

Title: When the meditating mind wanders

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Abstract (144 words)

The capacity for thought and the ability to assemble and manipulate concepts are cognitive features unique to humans. Spontaneous thoughts often occur when we are engaged in attention demanding tasks, with an increased frequency predicting negative affect. Meditation does not require thinking, however thinking occurs naturally during meditation. We develop the hypothesis that chronic thinking associated with strong emotional arousal during meditation practice might be detrimental to meditation practice and well being. One goal of meditation is to identify the arousal of emotions and thoughts, and remain equanimous with them. Over time, meditation may help dampen the attention grabbing power of these thoughts both during practice and in daily life, which may consequently help deepen meditation practice. However, when meditators fail to remain equanimous, the effects of these thoughts may be deleterious. We discuss how this hypothesis may help guide future research on meditation.

Manuscript (2196 words)

Mind wandering is the process of involuntarily thinking while engaged in an attention demanding task such as reading or meditating [1,2]. There has been some debate as to whether intentional or voluntary thinking should be considered as a form of mind wandering or whether mind wandering should be limited to cases where it is involuntary [3]. Irrespective of this distinction, research has shown that the neural structures implicated in meditation related processes and mind-wandering are coordinated, yet distinct [4,5]. Consistent with these results, from an experiential point of view, active thinking during meditation is usually seen as peripheral to the meditation task [5].

The origin of thoughts: content and the awareness of it

Where and why do thoughts arise? Thoughts arise in the consciousness of the individual that experiences them, and it is generally accepted within the neuroscientific community that their content is supported by a complex interplay of neural assemblies representing different concepts brought together by a given thought [6]. The content of a given thought might be linked to (1) external context - such as noticing something in our environment [7] or (2) physiological activity - such as thoughts triggered by hunger or (3) mental states and mood - such as

depressive mood leading to an increased number of negative thoughts about the past [8-10]. Libet's work [11] showed that the activity in our brain is linked to the content of the thought, and could be recorded before we become conscious of that thought. The degree to which we have control over the nature, content, and timing of thoughts that arise in our consciousness has been, and still is the subject of intense debate [12,13]. It is central to the idea of free will: the existence of individual free will should lead to some degree of control over the content of our thoughts. However, given that our thoughts are often directly triggered by our environmental surroundings, and also given the fact that even expert meditation practitioners generally report having thought processes during meditation [5], it is impossible to argue that we have complete control on the occurrence of our thoughts [12,13]. The question as to whether we have control at all over the nature of our thoughts or specific types of thoughts is beyond the scope of this opinion piece.

All meditation practices, including open awareness practices, involve the cognitive process of monitoring one's attention. This activity is additionally supported by some form of thought based activity (where the subject is actively planning or reflecting on the specific task at hand, which is in the case of meditation the act of focusing one's attention on the breath or object, working with the content of experience, or generating loving kindness and compassion). However, active thinking or mind wandering is usually not considered a central part of meditation, as in general, meditation points towards the awareness beyond the processes involved in the generation of thought. Although not central, insight into intentional and spontaneous thoughts as they occur during meditation may be an important aspect of advancement by the practitioner in Buddhist models of mental training. In the Rinzai Koan tradition, thought processes are considered of great importance wherein meditators are asked to solve an illogical riddle such as the "sound of one hand clapping", although even in this tradition the active thinking process aims at transcending itself. Another example of meditation involving thoughts is the practice of loving kindness meditation, where thoughts are used to elicit an experience of connectedness. In this case as well, the experience of connectedness is the ultimate goal and the thoughts are used as a way to achieve it. Even several reductionist approaches now concede that there is more to consciousness than thought processes, and that the awareness of being [13], which is arguably purely experiential and beyond thought, may exist. Awareness may support thinking, as qualia supports perception [14]. Thought processes involved during meditation may be separated into two parts: the content of the thought, and the awareness of it. Meditation points to the aspects of awareness that support thought, but does not require thought itself to be present.

However, the subject/object relationship between awareness and its content during thought may be an oversimplification. The witnessing presence during meditation implies a distance between the observer (awareness) and the observed (thoughts' content) [15,16]. Yet, most experiential approaches where the meditator investigates the relationship between awareness and its content argue that the two are closely integrated [17]. From the perspective of experience, a thought may not be experienced as an object independent of awareness, so the distinction between the content of a thought and its experience is likely not as simple as one of the subject/object relationship. For this reason, neuroscientific approaches which aim at studying awareness and how it relates to its content during meditation - content which has been shown to

be correlated with brain activity [18] - might help tackle what philosophers call the hard problem of consciousness [19] where the tangible (thought content) meets the intangible (the awareness of it).

Attention and thoughts

Increased top-down attention has been shown to correlate with both short and long-term attention [20,21]. Our hypothesis is that the attention and emotional intensity (i.e. attentional salience) [22] experienced and associated with a given thought determines the degree to which the thought is reinforced. In a recent study, the emotional intensity of a thought during the day determined whether they would be present in subsequent dreams, and the extent to which they could be recalled the following day [23]. These processes would explain why depressive patients find it exceptionally challenging to free themselves from ruminative patterns of thinking, despite a strong intention to do so [24]. The strong negative emotions associated with their thoughts would continually reinforce them in a closed feedback loop. Based on this model, this is also the reason why methods such as mindfulness based cognitive therapy [25] or acceptance commitment therapy [26] may help: by reframing the negative thoughts or training oneself to identify and react less strongly to them, they lose some of the intensity and attention grabbing power. This process may directly disrupts the closed reinforcement feedback loops.

The thought content reinforcement feedback loop hypothesis is consistent with clinical results obtained using non-meditation interventions. For example, both eye movement desensitization and reprocessing (EMDR) [27] or emotional freedom technique (EFT) [28], which consist in having participants perform a sensory-motor task as they reenact negative thoughts and feelings, has the tendency to divide the attention of the participant. This split of attention may help reduce the attention grabbing power of negative thoughts and feelings and potentially disrupt the closed reinforcement feedback loop. This may also explain why electroconvulsive therapy (ECT) is effective in treating more than 50% of people with treatment-resistant major depressive disorder [29]. While the therapy may lead to amnesia, it may also lead to the reorganization of neural assemblies in the frontal cortex involved in ruminative thought processes [30].

According to the somatic marker hypothesis, emotions associated with thoughts have bodily correlates [31] - for example muscular and physical tension correlating with mental stress [32]. It may therefore be necessary to integrate physiological activity and markers into our model of thought reinforcement. The arousal of the sensation associated with a given thought may influence the reinforcement of the neural structures activated by that thought. Some meditation traditions posit that this link is key, and that it is not enough to realize the relationship between the content of a given thought and its deleterious impact for it to go away, as is the case in most mental disorders that involve pathological thinking. By contrast, one must also attempt to sever the link between these thoughts and their physiological correlates. In a dialectic introspection method called the Sedona Method [33], participants are asked to recall upsetting thought(s) and then tune in to the bodily sensations that arise. They are then asked to evaluate the degree to which they are willing to let go of the physical sensation without reference to the original

thought(s). Similarly, the Goenka Vipassana tradition use the technique of body scanning and the discovery of physical tension or "samskaras" in different parts of the body to then work through the associated 'mental tension' and thoughts that arise when sitting with the physical discomfort - meditators develop equanimity through being 'at peace' with both physical and mental discomforts [34]. The transcendental meditation technique also asks meditation practitioners to adopt a positive attitude towards spontaneous thoughts, which are seen as the bubbling up and release of past tensions [35]. This attitude may lead meditators to become more equanimous towards the nature of their thoughts. Again sensory-motor task such as EMDR and EFT [27,28] performed while re-enacting negative thoughts and feelings may also disrupt this link between the content of thoughts and their physiological correlates.

Meditation and mind wandering

According to the Webster dictionary, meditation practice consists of "engaging in mental exercise (such as concentration on one's breathing or repetition of a mantra) for the purpose of reaching a heightened level of spiritual awareness." However, based on the thought content reinforcement feedback loop hypothesis presented in this paper, we argue that the mental effort made during meditation - especially if it is associated with chronic arousing thoughts and emotions (and it is unclear if mental effort could be devoid of such features) - may be ultimately detrimental to the goal of meditation. Even for mantra meditation and focused attention practices, the activity of the mind is only there to support "conscious awareness" and the specific object of focus is provided to still the wandering mind [35].

Thoughts arising in consciousness during meditation are treated differently based on the specific meditation tradition. Some traditions instruct practitioners to label their thoughts, whereas others to ignore them and view them as peripheral to the practice, and others, to ignore them but view them as a useful mechanism of release [35]. The fact is that thoughts and sensations – and as we have discussed previously, might be intimately linked together – and are the only objective content of consciousness during meditation. Giving thoughts one's focused attention may serve to reinforce them – therefore it is critical that one's attitude towards the nature of their thoughts and feelings during meditation remains relatively balanced.

From this perspective, the proper attitude during meditation with regard to thought might be one of mindful equanimity. By remaining equanimous, one does not directly attribute emotional value to the nature of the thought, consequently bypassing the reinforcement loop underlying the neural circuitry supporting its content. By remaining mindful, one realizes that there is more to the thought than its content – i.e. the conscious process that supports it. As the Indian philosopher Krishnamurti said "Meditation is to be aware of every thought and of every feeling, never to say it is right or wrong, but just to watch it and move with it. In that watching, you begin to understand the whole movement of thought and feeling. And out of this awareness comes silence." [36].

One important risk of meditation practice concerns the thoughts and feeling associated with the practice itself. Often meditation retreats in the west involve formal and structured practice, some

of them involving a lot of physical effort and pain as meditators sit for hours without moving or go through fasting and other forms of sensory deprivation [34]. Although this provides a background for which extraordinary states of consciousness may be attained, this might not be so different than ingesting mind altering agents to alter consciousness [37]. The neural networks are transiently altered but then settle back into states close to their original baseline activity. Worse, during formal meditation practice, thought patterns associated with strong emotions and physical sensations may be reinforced. Formal and constrained settings, as well as any setting where one has to discipline him/herself and may have strong thoughts about the list of do's and don'ts. While these types of practices may have been relevant in the early centuries of meditation practice, in modern and certainly in clinical settings, they host the potential for deleterious side effects by reinforcing the potential for negatively oriented thought feedback loops. For this reason, we argue that formal meditation in highly structured settings may be detrimental (to its intrinsic goal) for some participants who experience strong inner conflict about the nature of their thoughts and practice during meditation.

Future research

Previous findings on mind wandering and meditation show that meditation may help decrease the frequency of mind wandering [5,38]. Therefore, it would benefit future research on meditation to assess the quality of meditation, not only based on its depth, but also on the valence and attention grabbing power of mind wandering during meditation. In addition, physiological responses to these thoughts, such as muscular tension would be important to assess. These measures may then potentially be used as predictors of potential deleterious effect of intense meditative practice in some individuals.

References

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This article discusses the fact that mind-wandering reported in empirical investigations frequently occurs with, and without intention, and, more crucially, that intentional and unintentional mind-wandering are dissociable, and that there is a need to reconsider the bulk of the mind-wandering literature with an eye toward deconvolving these two different cognitive experiences. While this article is clear in its intentions to deconvolve these two different cognitive experiences, we believe mind wandering is an unintentional process, thus the term “intentional mind wandering” unnecessarily conflates mind wandering with directed internal thought.

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This article was one of the first to identify the distinct neural networks involved in the mediation/mind wandering cycle, having implemented a new fMRI method that used feedback from subjects to clarify cognitive fluctuations. The authors identified the neural correlates of four cognitive states during focused meditation, and found that naturalistic mind-wandering is associated with elements of default mode network. They also found that the salience and executive network activity are mapped to specific attentional processes, and showed that repeated meditation practice may lead to neural changes within relevant networks.

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This article depicts one of the first direct behavioral indices of meditation expertise and its associated impact on the reduced frequency of mind wandering. Tested using experiential probes, expert meditation practitioners reported a greater depth and frequency of sustained meditation, whereas non-expert practitioners reported a greater depth and frequency of mind wandering episodes.

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As of 2019, integrated information theory is the most popular theory of consciousness in neuroscience. It posits that consciousness emerges of complexity.

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Libet's 1983 work had an important influence on theory of consciousness and free will. In this experiment, subjects were asked to initiate movement at a random time of their choosing. Since the authors showed that brain activity correlated the movement onset several seconds prior to the movement -- and prior to subjects making their conscious decision -- some researchers have inferred that humans do not possess free will.

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This article describes what is now commonly called the hard problem of consciousness, or the difficulty to reconcile the phenomenological aspects of consciousness with the materialistic worldview. The concept of "hard problem of consciousness" has had a tremendous influence on the field of consciousness research and neuroscience of consciousness. It has divided the field of consciousness studies into 2 camps, one that believes there is a hard problem of consciousness and one that believes consciousness arises from inert matter and reject the hard problem of consciousness.

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This book was influential in neuroscience as it suggested that negative and positive thoughts might trigger unpleasant and unpleasant sensations and that emotions and feelings might consist in brain re-representation of these sensations. It suggested that there was more to consciousness than the brain. This is relevant for meditation practice which involves mindfulness of body sensation as a practice to achieve equanimity.

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In this book, Krishnamurti highlights the significance of transcending thought as a means of understanding the unifying and fundamental universality of pure awareness, which is void of thought and not bound to time, space, nor mental content or perception. The works of Krishnamurti, one of the great philosophers of his time delved into a multitude of micro-analyses of the true nature of thought, its relation to consciousness and awareness. Some of his key writings touch on the need to free oneself from thought and knowledge during meditation, as they control and dictate experience, preventing the ability to free in meditation to experience pure awareness.

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