Medicine for the wandering mind: mind wandering in medical practice

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CONTEXT Mind wandering – defined as a cognitive focus on information that is unrelated to immediate sensory input or the task at hand – is a ubiquitous characteristic of the human condition. When it occurs, the integrity of a wide range of cognitive skills can be compromised.

OBJECTIVES The current paper describes the phenomenon of mind wandering, explores its potential role in medical practice and considers how the education system may profitably control this ubiquitous cognitive state.

METHODS We argue that because many aspects of a medical professional's work (such as fatigue and depression) maximise the mind's tendency to wander, this experience is likely to be a common occurrence in many medical situations. We then review the psychological literature on mind wandering as it relates to medical practice.

CONCLUSIONS Based on this review, we suggest that because mind wandering interferes with an individual's ability to integrate current events into a more general context, its occurrence may lead to downstream problems in the way that symptoms are interpreted and treated. Finally, because the experience of mind wandering is often both difficult to control and hard to recognise, it is difficult to prevent. We argue that techniques that help individuals to become more mindful have the potential to ameliorate the cost of mind wandering to the medical profession. Given the ubiquitous nature of the experience of mind wandering, the integration of mindfulness training into medical education programmes could be of general benefit to society at large.

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INTRODUCTION

In an episode of the popular TV medical drama *House MD* (Fox Studios), one of the lead characters, Dr Robert Chase, suffers a brief absent-minded lapse that threatens the life of his patient and has implications for his career. Preoccupied with the news of his father's death, Chase's mind wanders briefly, causing him to fail to recognise the significance of a patient's symptom of stomach pain and preventing him from ordering the routine tests that might have saved her life. Although this narrative is fictional, the episode provides a clear illustration of how even the relatively short lapses in the integrity of external attention that occur when the mind wanders might impact medical decision-making processes with potentially calamitous consequences. This paper is divided into three main sections. The first considers the evidence for why mind wandering may be relevant to the medical profession. The second section reviews the psychological literature on why mind wandering interferes with task performance, and the third explores the sorts of educational strategies that may help address the problem.

IS MIND WANDERING RELEVANT TO THE MEDICAL PROFESSION?

Mind wandering is defined as the conscious processing of information that is unrelated to immediate sensory input and to the task currently being performed; it has frequently been studied in the context of the experiencing of task-unrelated thoughts while performing a laboratory task. It may seem unlikely that an intelligent and well-educated group such as medical practitioners would struggle with mind wandering. Indeed, the fact that mind wandering generally impairs learning[1,2] means that students who mind wander frequently are likely to do worse in educational contexts. Given the rigorous academic requirements of medical careers, students who go on to graduate and become medical practitioners are not likely to mind wander excessively. Although the robust selection demands of the medical profession ensure that those who struggle most with mind wandering never make the grade, there are nonetheless several reasons why the highly educated status of medical professionals does not eliminate the risk for mind wandering.

A first line of evidence that suggests medical practitioners are likely to experience some degree of mind wandering comes from studies that examine the link between mind wandering and low mood. Studies have routinely documented that states of enduring low mood (such as depression) are associated with greater mind wandering[3–5] and inducing unhappy mood leads to short-term increases in the amount of off-topic thought and absent-minded error.[6] Moreover, given that the experience of mind wandering can itself lower mood,[7] the complex link between affect and cognition may create a vicious cycle that will perpetuate the absent-minded state. As rates of clinical depression can be as high as 13% in medical students[8] and even 30% in general practitioners,[9] the association with negative mood suggests that mind wandering may be relatively frequent within the medical community.

Fatigue also increases mind wandering. The accuracy with which individuals can sustain attention on the external environment is well known to decrease with time spent on task.[10] As the duration of a task increases, both the likelihood of error and the rate of task-unrelated thoughts escalate.[11–13] Similarly, studies suggest that there are important circadian rhythms that impair the maintenance of attention and lead to changes in the rate of mind wandering.[14] Manly and colleagues demonstrated that the ability to sustain attention and avoid mind wandering-related error was better in the afternoon and early evening than in the late evening and early morning.[14] This apparent circadian rhythm in the experience of mind wandering suggests that the experience is likely to be especially damaging in shift work contexts.

As with the evidence for depression in medical practitioners, there is evidence that many groups of medical professionals work in conditions that make fatigue-related mind wandering likely. Medical practitioners are often required to work long hours or irregular shifts. For example, even after the implementation of the Accreditation Council for Graduate Medical Education's resident work hour limits in 2003, trainee doctors were found to work an average of 69 hours/week and 14% worked > 80 hours/week.[15] Studies suggest that both night work and schedule instability are strong predictors of fatigue-related clinical error.[16] Nurses who work shifts of > 12.5 hours are at greater risk for committing occupational error, and doctors who are on call 24 hours/day are twice as likely to suffer attentional failure and commit 36% more serious medical errors than those who work a normal length of day.[17] Clearly, shift work and fatigue can cause error in the medical setting, perhaps as a result of the mind wandering that can ensue when an individual is tired.

Finally, the often routine nature of medical practice also makes mind wandering more likely. Laboratory studies have documented that as an individual becomes practiced in a particular task, his or her mind is more likely to engage in task-unrelated thoughts.[18,19] This occurs because practice allows for a shift from a careful focus on performance to a more habitual mode of responding, in which attention is allowed to focus on other matters. In fact, the experience of mind wandering is one of the primary causes of error in well-practiced tasks,[13] even when individual differences in variables associated with intelligence are controlled for. Mind wandering may therefore lead to problems in highly practiced and routine medical tasks.

The combination of low mood, fatigue and the often routine nature of medical work provides fertile ground for mind wandering. This suggests that mind wandering may contribute to some proportion of medical errors. The next section of this review explores how we might understand the process by which mind wandering is related to poor performance, and how this process may impact on medical decision making.

A PSYCHOLOGICAL PERSPECTIVE ON MIND WANDERING

Although no study has directly examined the role of mind wandering in medical decision making, there are reasons to suspect that mind wandering will damage the process of gathering information that contributes to how a practitioner interprets a patient presentation and, as a result, will ultimately impact the treatment decision. Mind wandering is most often measured using the technique of experience sampling in which individuals provide subjective data in either an online[20] or a retrospective manner[6] on the thoughts they experienced under a given set of circumstances. For example, experience-sampling studies involve interrupting participants periodically during a task and asking them to report whether their attention was directed to the task at hand or to task-unrelated concerns, whereas retrospective measures require individuals to complete a brief questionnaire on the thoughts they experienced while recently completing a task. These subjective data are used to explore the information processes involved in cognition that is unbound to current sensory input and to understand the processes by which mind wandering impacts task performance.[2]

In principle, it is possible for an individual to mind wander without decrement to the perceptual or cognitive processing of external stimuli, but mind wandering typically occurs at the expense of attention to concurrent external information. This neglect of external information is referred to as perceptual 'decoupling'.[20] There is now abundant laboratory evidence that perceptual decoupling does occur during mind wandering with detrimental effects. For example, experience-sampling studies indicate that periods of mind wandering can derail the sustaining of attention to external stimuli,[21] impair recollection[20] and worsen text comprehension.[22]

Several possible reasons for why mind wandering may interfere with external attention have been suggested. One hypothesis is that mind wandering occurs because of deficits in the individual's capacity to sustain task focus in general; this is known as the 'executive failure hypothesis'.[13] This hypothesis suggests that the reason why mind wandering occurs is because the capacity to sustain focus on a demanding task has failed, allowing attention to return to its natural, or default, state. Important support for the executive failure view comes from studies that demonstrate that general deficits in attentional control explain a significant proportion of the variance in both task-unrelated thought and errors associated with this state.[13] Alternatively, mind wandering may interfere with external attention because resources are engaged in sustaining an internal train of thought that would otherwise be directed to the task at hand. According to this view, it is the manipulation of internal information that causes performance of the external task to suffer because we cannot attend to everything at once.[23] Unlike the executive failure view, this hypothesis suggests that the occurrence of mind wandering is a specific example of a more general process that allows the individual to generate, manipulate and maintain complex personal and social information in consciousness.[24] Consistent with the decoupling hypothesis, recent work suggests that the experience of task-unrelated thought is a distinct state of internal focus, rather than simply a state of distraction. In one study, participants completed a three-stimulus oddball task in which they were required to distinguish a target from an equally frequent distracter and a high-frequency non-target stimulus.[25] As the executive failure view suggests that individual differences in mind wandering are linked to distractibility, the tendency to engage in mind wandering should enhance the processing of the irrelevant distracting stimulus. Instead, the tendency to mind wander reduced attention to both targets and distracters, implying that mind wandering errors result from a state of internal focus rather than

simply a state of distraction.[25] However, as work on mind wandering is still in its infancy, more research is needed to fully explain why the experience occurs at the expense of the task at hand.[23]

In order to understand why mind wandering may be especially relevant to errors in decision making in medical practice, it is necessary to understand how the process of perceptual decoupling impacts on a complex task that requires both attention and inference. One way to do this is to examine mind wandering in the context of reading because narrative comprehension is an activity that shares many similarities with the process of medical diagnosis. In reading, just as in decision-making processes, inferences must be made that are based on both concurrent external input and information stored in memory.[26] In the same way that a doctor must interpret incoming information based on what he or she already knows, the reader must also bring his or her experience to bear on what is being read. As both reading and decision making depend upon the context within which information is processed, this synergy makes understanding mind wandering during reading a reasonable proxy for understanding its potential role in interfering with the way that medical decisions are framed.

One observation that suggests that mind wandering can interfere with the way that events are interpreted and understood comes from studies examining eye movements that occur while the mind wanders during reading. These recent studies capitalise on the ability of eye tracking to provide a covert measure of the extent to which the reader processes the words that make up the narrative.[27,28] Although it is usually true that readers pause for longer intervals while reading infrequent or unusually long words,[29] reading times during periods of mind wandering have been seen to be slow and not to vary according to these lexical features. Given that the distinctiveness of long and infrequent words is based in part upon the other words in a text, the absence of any impact of these lexical features on reading times during mind wandering suggests that the reader is temporarily insensitive to the broader context in which the narrative unfolds.

This inability to frame textual information correctly during mind wandering is also related to the way that the experience interferes with text comprehension. In one study, a thought-sampling procedure was used in which participants who were reading a detective novel were interrupted just after they had read critical points in the narrative and were asked whether they had been mind wandering or were instead focused on the story.[30] Participants were also interrupted at random points in the text that were unrelated to the key issue in the story (which character committed the crime). These random probes acted as controls, providing a baseline for overall levels of mind wandering. Analysis indicated that the likelihood of correctly solving the crime depends upon the rate of mind wandering while reading crucial sections of the narrative, but does not depend on the rate of mind wandering while reading other sections of the text. The targeted impact of mind wandering at these crucial points in the narrative suggests that the experience interferes with a participant's capacity to incorporate clues from the story into his or her model of the crime. This absence of information, in turn, leads participants to build a model that lacks sufficient contextual detail to guide (or frame) their subsequent behaviour in an effective way.[30] Together with the eye-tracking experiments described previously, this study suggests that, during mind wandering, events cease to be framed within the context of an individual's experience and this leads to the ineffective use of this information in guiding behaviour.

A schematic of how these data from reading tasks may potentially generalise to the process of medical diagnosis is presented in Fig. 1. In this diagram, the different stages of making a decision are represented by the sequence of boxes and show: (i) the gathering of information; (ii) the interpretation of evidence, and (iii) the process of deciding on a course of treatment.[31] The upward arrows indicate the external factors that contribute to how the problem is framed (such as the different symptoms with which a patient presents). The downward arrows indicate the contribution that an individual's experience and knowledge makes to problem framing (such as by prompting the practitioner to order specific tests when a particular constellation of symptoms is presented).

Figure 1(a) presents a situation in which attention is firmly coupled to the task at hand (as is likely in most medical situations). In the left-hand panel (Stage 1), the coupling of attention to external events allows for the effective gathering of information when a patient presents his or her symptoms. Thus, as long as attention is successfully coupled during the patient interview, the relevant information (indicated by the white upward arrows) is gathered by the individual (leading to the white downward arrows in Stage 2). In this way, normal information gathering allows medical professionals to provide a context in

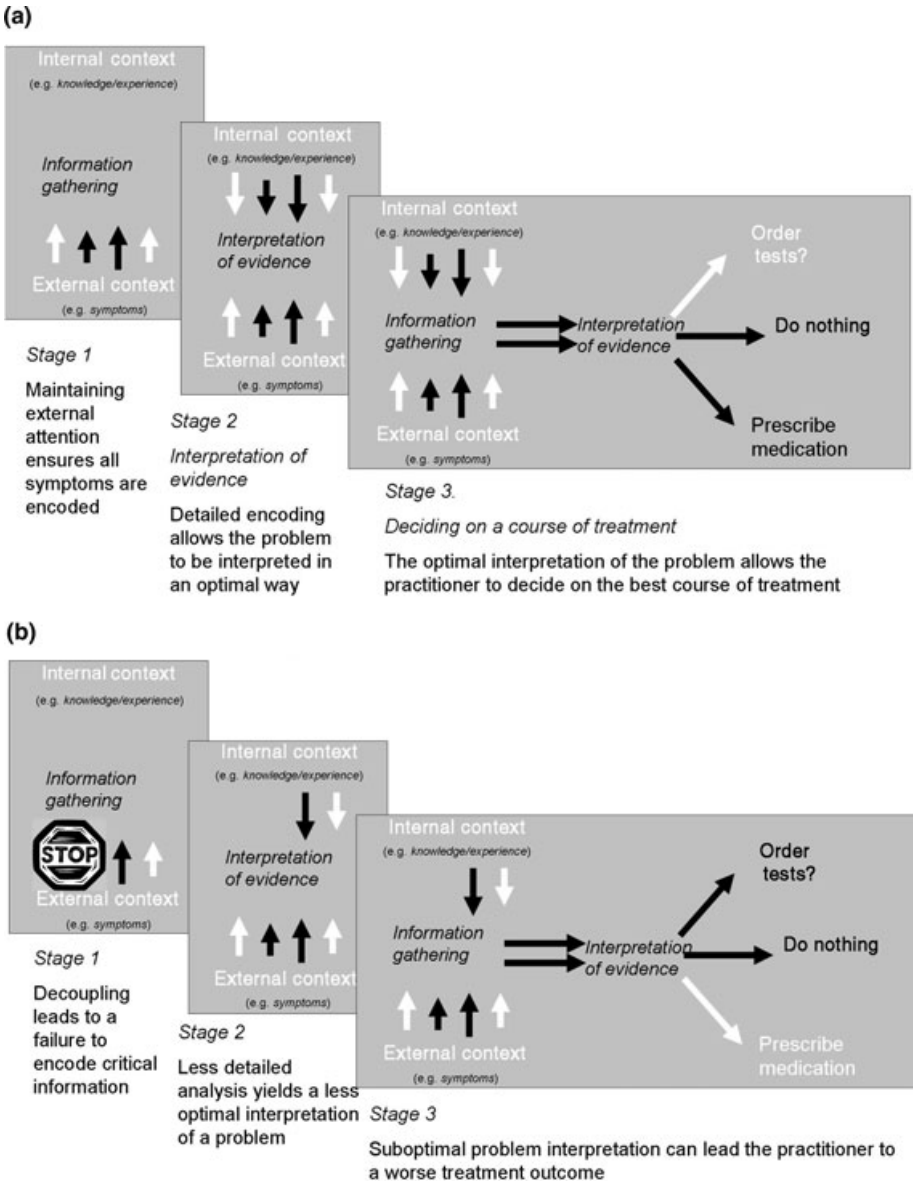

Figure 1 Schematic of the different stages of a decision-making process in medical practice in (a) a context in which attention is focused and (b) a context in which the practitioner's mind wanders. Stage 1 refers to the gathering of information; Stage 2 refers to the interpretation of evidence, and Stage 3 refers to the act of deciding on a course of treatment. Upward arrows indicate external factors that contribute to how the problem is framed. Downward arrows indicate the contribution an individual's experience and knowledge make to problem framing

which symptoms are interpreted correctly and thus often the correct decision is made (Stage 3).

When the mind wanders from the constraints of the external world to engage in internal thought, the coupling between attention and external events breaks down. This process of perceptual decoupling is illustrated in Fig. 1(b), which shows that certain aspects of relevant external information are blocked from entering attention (as indicated by the STOP sign in Stage 1). As a result, the individual does not perceive this information as significant (as indicated by the presence of only a single downward arrow in Stage 2). This failure to gather all of the relevant facts makes the individual less able to interpret the evidence correctly and alters the decisions he or she makes about the course of treatment (e.g. the practitioner may prescribe medication rather than order more tests; Stage 3). One important aspect of these errors is

that because failure to encode the symptoms leads to an inappropriate context in which to make a decision, the significance of the initial symptom may not be recognised. In such cases, the individual may not recognise the error until some time later. Many medical errors exhibit this hidden cost and only reveal their true severity sometime after the events have occurred (although it is important to note that in many medical situations the individual has multiple opportunities to identify the crucial symptoms afflicting a patient).

Because the process of perceptual decoupling can interfere with even basic attentional processes,[32] it is likely to interfere with the ability to gather information, even for experienced medical practitioners. Moreover, many medical practices (such as surgery) rely on the ability of multiple professionals (e.g. surgeon, anaesthesiologist, nurse) to maintain a common model of unfolding events. Such shared mental models involve what is known as 'situation awareness'.[33] Unlike solo activities, situations that rely heavily on such shared representations for success depend on the combined experience of multiple experts. In situations like surgery, a lapse of attention by a single individual may jeopardise the performance of the whole team.

EDUCATIONAL STRATEGIES FOR REDUCING MIND WANDERING IN THE MEDICAL COMMUNITY

Although educating medical professionals about the causes and consequences of mind wandering may be helpful, it is unlikely to offer a complete solution. Moreover, attempts to deliberately control mind wandering can – ironically – increase the rate at which the mind wanders, as was demonstrated by a series of classic studies illustrating that attempts to directly control conscious thought often backfire.[34] In this paradigm, participants are asked to suppress any thoughts about a particular topic (e.g. a white bear) for a short time, after which they are asked to indicate how many times they think about that topic during a subsequent period in which they are not asked to suppress any thoughts. The intention to suppress a thought results in a rebound effect, in which, relative to a control condition, the individual thinks about the suppressed topic even more frequently. Based on these findings, attempts to simply force thoughts out of mind are unlikely to reduce mind wandering in a stable manner. Further problems arise from the fact that we often recognise that mind wandering has occurred only after some time has elapsed.[35] This absence of meta-awareness is a further hurdle for pedagogical solutions to mind wandering; simply educating people about the dangers of mind wandering will not solve the problem if the individual does not realise he or she is doing it. In fact, mind wandering is especially damaging to performance when it occurs without awareness, which suggests that the difficulty in recognising when mind wandering takes place may exacerbate its link to error.[21,22,36]

Although simply providing better education is unlikely to fully address the problem of mind wandering, existing research suggests at least two broad strategies by which mind wandering can be reduced. Firstly, addressing those factors that are known to promote mind wandering can minimise its occurrence. Secondly, simple exercises designed to train attention can provide individuals with greater control over their wandering minds. We consider these strategies in turn before discussing how the combination of both may be most effective.

Understanding the causes of a phenomenon is often the first step in learning how to change it. As we have shown, converging evidence suggests that both negative affect and fatigue play important roles in the occurrence of mind wandering. Strategies to reduce negative affect and fatigue would therefore be expected to also have an impact on mind wandering. Consistent with this hypothesis, a study on intern workload found that medical interns with less exhausting work schedules committed significantly fewer medical errors.[37] Although there are probably numerous reasons for this improvement, given what is known about mind wandering and fatigue, an enhanced ability to maintain undistracted attention is likely to have contributed.

Despite preliminary evidence that brief training programmes can improve mood and reduce burnout in medical professionals,[38] there are clear feasibility challenges associated with these strategies. An alternative strategy is to train an individual's capacity to sustain attention. For example, mindfulness training has long been employed to reduce mind wandering and its potential relevance to the medical community has not gone unnoticed.[39] Unlike the counterproductive strategy of trying to suppress thoughts, most strategies for cultivating mindfulness involve training one's ability to sustain attentional focus on objects such as the breath. A growing body of research indicates that mindfulness training enhances attention in a manner that is consistent with the assumption that it decreases mind wandering. For example, intensive meditation training

during a 3-month retreat leads to improvement in the individual's ability to sustain attention on a simple vigilance task that requires the participant to make perceptual judgements on the relative size of stimuli.[40] Furthermore, extensive training also improves the ability to detect target stimuli during the extremely rapid presentation of visual information (at the rate of approximately one stimulus every 100 milliseconds), which has been interpreted as a more effective allocation of attention over time.[41] Other studies have found improvements in attention in training for periods as brief as 2 weeks or 4 days.[42,43] Meditation training also results in improved mood, suggesting a potentially synergistic effect on mind wandering derived from both the attention training and the accompanying positive mood.[42]

This potential synergy of combining strategies to reduce mind wandering is also found in the mindfulness-based stress reduction (MBSR) programme. This widely available and intensively researched 8-week programme helps participants develop the capacity to focus undistracted attention on the here and now, and has been used effectively to complement medical treatments for a long and growing list of conditions.[44] Although this programme is primarily focused on cultivating mindfulness, it has also been studied as a tool for helping medical professionals deal with the stress and fatigue caused by their challenging careers. In fact, the MBSR programme has proven effective in reducing stress, fatigue and burnout among both medical students and professionals (see review[45]). These findings indicate that the MBSR programme should be particularly effective in reducing disruptive mind wandering because it develops the skills required to sustain attention while reducing negative affect and burnout. Indeed, a study predicting that the MBSR programme would improve psychotherapists' ability to attend vigilantly to patients' non-verbal signals found that those who participated in the MBSR programme were rated as better able to communicate with their patients.[46] Furthermore, the MBSR programme has been shown to reduce the incidence of distracting thoughts and rumination among both medical and nursing students.[47] However, although the MBSR programme represents a reliable path to the benefits of mindfulness training, a growing number of resources for those without access to this programme are freely available (e.g. http://www.getsomeheadspace.com, which provides free online courses). With ongoing practice, the capacity to attend without distraction during meditation, daily life or a patient interview is always freely available to anyone who commits to minimising those circumstances that lead to mind wandering while simultaneously cultivating the skill of maintaining undistracted attention.

CONCLUSIONS

The current review suggests that mind wandering has important relevance to medical practice because it has the potential to interfere with the information-gathering process upon which medical decisions are based and because it often accompanies the low mood, fatigue and routine work that are common in the medical community. Together, these observations indicate that mind wandering is likely to be a significant cause of error in medical practice.

The fact that mind wandering is both difficult to control and hard to recognise poses a specific challenge to those concerned with ameliorating this problem in medical practice. Rather than simply educating medical practitioners about the damage that mind wandering may cause, providing individuals with techniques for regulating their attention may be more successful. We would advocate that, to complement attempts to improve the working conditions of medical practitioners in order to enhance mood and reduce fatigue, mindfulness training programmes should be integrated into standard medical training in an effort to reduce the risk for absent-minded error.

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