

The Mental Health Aspect of Mind Wandering

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ABSTRACT

The mind rarely remains on one topic for a prolonged period without deviation. It's a dynamic nature of the experience of the mind that everyone experiencing mind wandering, in which attention switches from a current task to unrelated thoughts and feelings. Studies had explored the phenomenology of mind wandering and highlighted the importance of its content and relation to metacognition in defining its purposeful effects. This study is about the mental health aspects of mind wandering which involve a complex balance of costs and benefits: Its association with various kinds of mental health-related explanation, therapeutic benefits and its applicability in mental health.

Keywords: *Mind Wandering, Mental Health, Cognition*

Experience is not constantly hitched to the here and now, rather, it ebbs and flows between the mental contents of the internal and the external sources. The mind rarely remains on one topic for a prolonged period without deviation. It's a dynamic nature of the experience of the mind that everyone experiencing mind wandering, in which attention switches from a current task to unrelated thoughts and feelings. Studies had explored the phenomenology of mind wandering and highlighted the importance of its content and relation to metacognition in defining its purposeful effects. Even though there is a long tradition of research which is based on how the attention shifts from one external source to other (Antrobus et al., 1966). It was recently tried to understand how mind shifts between the external events and internal thoughts and feeling. This study is about the mental health aspects of mind wandering which involve a complex balance of costs and benefits: Its association with various kinds of mental health-related explanation, therapeutic benefits and its applicability in mental health.

Mind Wandering

Singer, Klinger, and Antrobus had conducted a study on daydreaming in the late 1960s and in early 1970s, and after this, only a handful of people had made researches on the mind's capacity to stray from external events and to generate thoughts with no referent in the environment. It is since last decade much importance has been given to the topic of Mind

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wandering. A confluence of a factor has contributed for suitability of Mind wandering as the topic of research (Smallwood & Schooler, 2006).

Later the scientific consideration of consciousness became more accepted, and along with this the investigation of mind wandering, and even there were gradual methodological advances in the study of consciousness. The stream of consciousness is gradually illuminated by many strategies which may involve, self-reports, behavioral measures, and neurocognitive measures, all of these used together to make an inference about the underlying mental state (Schooler & Schreiber, 2004). The advances in Cognitive-neuro sciences has a very important effect on research on mind wandering and in particular technologies such as fMRI (Functional magnetic resonance imaging) (Ogawa et al., 1990).

The fMRI which offers a spatial resolution appears to become a primary tool in investigating the inner working of the mind. In the early years of the present century, a network of brain region known as 'default mode network was discovered', which is on the medial surface of cortex, and it is also observed that this brain network becomes active when a person involves in sort of thinking, that occurs during mind wandering, which may involve thoughts about themselves, or about others or even may be about the future.

This discovery about the DMN (Default Mode Network) has given the viable starting point, which provides the brain a basis to understand mind wandering. Many studies indicate that about 25 to 50% of the waking hours, people are engaged in thoughts which are unrelated to here and now (Killingsworth & Gilbert, 2010). For our species, it can be considered that unconstrained mental process is the norm rather than the exception. Gradually more importance is given to the scientific study of mind wandering with regards to how, when and why mind wanders.

In spite of our best efforts to maintain focus, the mind meanders off to the topic of its own choice. Historically, many mainstream researchers would have overlooked the study of mind wandering because of the concern that it is too difficult to study. But gradually many investigations have validated self-reports of mind wandering. These can reliably demonstrate changes i.e., behavioral markers such as gaze duration (Reichle, Reineberg & Schooler, 2010), reaction time and performance and also many physiological measures namely HR (heart rate), pupil dilatation and as already mentioned brain activity by fMRI, EEG, and event related potential (ERP) techniques. It is also observed that when the mind wanders, they become perceptually decoupled, which results in perceptual responsiveness to the external stimuli.

Mind Wandering In Daily Life

One of the most significant aspects of mind wandering is its relevance to everyday experience. Many everyday activities may be related to the effect of mind wandering. The experience is costly in educational contexts because it can profoundly undermine reading comprehension, attending to lectures and even test taking (Mrazek et al., 2012). Drivers are

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also especially vulnerable to mind wandering. Mind wandering increases the velocities and response times of drivers to sudden events while reducing the amount of headway distance that they maintain (Yanko & Spalek, 2013). Further evidence is provided by epidemiological investigations of victims of car accidents show the likely contribution that mind wandering has in driving accidents (Galéra et al., 2012), queried accident victims in emergency rooms regarding their circumstances immediately before the crash. Although a variety of factors discriminated the responsible from the non-responsible driver (including alcohol consumption, external distraction, negative affect, psychotropic drug use, and sleep deprivation), being deeply absorbed in mind wandering was the single best predictor of accident responsibility.

Specialists are also susceptible to mind wandering. Aviation is one domain in which mind-wandering appears to be pervasive. Casner and Schooler (2013) conducted a study and they used ES with professional pilots in a full-motion 747-400 flight simulator certified for airline training and testing. A follow-up study revealed that when pilots took the role of co-pilot, mind wandering occurred nearly as twice as often as when they were in the role of the pilot. Moreover, co-pilots no longer evidenced the capacity to reign in mind wandering when performance was challenged. These findings suggest that even highly trained experts can mind wandering in their domain of expertise, and although they may often manage to limit mind wandering to times that are minimally disruptive, they occasionally fail to do this.

Regarding everyday mind wandering most of the research focuses on the many situations in which mind wandering has detrimental consequences. Nevertheless, one recent study suggests that mind wandering may be helpful involving an important real-world context. Few studies examined the situations surrounding the generation of creative ideas by professional writers and physicists. The result shows that over 40% of the participants' creative ideas occurred when they were engaged in a non-work-related activity and/or thinking about something unrelated to the topic. Moreover, although creative ideas that occurred during mind wandering were not rated overall as more creative, they were more likely to be characterized as involving an "Aha!" experience and contributing to overcoming an impasse (Baird et al., 2012).

BENEFITS OF MIND WANDERING

There are many beneficial aspects of mind wandering, which will help in compensating some of its disruptive consequence, which can be listed as follows

1. ***Mind wandering promotes planning for the future:*** A Large proportion of thoughts which comes to our mind while mind wandering is usually related to future, that is prospective (Baird et al., 2011), which usually occurs while involved in a task requiring much less attention and working memory demands (McVay & Kane, 2010). This future orientation of mind wandering, when combined with individual's current concern, will help the individual in anticipation and planning of personally relevant future goals, which is also known as autobiographical planning. And hence we can say that mind wandering helps in cementing the link between personal goals and anticipating the

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future and even that the content of mind wandering is more frequently future-focused, rather than past or present focused.

2. ***Mind wandering promotes creativity:*** “At the moment when I put my foot on the step, the idea came to me, without anything in my former thoughts seeming to have paved the way for it, that the transformation that I had used to define the Fuchsian functions were identical with those of non-Euclidean geometry” (Detlefsen, 1993). Empirical research, have suggested that mind wandering could be linked to enhance creativity and it is also observed that individuals with ADHD had scored higher on laboratory measures of creativity (White & Shah, 2006), along with this, even questionnaire-based assessments of achievements in creative arts, than those individuals who do not have features of ADHD. It is also observed that if we focus much on our problems, deliberately it will only block creativity, but on the other hand, the distraction will enhance this (Dijksterhuis & Meurs, 2006). In an experiment conducted by Baird et al. (2012) where they had tested a hypothesis, which mainly dealt with the fact that “Mind Wandering” is associated with enhanced creativity. From that study, it was also learned that the incubation process, which is related to mind wandering plays an important role in mind wandering. Those studies provided convincing evidence that, the conditions, which favor mind wandering also, enhance creativity. Even though mind wandering is linked to compromised performance in many tasks, which is experimenter defined (Killingsworth & Gilbert, 2010), it does provide a spring of creative ideas.
3. ***Relieves boredom:*** There is a novel finding that, when mind wandering is related to topics which we find personally interesting thereby suggesting that there is a potential benefit of mind wandering which is to relieve boredom. When we are allotted a tedious task, or situation, our mind may tend to wander which occurs as a form of escape, which may occur intentionally. Our mind has the ability to disengage from the current external environment, and then it will engage in an alternative train of thoughts. This may be an adaptive measure; which has evolved, and which intern allows us to overcome from disinteresting work, without overtly abandoning the necessary task (Baird et al., 2010). There is a recent study which was done and supports this Baird et al. (2010) in which participants were given a task for about 45 min, and the task given was a very tedious one. Once the task was completed, the pre and post-task mood of participants were assessed, and they were less happy overall following their participation in the task, and it was also revealed that in them, the magnitude of the drop in mood was proportionate to the extent to which the people’s mind had wandered.
4. ***Promotes dishabituation:*** Paradoxically, mind wandering may promote the long-term learning and memory. This occurs by promoting the dishabituation, which mainly occurs by the re-representation of the “old” stimulus as “new”. There are two types of learning practices, which are “distributed” versus “massed” practice (Cepeda et al., 2006). In the former, the learning episodes, are spaced widely with respect to time whereas, in the later one, the learning episodes were much closer. The advantages, of distributed practice, stems from the processing benefits which are afforded by the dishabituation. This dishabituation occurs possibly by the mind wandering, which

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occurs during the learning task, which in turn provides the mind the opportunity to return to task with a refreshed capacity for attentive processing.

5. ***Provides Meaning:*** Mind wandering helps people to place their experience in life in a meaningful context. This process, in which we find meaning in our personal experiences, can foster well-being (Carnelley & Janoff-Bulman, 1992) and even may enhance our health outcomes (Taylor et al., 2000). Research also indicates that if we engage our self in mental time travel, which is mainly about specifically remembered or anticipated events, then it results in enhancing the self-related meaning to the life. As we know that mind keeps on wandering either to the past or to the future, as a result it will provide an important context for integrating experienced and anticipated events into a meaningful life narrative.
6. ***Parallel to night dreaming:*** Mind wandering serves a role, which rivals that of dreaming. Indeed, there exists a parallel between dreaming and mind wandering, and there are a lot of similarities. In both, the condition the attention needs to be decoupled, from the perceptual inputs and in addition to that, in both the conditions there are self-generated thoughts. Additionally, in both of them, there is a dampening in the executive and Metacognitive processing. There is a benefit such as creative incubation which occurs in both of them (Cai et al., 2009). Both of them mainly focuses on the negative contents, and because of this simulations occur, and this in turn results in the preparedness against the potential threats.

Why Does Mind Wander?

Gradually, we have been able to understand the process of mind wandering, but those factors which influence the occurrence of the experience remains less well understood. The hypothesis such as current concerns hypothesis, executive failure hypothesis, and meta-awareness hypothesis, all of these make an important prediction, which is regarding that why self-generated mental activities occur.

Among these, according to the current concerns hypothesis, the mental content is motivated by the priorities that the mindsets on the available stimuli, this view is consistent with few studies, which have manipulated by varying the silence of internal states, which is done by priming the self-memories or goals prior to the task performance.

One example is when priming self-memories raise the tendency of an individual to focus on future goals, and this enhanced focus about the future is associated with a stronger bias to remember self-relevant information (Schooler et al., 2011). In the same way, if the individual is primed in the form of a to-do list, will result in an increased focus on the future.

MEASUREMENTS

The technique of experience sampling (ES) is used in investigating mind wandering. Even though the researcher's main interest is in the wandering which leads our mind to stray from the moment, but what is experimentally measured corresponds to the content of conscious experience, at a particular moment of time.

Experience Sampling (ES)

A tool for measuring the wandering mind; experience sampling refers to the collection of self-reports which is regarding participants who are undergoing experiences (Kahneman et al., 2004).

In Experience Sampling, there are many different methods which are used to measure mind wandering, which can be listed as follows;

- 1. *Probe-caught method:*** This is the most common method, which is used to acquire data. In this methods, the participants are repeatedly interrupted, which is intermittent, and at that times they are probed, regarding the contents, of their experience (Smallwood & Schooler, 2006). This process can actually occur in a random manner or even in a quasi-random manner. In this method, one significant point regarding the duration was revealed that the off –task thoughts were reported more frequently, with larger gaps between the probes and those thoughts used to occur comparatively less frequently if the time gap was short (Seli et al., 2013).
- 2. *Self-caught method:*** In this method of Experience Sampling, what happens is that the participants are them self-asked to provide the Experience Sampling reports. That is, they are supposed to spontaneously report when they catch their mind to be wandering (Smallwood & Schooler, 2006). When this method is combined along with the probe-caught method, it helps in estimating the capacity of the participants to reflect upon their conscious experience (Schooler et al., 2011).
- 3. *Retrospective method:*** In this method, the Experience Sampling data are obtained once the task is completed, which is done via questionnaires. In this, the natural time course of the task is preserved (Barron et al., 2011; Smallwood et al., 2012). This method may be important in certain covert measures, for example in resting state of fMRI. This method has a limitation that, the measures which are obtained can be confounded with individual differences. This can be overcome by multiple measurements recorded within the same individuals (Gorgolewski et al., 2014).
- 4. *Open-ended methods:*** In this method of Experience Sampling, the participants are asked to describe their thoughts in their own words, which they experienced during a task (Baird et al., 2011). There is an advantage in this method of Experience Sampling, which is, there is no imposing of categories which will constrain the participants to reports.

Triangulation (Schooler & Schreiber, 2004) is required between different techniques, as it will take care that the account of mind wandering which is given will not be tied to a specific method. The findings, which we obtain by Experience Sampling is subjective, and hence it is difficult to verify about them objectively. So, for this problem, the best solution would be that if we can combine the subjective and objective indices of cognitive function.

Many studies have found that variability is an important characteristic of mind wandering state, which is in terms of both the response time (Cheyne et al., 2011), as well as the physical posture (Seli et al., 2014). It is observed that the mind wandering is associated with

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divergent eye movements (Foulsham et al., 2013) greater pupil dilatation, (Franklin et al., 2013) as well as more frequent eye blinks, and also changes in EEG readings and in blood-oxygen- level dependent (BOLD), in those signals which are recorded through fMRI. Research has been done at the neural level, in which the multi-vocal pattern analysis predicts the subjective reports of the contents of thoughts at rest. These covert markers help in validating the subjective measures and allows the different cognitive and neural accounts of the mind warding experiences to be tested. These even raise the possibility that, indirect markers of mind wandering could ultimately be used to detect the occurring of mind wandering, without even disturbing or interrupting the study participants.

EFFECTS OF MIND WANDERING ON NEUROCOGNITIVE FUNCTIONS

Mind wandering attenuates, many neurocognitive functions, such as sensory-motor processing, cognitive processing, and it even disrupts the attention and motor task performance. For the normal functioning, in our day to day life we need to suppress out attention towards the goal irrelevant events in our immediate environment, and rather we need to focus our attention towards the relevant ones.

The executive function model, which was proposed by Smallwood and Schooler (2006), explained that during mind wandering, the executive resources are decoupled from our immediate environment, and instead, it is being directed towards the inner stream of thoughts, which occurs via sensory-motor attenuation. Hence it is suggested that attenuation of external processing plays a very important role in mind wandering (Schooler et al., 2011; Smallwood, 2013).

Mind wandering is associated with the decrease in sensory and cognitive processing of external inputs. And along with this there is even change in accuracy and variability of response in attention as well and motor task performance. Even though many studies say that the mind wandering negatively affects the executive function, there are few which suggests that the association between the two are not exclusive. There is activation of executive prefrontal and parietal brain areas, in addition to DMN, when there is mind wandering (Christoff et al., 2009). The other point is during online task performance, studies show that there is involvement of DMN (Assaf et al., 2009).

Even though during early research, there existed an assumption of a dichotomy between mind wandering and executive function but a mature approach would show that there is the interplay between the two and neural mechanism behind it (Smallwood & Schooler, 2006). Consistent with this line of thought (Spreng & Grady, 2010) suggested that there is a third anatomically network. This network is helpful in planning across the domain, which in turn helps in supporting externally or internally focused cognition, which is done by either done by the default or dorsal attention network.

- 1. Cognitive processing:** It is shown that whenever there is an attentional lapse, it results in disruption of behavior, but the neural mechanism behind this is not clear. Weissman et al. in 2006 had conducted a research, where during a global/local task, the reaction

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time (RT) and the neural activity was measured (i.e. fMRI). Along with this, using behavioral measure they concluded that slower RTs to relevant stimuli was an index of attentional lapses. It was also observed that during these instances of attention lapse, there was a down-regulation of attentional orientation, working memory as well as conflict resolution.

2. **Sensory processing:** There is a notion that the mind wandering attenuates cognitive response to visual stimuli. In one research ERPs was recorded on samples, who were performing a variation of SART (Robertson et al., 1997), and from that research, the result was a decrease in sensory evoked cortical activity to task-irrelevant probes in the interval which was prior to mind wandering (Kam et al., 2011).
3. **Attention and motor task performance:** As we already know that during mind wandering, the sensory and cognitive processing of environmental stimuli attenuates, and hence it is not surprising that mind wandering disrupts the attentional system and the motor task performance, which is confirmed by the behavioral study. Increased RT (Reaction time) and errors have been reported during the periods of mind wandering (McVay & Kane et al., 2009). During mind wandering, it's not that only reaction time is increased, but along with that the response which is obtained is more impulsive and less stable.
4. **Other effects on Neurocognitive functions:** Even though, when our mind has wandered we will still be able to respond to the external environment adequately, which thus suggests that there are some of the aspects of the attentional processing of stimuli which remains preserved, and in turn allows us to adaptively respond to the stimuli. The extent to which the neurocognitive functions remains preserved during mind wandering depends on the nature of the stimulus, as well as the importance of stimulus.

Mind Wandering and Brain Areas

In 2001 Shulman and his colleagues revealed by a meta-analysis of PET data that a set of brain areas, including the medial frontal cortex (MFC), the posterior cingulate (PCC), and the angular gyrus (ANG), were almost never activated in any sensory, motor or cognitive experiments and activity in large parts of those areas was relatively greater during rest than during stimulated conditions. Marcus Raichle, a neurologist at Washington University in St Louis, Missouri, and his colleagues proposed the presence of a 'default-mode of brain function', which the human brain normally returns to as its baseline state when not engaged in external demands of the environment. These brain regions active during the supposedly resting state have come to be known as the "default mode network" (Gusnard & Raichle, 2001).

According to an 'internal mentation hypothesis', default network activity gives rise to spontaneous introspective processes, also referred to as 'mind wandering' (Andrews-Hanna et al., 2010). The default-mode network (DMN) includes the precuneus, posterior cingulate cortex, medial prefrontal cortex and bilateral temporal-parietal junction and the functional significance of the DMN includes its role in self-referential thought and autobiographical memory retrieval (Kim, 2012). A lot of literature on the DMN and mind wandering suggest

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that both have similar properties. Mind wandering periods have been associated with activations of the DMN. One of the first functions that have been attributed to the default network is indeed that of bringing to mind memories of the past (Kirschner et al., 2012).

The DMN has been shown to be involved in the kind of thoughts that people experience during mind wandering e.g. tasked with imagining another place or time (Schacter et al., 2012), or to think about themselves (Mitchell et al., 2005), theory-of-mind processes and make decisions about personal preferences (Moran et al., 2013). Mind-wandering state is conceived of as a process that is in opposition to external perception, at rest the core elements of the DMN are anticorrelated with brain regions engaged by external sensory processes, such as regions of the occipital cortex and the degree of the anticorrelation between these regions and the medial prefrontal cortex is enhanced for participants who mind wander more during reading (Smallwood, 2013). It was observed that default network activity increased prior to errors during sustained attention tasks and can be manipulated by meditation practice. Furthermore, damage to portions of the network, particularly MFC, was reported to produce an absence of spontaneous thought and a sensation of ‘mental emptiness’ (Brewer et al., 2011).

As mentioned above the roles of DMN and its relationship with mind wandering, one may speculate that we tend to engage in self-referential thoughts or autobiographical memory retrieval during mind wandering. Undoubtedly, more studies are necessary to determine the extent to which we can draw inferences about mind wandering based on research findings of DMN.

MIND WANDERING AND PSYCHOPATHOLOGY

Many studies have shown that there is a link between psychiatric disorders and elevated experience of mind wandering. The psychiatric conditions that have been studied in some depth include depression, ADHD, schizophrenia.

1. ***A wandering mind and mood:*** It is observed in the studies that there is greater mind wandering in individuals with unhappy mood, and it may even undermine future happiness. Thus a number of studies in past have demonstrated a negative relationship between mind-wandering and mood (Smallwood & O'Connor, 2011). The most notable of which was a large-scale experience-sampling study where they found that individuals reported worse mood when they were mind-wandering relative to when they were on-task, and even when individuals reported mind wandering about pleasant topics, their mood rating was never better than when they were on-task (Killingsworth & Gilbert, 2010). Although mind-wandering may normally be a downer, if someone is mind-wandering about a topic that he or she finds especially interesting, might such stimulating musings be one case where mind-wandering is actually uplifting. Recently a mind-wandering experience-sampling study suggested that overall on-task reports had a higher positive mood rating than off-task reports. However, the effect of a mind-wandering episode on mood was varied based on how interesting and useful it was. Positive mood ratings were significantly correlated with both interest and usefulness

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assessments of the mind-wandering episode. Additional analyses revealed that high-interest episodes were associated with a more positive mood than on-task episodes, whereas highly useful episodes did not differ significantly from on-task episodes (Franklin et al., 2013). These results suggest that the content of mind-wandering episodes can make a big difference for its effects on mood and affect. Specifically, mind-wandering episodes of high interest may lead to increased positive mood relative to be on-task.

- 2. *A wandering mind and ADHD:*** The elevation in mind wandering have also been observed in some individuals that are ADHD (Attention Deficit Hyperactivity Disorder), or are more generally impulsive in nature. There are two main reasons for the individuals to spend time mind wandering, one reason is when there is failure to constrain the attention to the task at hand, and this mechanism explains why those individuals who have poor impulse control (such as that individual, with ADHD) and have a problem in controlling their attention, engage themselves in mind wandering more frequently (Franklin et al., 2016). On the other hand, people may involve themselves in mind wandering as an internal attempt in order to overcome or to re-address, the problems in their personal life. For e.g., rumination has also been linked to difficulties in relinquishing a previous mental set during the task switching paradigms. Even studies have shown that ruminative self-focus engages both the areas of the default mode network (DMN). The ruminative mind wandering arises because of the emphasis that, it resolves the personal problems.
- 3. *A wandering mind and schizophrenia:*** It is studied that, individuals who suffer from schizophrenia, have shown to engage in internally generated thoughts more frequently. Garrity et al. (2007) studied the relationship between functional connectivity of DMN and symptom severity of schizophrenia. Later it was found to be abnormal functional connectivity in schizophrenia patients but how spatial and temporal dynamics of resting state networks (DMN) contribute to individual psychopathology in schizophrenia is not known. However, studies show that altered functional connectivity and temporal dynamics of DMN correlated with positive symptoms including hallucinations, delusions, and disorganization, while hippocampus connectivity in DMN and severity of hallucinations have a negative correlation. It suggested a role of DMN in the generation of psychotic symptoms, in which impaired source monitoring is associated with impaired connectivity of the hippocampus in DMN (Rotarska-Jagiela et al., 2010).

DRAWBACKS OF MIND-WANDERING

Mind-wandering can significantly interfere with the individuals' primary task performance. The following are the domains in which negative effects of mind-wandering have been studied, including reading, vigilance, and mood.

- 1. *Reading:*** Mind-wandering is mostly found to be associated with poor comprehension and superficial perceptual encoding of written documents during reading. The studies show that it produces deficits in immediate comprehension (e.g.-if information presented of a fact-based question just before, incorrectly answered by an individual) and more significantly it produce deficits in complex reading comprehension, such as

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finding out meaning and making creative models according to situations and narratives (Franklin et al., 2013). Mind-wandering may affect how individuals speak while reading out loud due to its effects on semantic processing in the visual modality. While reading it leads to comprehension deficits in a specific item and model-building and is associated with a decreased coupling between ocular, vocal and manual responses and their lexical-semantic determinants (Smallwood & Schooler, 2015).

2. ***Sustained Attention:*** The sustained attention to response task (SART) is a go/ no-go task of vigilance that is frequently used as indirect markers of mind-wandering. The effects of mind-wandering on SART performance are routinely observed in distinct behavioral measures such as errors of commission, errors of omission, reaction times (RT) and their anticipations and variability. It has been proposed that commission errors reflect a pronounced state of task disengagement and increased RT variability reflects a lesser degree of disengagement (Baird et al., 2012). So, there is much evidence that mind-wandering brings costs for the ability to sustain attention.
3. ***Mood and Affect:*** Recent evidence suggests that individuals are generally less happy when they are wandering mind than when they engaged in the task. Studies show that mind-wandering has significant costs for individuals as it is often associated with negative mood and affect. However, this relationship can be further qualified when the content of mind-wandering is also considered (Killingsworth & Gilbert, 2010).
4. ***Working Memory and General Aptitude:*** Recent work shows that mind-wandering contributes to the strong relationship between general fluid intelligence (gF) and working memory capacity (WMC) and is associated with worse performance on measures of general aptitude. The WMC and gF were positively correlated with each other and negatively correlated with mind-wandering (Mrazek et al., 2012). Trial-by-trial analyses suggested that mind-wandering and WMC correlate negatively in which participants who felt more difficulty with the span task failed to remain engaged and the effect of financial incentives on complex span performance could be mediated by a decrease in mind wandering. It means that mind-wandering disrupts WMC test performance. Few studies suggest that mind wandering is seen as a consequence not a cause of poor performance. By mental training aimed to reduce mind wandering one might get improved the performance on a test of general aptitude (Perrig et al., 2009).

Does Mindfulness Suppress Creativity?

Noting that mindfulness and mind-wandering appear to be opposite tendencies and that benefit of mind-wandering is its capacity to enhance creativity, there may be paradoxical costs associated with too much mindfulness and it might suppress certain types of creative processes (Baird et al., 2012). Recently, researchers studied that the people who are chronically less mindful and hence more prone to mind-wandering might perform better on tests of creativity. At first glance, this proposal seems counter-intuitive. After all, mindfulness is generally beneficial for cognitive abilities. Yet, creative problem solving is special in that it does not necessarily require the kind of controlled, analytic thought involved in many cognitive tasks (Kounios & Beeman, 2009). This proposal is also consistent with the link

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between ADHD and creative achievement. Thus, it is possible that being chronically less mindful may help creative performance.

To investigate individual differences in relation to creative performance, a number of studies have focused on structural differences in the brain. Interestingly, these studies have found that differences in creative performance correlate positively with activation in areas associated with the default mode network which is associated positively with mind-wandering and negatively with mindfulness. Thus, recent neuroanatomical evidence supports the hypothesis that individual differences in mind-wandering and mindfulness are differentially related to creativity (Brewer et al., 2011). A recent study tested the relationship between creativity and mindfulness more directly by using the MAAS and measured creative problem-solving performance on the Remote Associates Test (RAT). The results showed a negative correlation between mindfulness scores and RAT performance. Thus, this finding provides the direct evidence that being less mindful helps to be more creative. Again if mindfulness is harmful to creative tasks because creativity does not necessarily rely on analytic thought, then lacking mindfulness should be beneficial when dealing with problems that are less amenable to solution by analysis versus ‘insight.’ Creativity researchers have long been intrigued by the fact that the same creative problems can often be solved through analytic thought, much like a non-creative cognitive task, or through spontaneous insight, typically referred to as a ‘Áha’ experience (Zedelius & Schooler, 2015).

Mind Wandering Easy To Report But Difficult To Notice

Converging evidence from behavioral, neurocognitive and combined paradigms indicate that, when prompted, people can accurately report whether or not they are mind wandering. By contrast, the individuals routinely mind wander without spontaneously noticing the fact. A contributing factor to difficulties in recognizing mind wandering may be that the brain regions involved in the noticing its occurrence could be hijacked by experience. Most of the brain regions involved in mind wandering are also implicated in systems which might be expected to engage in the monitoring of the state itself. The following two processes might be hijacked and contribute to difficulties in noticing mind wandering (Schooler et al., 2011).

- 1. Mental state attribution:** The brain regions of the medial prefrontal cortex (PFC) are recruited both during mind wandering and in tasks that require a theory of mind. Because mental state attribution involves the application of metacognitive processes to information of a stimulus-independent nature (e.g. inferences about the mental state of another individual), the involvement of these brain areas during SIT could prohibit their utility in the service of noticing the wandering mind (Schooler et al., 2011).
- 2. Cognitive control:** Periods of mind wandering also engage brain regions such as the dorsal ACC, which are known to be involved in error detection and conflict monitoring, and the anterior PFC, involved in cognitive meta-awareness. If mind wandering engages both metacognition and error-detection systems in the service of generating a coherent stream of SIT, then the fact that these systems are already engaged might make them less capable of detecting a mind-wandering episode (Schooler et al., 2011).

Mind Wandering and Aging

Giambra (1989) studied that mind wandering declined with age and attributed this finding to increased age being associated with reduced unconscious information processing. Giambra's findings differ from the perspective that aging impairs executive control. He discussed these results as when performing a task that does not require full attention. Excess attentional capacity can be devoted to mind wandering. Accordingly, younger adults have the more attentional capacity and more often an excess to allow mind wandering. Later on, some studies suggest that older adults mind wander less than younger adults (Carriere et al., 2010), while other older studies found no age differences (Einstein & McDaniel, 1997). The rate of mind wandering is meaningfully related to the degree of attentional or executive control, such as one's ability to inhibit task-unrelated thought. Compared with younger adults, older adults have less efficient attention regulation allowing for more irrelevant thoughts to enter mind wandering. Furthermore, reduced cognitive control has been predicted by lower working memory capacity (WMC) scores that are associated with higher mind wandering rates. Mind wandering influenced by the contribution of age-related changes, attentional control and situation model processing (McVay et al., 2013).

CONCLUSION

Mind-wandering is a universal phenomenon which accompanies much of our daily lives from childhood to adulthood. Mind-wandering can be a major detriment to cognitive performance and well-being, yet it may also enable future planning, facilitate creativity, and at least on occasion provide uplifting stimulation. The use of mindfulness may help to reduce mind wandering and thereby decreasing some of its negative consequences. At the same time, those who are routinely mindful may sacrifice some of the creativity. For many people, a simple move toward greater mindfulness is likely to afford significant benefits, reducing the many negative consequences of mind-wandering and enhancing well-being in some of the other ways attributed to mindfulness, such as improved health and reduced stress (Tang et al., 2007). For others, an easing up on the rigorous requirement of always being attentive to the goings-on of the present moment might enable a freedom of thought that enables enhanced creativity. So we have to find the right balance between the focus on mindfulness and the freedom of a mind untethered to the present. The optimally balance mind wandering and mindfulness must await further research. Future research should take advantage of advances in technology to help people to better recognize their mental states and adjust them accordingly to the situation. Each of us would be advised to take heed of the fact that mind-wandering can markedly impede our ability to perform to the best of our abilities. Developing the habit of mindfulness, through regularly taking note of our thoughts and possibly initiating a meditation practice, would be helpful for many of us but we should not seek to eliminate mind-wandering entirely from our lives, a site may offer some unique benefits when carried out at the appropriate times. Ultimately, each one of us must determine for ourselves the optimum balance between mind-wandering and mindfulness.

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