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Manipulating cues in mind wandering: Verbal cues affect the frequency and the temporal focus of mind wandering

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ABSTRACT

Our understanding of mind wandering (MW) has dramatically increased over the past decade. A key challenge still facing research is the identification of the processes and events that directly cause and control its occurrence. In the present study we sought to shed light on this question, by investigating the effects of verbal cues on the frequency and temporal focus of MW. To this aim, we experimentally manipulated the presence of irrelevant verbal cues during a vigilance task, in two independent groups (Verbal-cues group *vs.* No-cues group).

We found that compared to the No-cues group, the Verbal-cues group reported a higher amount of MW, mostly triggered by the irrelevant cue-words, and a higher proportion of past-oriented MW compared to the other temporal orientations. These results demonstrate that task-irrelevant verbal stimulation increases the frequency of MW and steers its temporal orientation toward the past. Implications for the research on MW are discussed.

1. Introduction

While reading a book, driving the car, or attending a class, there may be moments when our attention drifts away from an ongoing task toward internal thoughts whose content is unrelated to the task, like memories or prospective thoughts. We refer to this "shift of attention away from a primary task toward internal information" (Smallwood & Schooler, 2006, p. 946) as mind wandering (MW).

Converging evidence suggests that MW is a ubiquitous and pervasive mental activity, common across different cultures and groups (see for a review, Smallwood & Schooler, 2015). Experience sampling studies have indeed shown that people spend between 25% and 50% of their daytime engaged in MW (Kane et al., 2007; Killingsworth & Gilbert, 2010), and the frequency of MW might even increase during well-practiced tasks (e.g., driving, reading) (Mason et al., 2007).

First studied by a handful of researchers almost fifty years ago (Antrobus, Singer, & Greenberg, 1966; Klinger, 1971; Singer, 1966), in the past decade MW has received a widespread scientific attention in both psychology and neuroscience (Christoff, Irving, Fox, Spreng, & Andrews-Hanna, 2016). In particular, research on MW greatly benefited from the adoption of the "strategy of triangulation" (Smallwood & Schooler, 2015), whereby self-reports, behavioral measures, and physiological measures are combined together, to make inferences about covert mental experiences.

What still remains unclear, though, is the neurocognitive mechanism by which MW arises and unfolds over time, that is *why* and *how* the mind wanders. As argued by Smallwood (2013), any comprehensive account of MW is expected to address and explain the process of the *initial occurrence* of MW as well as its *maintenance-continuity* over time (i.e., the process-occurrence framework; Smallwood, 2013). One of the reasons for the inability to determine the onset of MW is the difficulty in causally linking MW to a

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preceding event that triggers the onset of MW (i.e., imperative stimulus; Smallwood, 2013). In the MW literature MW episodes have been mainly described as self-generated (e.g., Smallwood, 2013) and stimulus-independent (Antrobus, 1968), terms that emphasize their independence from external stimuli and ongoing actions.

However, during the last few years, empirical evidence has been reported suggesting for a role of external stimuli in MW (McVay & Kane, 2013; Plimpton, Patel, & Kvavilashvili, 2015; Song & Wang, 2012). For example, in the experience sampling study by Song and Wang (2012), in most MW samples (88%) participants could report the trigger for the MW and nearly a half was reported to be associated with internal (49%) and half with external (51%) cues.

An important contribution to addressing the question of the onset of MW and its cue-dependent nature has been recently provided by the related research field on involuntary autobiographical memories (IAMs). IAMs are memories of personal events that come to mind spontaneously, without any deliberate attempt to retrieve them (Berntsen, 1996, 1998, 2009; Kvavilashvili & Mandler, 2004; Mace, 2004, 2005). Crucially, IAMs share similar features with MW (Johannessen & Berntsen, 2010; Marchetti, Koster, Klinger, & Alloy, 2016), as studies have highlighted that these memories are more likely when one is engaged in undemanding activities that require little attention and concentration (Berntsen & Hall, 2004; Kvavilashvili & Mandler, 2004). It is also noteworthy that IAMs are largely elicited by easily identifiable external cues (e.g., Berntsen, 1996; Berntsen & Hall, 2004; Mace, 2004), generally related to prominent aspects of the remembered experiences (e.g., Berntsen, 1996; Berntsen & Hall, 2004). Direct comparisons between IAMs and involuntary future thoughts revealed for both kinds of involuntary cognitions clearly identifiable triggers but IAMs were more likely to be triggered by environmental cues compared to the future thoughts (e.g., Berntsen & Jacobsen, 2008).

In one of the most successful paradigms, developed by Schlagman and Kvavilashvili (2008) to assess IAMs in a laboratory setting, participants are exposed to a long sequence of trials of mostly horizontal lines and have to detect an occasional target (i.e., vertical lines), while being simultaneously exposed to irrelevant cue-words, presented in the center of each slide (i.e., 'relaxing on a beach' or 'crossing the street'). To assess the frequency of IAMs, both self-caught (Schlagman & Kvavilashvili, 2008) or probe-caught (Vannucci, Batool, Pelagatti, & Mazzoni, 2014) procedures have been used in the studies. This paradigm elicits a fair amount of IAMs, the majority of which (85% in the original study) are reported as being triggered by the word-cues on the screen.

Recently, Plimpton et al. (2015) used a modified version of this paradigm, originally developed for studying IAMs, to investigate the association between external cues and the frequency and temporal orientation of task-unrelated thoughts (TUTs). In the study, participants were stopped 11 times during the vigilance task and recorded their thoughts at that moment. The results revealed that the majority of reported TUTs (86%) had an identifiable external trigger, and, in most cases (85%), the trigger was one of the verbal cues appearing on the screen. As for the temporal orientation of TUTs, the frequency of past-focused thoughts was significantly higher than future and current thoughts. The cue emotional valence interacted with the temporality of the thoughts, with negative cues being more likely to elicit past thoughts, while positive cues being more likely to elicit future thoughts.

These findings suggest that both the frequency and the temporal focus of TUTs may be function of the external context, rather than being completely self-generated. Nevertheless, a few caveats are warranted. First, given the absence of a direct experimental manipulation of the presence of verbal cues, it is not possible to conclude that the presence of verbal cues was the direct *cause* of the occurrence of TUTs and the steering of their temporal focus toward the past. Moreover, in the study by Plimpton et al. (2015), the authors primarily referred to TUTs as a category comprising both mind wandering and external distractions (EDs), while previous taxonomies (i.e., Robison & Unsworth, 2015; Stawarczyk, Majerus, Maj, Van der Linden, & D'Argembeau, 2011; Unsworth & Robison, 2016) and empirical evidence (i.e., Unsworth & McMillan, 2014) suggested differential effects for these two phenomena.

In the present study, we aimed to capitalize on these recent promising findings, by experimentally investigating the *causal* role of verbal cues in triggering and shaping MW. We did so, by addressing two major questions: First, does exposure to task-irrelevant verbal information directly trigger MW during a vigilance task? If so, we should find a higher frequency of MW during a vigilance task with verbal cues compared to an identical vigilance task with no verbal cues. This question mirrors the current research agenda on spontaneous thought that underlines the crucial importance of tracking the onset of each single MW episode (i.e., "*why*"), rather than simply ascertaining its presence or absence (Smallwood, 2013).

Second, does the exposure to verbal information influence the temporal orientation of MW and, specifically, increase past-oriented MW? The indirect evidence we reviewed above would suggest that the exposure to verbal information stimulate the mind to wander toward the past, compared to an identical condition with no verbal information presented. However, so far, no studies investigated whether the exposure to verbal information might systematically affect the temporal orientation of MW.

To address these two questions, in the context of a *between-subject* design, we experimentally manipulated the presence of verbal cues during the vigilance task in two independent groups, "Verbal-cues" group and "No-cues" group respectively. Since evidence has been reported for negative verbal cues being more likely to trigger past memories and positive verbal cues to trigger thoughts about the future (Plimpton et al., 2015), to avoid any bias in favour of a specific temporal focus of MW, all the verbal cues employed in the present study had been previously evaluated as emotionally neutral and a-temporal (see Section 2).

In the study, a self-catching procedure was used, thereby instructing participants to report the occurrence of any spontaneous mental content not directly related to the task at hand. In line with the taxonomy proposed by Stawarczyk et al. (2011), we distinguished TUTs in external distractions (ED) and mind wandering (MW) episodes, as these two phenomena were shown to have partially distinct associations with attentional control and working memory (Unsworth & McMillan, 2014). To our knowledge, it is still unknown whether task-irrelevant verbal cues might have differential effects on the frequency of MW and ED. Given the association reported in the literature between past-oriented MW and negative mood (e.g., Poerio, Totterdell, & Miles, 2013; Smallwood & O'Connor, 2011), positive and negative affect were measured (through the Positive and Negative Affect Schedule, PANAS) at the beginning of the experimental session. Finally, phenomenological information on each reported thought was acquired.