Mind-Wandering by Jonathan Smallwood & Jonathan W Schooler

The mind never stays still. Without constant vigilance our minds can, and often do, wander from the constraints of our current task to our own private thoughts and feelings. The experience of **mind-wandering** is one of the most introspectively accessible examples of the challenges of mental control. For example, everyone is familiar with the experience of suddenly realizing, while reading, that although one's eyes have continued to move across the page, one's mind has been fundamentally elsewhere. The example of mindless reading strikingly illustrates two fundamental aspects of mind-wandering (also known as daydreaming, stimulus independent thought or task unrelated thoughts). First, the frequent disparity between what one is doing and what one is thinking about illustrates the process of "decoupling" (Smallwood & Schooler, 2006) whereby attentional resources cease to be constrained by external sources, and instead become focused on information of an internal origin. This reduced dedication of resources to the on going task compromises task performance.

A second striking aspect of mind-wandering is illustrated by the surprise we feel when we recognise that our mind has wandered. In contrast to other less demanding tasks such as driving or listening to music, in which one may knowingly allow their mind to wander, we know that when we read it is not possible to follow the narrative while at the same time maintaining an unrelated train of thought. When we mind wander during reading, our comprehension of the narrative is clearly compromised. Since mind-wandering unrelated to the narrative is unlikely to be deliberate (at least when one is sufficiently motivated) its' common occurrence in tasks like reading demonstrates that we often temporarily lack awareness that our mind has wandered. As such mind-wandering can be seen as common everyday example of a failure to take stock of the current contents of consciousness. The ability to reflect on the contents of consciousness is referred to as **meta-awareness**.

Measuring mind-wandering

Under laboratory conditions two different approaches have been used to sample mind-wandering. The first approach, the **probe-caught** method, samples the experience of the individual at varying time intervals as they perform a cognitive task. The second approach, the **self-caught** method requires that the individual responds with a button push whenever they catch their own mind-wandering.

Probe and self-caught measures of mind-wandering yield different information on the occurrence and awareness of mind-wandering because they systematically sample the different aspects involved in off-task experiences. The probe-caught technique provides evidence of how readily the mind turns inward, and can be used to study the onset of **decoupling,** or the likelihood that attention has drifted from the task in hand. On the other hand, the self-caught method requires the individual to recognise that their mind is wandering, and so illustrates the engagement of **meta-awareness** of their own mind-wandering. Evidence of the value of distinguishing between probe-caught and self-caught mind-wandering comes from the findings that the two measures are differentially associated with task performance. Interestingly, it is the probe caught mind-wandering episodes that tend to be maximally associated with detriments in performance. The more modest consequences of self-caught mind-wandering episodes suggest that when individuals become aware of mind-wandering, they are able to circumvent its costs either by more effectively dividing attention or terminating the episode and returning attention to the task.

Smallwood, J. & Schooler, J. W. (2009). Mind-wandering. In: T. Bayne, A. Cleermans & P. Wilken (Eds), The Oxford Companion to Consciousness. pp. 443-445. Oxford: Oxford University Press.

Situational Constraints on Mind-wandering

Generally, if the primary task occupies working memory resources then attention stays coupled to the task more effectively and for longer periods; as a result mind-wandering is infrequent. For example, Antrobus, Singer and Greenberg (1966) observed that mind-wandering was more frequent in a simple signal detection task with a slow stimulus presentation rate than one with a faster rate of presentation. More recently, the suppression of mind-wandering was shown to depend on whether the task involves rehearsal within working memory (Teasdale, Lloyd, Proctor & Baddeley, 1993). Interestingly, the working memory of the individual seems to moderate the extent to which mind-wandering is experienced (Kane, Brown, McVay, Silvia, Myin-Germeys & Kwapil, 2007).

The simple involvement of working memory, however, is not the whole story with respect to mind-wandering. Attention is often drawn to objects that are interesting rather than complex. Moreover, according to ironic processing theory (Wegner, 1994) in certain circumstances a working memory load can, in fact, be detrimental to our attempts to remain on task. In the context of tasks with a narrative, such as reading, it appears that our experience is held by features of the task which interest us rather than those which are simply difficult to complete. Grodsky and Giambra (1989) demonstrated that mind-wandering during reading was predicted by interest in text rather than difficulty to follow. Presumably, participants find it a more absorbing experience to read an interesting story and as a result their minds wander less. Difficult expository texts, while requiring effort, do not lead to absorption and so attention is maintained on the task through our own vigilance.

When tasks are simple, the extent to which they occupy working memory resources determines whether mind-wandering occurs. As task complexity increases, however, mind-wandering is suppressed not simply by working memory involvement, because tasks such as reading a dry expository text require more resources than does reading an intriguing fiction story. Instead, mind-wandering is suppressed when we engage in a task which absorbs us in the experience of task-completion. We have suggested that the influences of factors like absorption or structure on mind-wandering, provides evidence that certain situations provide a cognitive **affordance** which help to anchor attention in the current context (Smallwood & Schooler, 2006). The notion of an affordance emphasises that certain situations provide the individual with the opportunity to focus on the here and now and that, if motivated to do so, can be used to temporarily escape from our own private thoughts and experiences. Considering our last visit to the cinema, it is obvious that the skill of the director and the effectiveness of the actors, rather than the amount of working memory load, determined whether the film afforded absorption or encouraged mind-wandering.

The Neurophysiology of Mind-wandering

The relative dearth of research on mind-wandering means that few studies have directly examined the neuropsychological concomitants of mind-wandering. Studies have documented that periods when mind-wandering physiological activity (such as heart rate and skin conductance) is elevated. This physiological activity reflects the fact that during mind-wandering our attention is often drawn to our own current concerns – topics which are more emotionally arousing than the dry and relatively uninteresting cognitive situations in which these studies take place (see Smallwood & Schooler, 2006).

One important implication of understanding the neuropsychological substrates of mind-wandering is that it provides a novel method for understanding brain activity that is unconstrained by the external environment. Research has documented that when deprived of external stimulation the brain recruits a network of discrete areas which are commonly referred to as the 'default network' (Raichle, MacLeod, Snyder, Powers, Gusnard & Shulman, 2001). One plausible reason why this phenomenon occurs is because when resting participants can indulge in private thought, an activity which shares the same lack of environmental constraint as is involved in mind-wandering. Researchers have recently documented that situations that lead to task–induced deactivations in the 'default network' correspond to the same situations in which mind-wandering is reduced. Indeed a recent study (Mason, Norton, Van Horn, Wegner, Grafton & Macrae, 2007) using fMRI found that under circumstances when practice on a task had reduced the need for attentional supervision there was enhanced default network activation.

In the future, it may be possible to use changes in the activity of the default network, or other indirect measures of mind-wandering including response time, physiological activation or evoked response to task stimuli (Smallwood, Beach, Schooler & Handy, 2008), to reveal mind-wandering unfolding in real-time. Methodologically, this would revolutionize the study of mind-wandering by enabling the empirical examination of these private experiences without bringing them to the attention of the participant, and thereby prematurely terminating the episode.

REFERENCES

Antrobus, J.S., Singer, J.L., & Greenberg, S. (1966). Studies in the stream of consciousness: Experimental suppression of spontaneous cognitive processes. *Perceptual and Motor Skills, 23*, 399-417.

Grodsky, A., & Giambra, L. (1989). Task unrelated images and thoughts whilst reading. In J.Shorr, P. Robin, J.A. Connek and M. Wolpin, *Imagery: current perspectives*, NY, Plenum Press.

Kane, M.J., Brown, L.H., McVay, J.C., Silvia, P.J., Myin-Germeys, I., & Kwapil, T.R. (2007). For Whom the Mind Wanders, and When: An Experience-Sampling Study of Working Memory and Executive Control in Daily Life *Psychological Science 18 (7),* 614–621.

Mason, M., Norton, M., Van Horn, J.D., Wegner, D.W., Grafton, S.T., & Macrae, C.N. (2007) Wandering Minds: The Default Network and Stimulus-Independent Thought. *Science, 315*, 393-395.

Raichle, M. E., MacLeod, A. M., Snyder, A. Z., Powers, W. J., Gusnard, D. A., & Shulman, G. L. (2001). A default mode of brain function. *Proceedings of the National Academy of Sciences, U.S.A., 98,* 676–682.

Smallwood, J., & Schooler, JW. (2006). The Restless Mind. *Psychological Bulletin*, *132*(6), 946 -958

Smallwood, J., Beach, E., Schooler, J.W., & Handy, T.C. (2008) Going AWOL in the Brain: Mind-wandering Reduces Cortical Analysis of External Events. *Journal of Cognitive Neuroscience*.

Teasdale, J.D., Lloyd, C.A., Proctor, L., & Baddeley, A. (1993) Working Memory and Stimulus-independent-thought: Effects of Memory Load and Presentation Rate. *European Journal of Psychology, 5* 417-433.

Wegner, D. M. (1994). Ironic processes of mental control. *Psychological Review, 101*, 34-52.