18] Oakley, B. (2014). p. 3.

concentration and effortful computation. I did the best thinking of my life on leisurely walks with Amos."[19]

The focused and the diffuse modes seem designed to work together in a dynamic, integrated process of deep learning.

Although the evidence cited here highlights the importance of the undermind, it should be clear that its processing power is dependent on the subject of study already having been digested, to some degree, in the focused mode. In other words, both the focused and the diffuse modes seem designed to work together in a dynamic, integrated process of deep learning.

Strategic (Dis)engagement

So how can we apply this understanding of the different capacities and modalities of the brain to the challenge of mastering a complex subject? Consider the following suggestions, adapted from recommendations made by Barbara Oakley:

- **Alternate modes.** When studying, alternate between periods of intensely focused attention and "periods of rest." Oakley suggests that "unless you are really enjoying what you are doing, keep your working sessions short."[20] One approach, the Pomodoro Technique,[21] recommends a break after 25-minute sessions of focused attention.

- **Fully disengage.** Although breaks might often be of short duration, the "resting times between your focused-mode efforts should be long enough to get your conscious mind completely off the problem you're working on."[22]

- **Re-engage.** When learning new material, do not let more than a day pass without revisiting the subject.

- **Access another perspective.** Although you should ponder the problem yourself, one option for breaking out of the "narrow beam" focus is to "ask someone else for a different perspective on how to solve the problem or a different analogy to understand the concept."[23]

- **Pose a question.** When you hit an intellectual wall, be curious, and formulate a question that your unconscious mind can work on. As Oakley puts it, "articulating your question is 80 percent of the battle."[24]

- **Try diffuse-mode activities.** Diffuse mode activities that engage us physically include:[25]
    - going to the gym
    - playing a sport

[19] Kahneman, D. (2013). p. 40. [Amos Tversky was Kahneman's good friend and collaborator.]
[20] Oakley, B. (2014). p. 33
[21] Developed by Francesco Cirillo
[22] Oakley, B. (2014). p. 39
[23] Ibid., p. 40.
[24] Ibid., p. 22.
[25] Suggested activities are from Oakley, p. 35.

- walking, jogging
- drawing
- playing music
- dancing
- taking a bath
- meditating
- sleeping

Other diffuse-mode activities suggested by Oakley engage us cognitively:

- playing video games
- surfing the web
- talking to friends
- texting friends
- reading a relaxing book
- watching a movie

Fast and Slow Learning

The idea of allowing more time for the slow and unconscious processing of information may feel counter to the widespread assumption that being "smart" is about thinking fast. There are potential downsides to fast thinking, however, particularly the risks of premature closure on a subject and overconfidence in one's conclusions. Slow learning, in contrast, is a process that allows the necessary time to alternate between states of narrowly focused attention and states of diffuse attention, generating a deeper assimilation of complex material. Barbara Oakley believes that "learning slowly can mean you learn more deeply than your fast-thinking classmates."[26]

Guy Claxton reflects on the question of why, in our fast-paced, technologically driven culture, we seem to have lost an ability to sit in that state of open-ended ambiguity and pondering that is characteristic of slow thinking:

> Perhaps the most fundamental cause of the decline of slow knowing… is that as a culture we have lost our sense of the *unconscious intelligence* to which these more patient modes of mind give access…. Modern Western culture has so neglected the intelligent unconscious – the *undermind*, I shall sometimes call it – that we no longer know that we have it….[27]

It seems that we so much identify with our rational minds – that part of our conscious, thinking selves that promises a sense of supreme control – that we have lost sight of the fact that just as our hearts beat, our hair grows, and our bodies heal without conscious effort, there is a part of the mind – the *undermind* – that has the ability to solve problems that seem beyond our reach. So the next time you are wrestling with a seemingly insurmountable intellectual challenge, remember that although your conscious, effortful, focused, thinking self may have hit a wall, the solution might not be beyond your wildest dreams.

[26] Oakley, B. (2014). p. 36.
[27] Claxton, G. (1998). pp. 6-7.

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