



## Mind-wandering: Phenomenology and function as assessed with a novel experience sampling method

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### ABSTRACT

Mind-wandering refers to the occurrence of thoughts whose content is both decoupled from stimuli present in the current environment and unrelated to the task being carried out at the moment of their occurrence. The core of this phenomenon is therefore stimulus-independent and task-unrelated thoughts (SITUTs). In the present study, we designed a novel experience sampling method which permitted to isolate SITUTs from other kinds of distractions (i.e., irrelevant interoceptive/exteroceptive sensory perceptions and interfering thoughts related to the appraisal of the current task). In Experiment 1, we examined the impact of SITUTs on the performance of the Sustained Attention to Response Task (SART; a Go/No-Go task). Analyses demonstrated that SITUTs impair SART performance to the same extent as irrelevant sensory perceptions. In Experiment 2, we further examined SITUTs in order to assess the possible functions of mind-wandering. We observed that the content of most of reported SITUTs refers to the anticipation and planning of future events. Furthermore, this “prospective bias” was increased when participants' attention had been oriented toward their personal goals before performing the SART. These data support the view that an important function of mind-wandering relates to the anticipation and planning of the future.

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### 1. Introduction

An important feature of the human mind resides in its propensity to spontaneously generate thoughts when some of its resources are left idle (Antrobus, Singer, Goldstein, & Fortgang, 1970; Christoff, Gordon, & Smith, in press; Giambra, 1995; Klingler, 1990, 2009; Pope & Singer, 1978; Scerbo, Bliss, Freeman, Mikulka, & Schultz Robinson, 2005; Singer, 2003; Smallwood, 2009; Smallwood & Schooler, 2006). For instance, when performing boring or redundant activities, it is relatively frequent that our mind drifts away from the current task and wanders towards memories, future plans, personal concerns and other thoughts whose content is not the direct reflection of our immediate stimulus environment. The core characteristic of such thoughts, generally labeled as mind-wandering (Smallwood, 2009; Smallwood & Schooler, 2006) or daydreams (Klingler, 1990; Singer, 1975), is that their content is both decoupled from stimuli present in the current environment (i.e., they are stimulus-independent; Antrobus, 1968; Teasdale et al., 1995; Teasdale, Proctor, Lloyd, &

Baddeley, 1993) and unrelated to the activity being carried out at the time of their occurrence (i.e., they are task-unrelated; Giambra, 1989, 1995; Scerbo et al., 2005). They can therefore be broadly defined as “stimulus-independent and task-unrelated thoughts” (abbreviated here as SITUTs).

Research suggests that SITUTs are concomitant with almost every kind of activity, occurring (albeit with reduced frequency) even when highly resource consuming tasks are performed (Antrobus et al., 1970; Smallwood, Fishman, & Schooler, 2007) and representing on average between 10% and 30% of our daily thinking time (Kane et al., 2007; Klingler, 1990). It has been proposed that SITUTs depend, at least in part, on the same cognitive resources as (and thus compete with) task-related processing, as they generally impair performance on the task being carried out at the moment of their appearance (Antrobus et al., 1970; Smallwood, 2009, 2010; Smallwood, Fishman, et al., 2007; Smallwood & Schooler, 2006). Mind-wandering has, for instance, been linked to decreased text comprehension (Schooler, Reichle, & Halpern, 2004; Smallwood, McSpadden, & Schooler, 2008) and to higher variability of reaction times and increased number of errors in Go/No-Go tasks (McVay & Kane, 2009). However, the results of many studies are still debated and may be subject to problems of interpretation because of the specific methods used to assess the occurrence of mind-wandering (e.g., Christoff, Gordon, Smallwood,

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Schooler, & Smith, 2009; Gilbert, Dumontheil, Simons, Frith, & Burgess, 2007; Mason et al., 2007a,b). In this study, we present and validate a novel experience sampling method that assesses the occurrence mind-wandering episodes in a more rigorous way, and use this new method to further investigate the function and phenomenology of SITUTs.

Currently, the most commonly used method to assess mind-wandering consists of probing the subjects' conscious experience at random intervals while performing various cognitive tasks (i.e., the thought-probe method; Giambra, 1995; Smallwood & Schooler, 2006). Typically, probes interrupt tasks requiring sustained externally-driven attention (e.g., reading tasks or signal detection tasks; Smallwood, Fishman, et al., 2007) and participants are instructed to report whether they were totally focused on the proposed task just before the interruption (i.e., on-task or stimulus-dependent reports, depending on which aspect of SITUTs is emphasized by the study) or whether they were distracted by task-unrelated conscious experiences (or stimulus-independent conscious experiences). In some studies (e.g., Teasdale et al., 1993, 1995), participants simply have to say what they had in mind at the moment of the thought-probe and the experimenters later classify the reports as reflecting on-task (or stimulus-dependent) or off-task (or stimulus-independent) conscious experiences. Whether self-reported or judged by the experimenter, off-task (or stimulus-independent) reports are considered to reflect the presence of mind-wandering episodes (e.g., Forster & Lavie, 2009; Giambra, 1995; Mason et al., 2007b; McKiernan, D'Angelo, Kaufman, & Binder, 2006; Smallwood, McSpadden, & Schooler, 2007).

However, as illustrated in Fig. 1, distractions occurring during tasks requiring sustained focused attention to the external environment can originate not only from SITUTs but also (1) from interfering thoughts related to the appraisal of the current task, such as, for instance, wondering when the task will end or thoughts about one's overall performance (i.e., task-related interferences, abbreviated here as TRIs; Matthews, Joyner, Gililand, Campbell, & Faulconner, 1999; Smallwood, Baracaia, Lowe, & Obonsawin, 2003; Smallwood, Davies, et al., 2004), and (2) from exteroceptive and interoceptive perceptions caused by irrelevant stimuli, such as noises, hunger, thirst and so forth (i.e., external distractions, abbreviated here as EDs; Forster & Lavie, 2008a,b; Lustig, Hasher, & Tonev, 2001; Unsworth, Redick, Lakey, & Young, 2010). The dichotomous division of conscious experiences into on-task and off-task (or stimulus-dependent and stimulus-independent) does not permit to clearly distinguish between these different categories

(Christoff et al., 2009; Gilbert et al., 2007; Mason et al., 2007a,b). As shown in Fig. 1, TRIs, EDs, SITUTs, and being fully focused on the current task can all be conceptualized along two dimensions: "task-relatedness" and "stimulus-dependency." If the classification of ongoing conscious experiences is limited to on-task and off-task reports, EDs and SITUTs may be mixed in the same category. Similarly, if the division of conscious experiences is confined to stimulus-dependent or stimulus-independent reports, there is a risk for TRIs and SITUTs to be pooled together. This lack of precision of typical thought-probes is problematic as, currently, little is known about the precise nature of distractions caused by SITUTs versus EDs or TRIs.

In the present study, we used the conceptualization of conscious experiences based on the stimulus-dependency and task-relatedness dimensions described in Fig. 1 to develop a novel kind of thought-probes that clearly distinguishes SITUTs from other classes of distractions (i.e., EDs and TRIs). These new probes permitted us to determine in Experiment 1 whether SITUTs still affect task performance when they are rigorously separated from other kinds of distractions, and also to directly assess the similarities and differences between SITUTs, EDs, and TRIs in terms of their impact on task performance.

In spite of their negative impact on current task performance, SITUTs may nevertheless serve a variety of useful functions. Daydreams and mind-wandering episodes have notably been supposed to be involved in the maintenance of an ongoing sense of identity, in emotion regulation, creative thinking, self-entertainment during boring activities, or maintaining arousal in situations of poor environmental stimulation (for reviews, see Antrobus et al., 1970; Gold & Cundiff, 1980; Klinger, 1999). Furthermore, several authors have emphasized the potential importance of SITUTs in problem solving and planning for the future (Bar, 2007, 2009; Bar, Aminoff, Mason, & Fenske, 2007; Binder et al., 1999; Buckner & Vincent, 2007; Singer, 1966; Smallwood & Schooler, 2006). For example, discussing the possible function of daydreams, Binder et al. (1999, p. 85) suggested that "[...] by storing, retrieving, and manipulating internal information, we organize what could not be organized during stimulus presentation, solve problems that require computation over long periods of time, and create effective plans governing behavior in the future." Mind-wandering episodes may thus be more than simple attentional lapses and consist in a redirection of cognitive resources away from the ongoing task and towards the processing of personal goals and concerns (Christoff et al., 2009; Smallwood, 2010; Smallwood & Schooler, 2006). Yet, to date, very few empirical studies have directly focused on the possible functions of SITUTs (Smallwood, 2009) and the evidence for their possible role in anticipating and planning future events, notably through the processing of personal goals and concerns, is inconsistent.

In a recent study, Smallwood, Nind, and O'Connor (2009) have suggested that the content of mind-wandering episodes mainly involves thoughts about the future. Using the above-mentioned thought-probe method, these authors found that off-task thoughts were more frequently oriented toward the future than toward the past and concluded that mind-wandering was characterized by a "prospective bias." However, other laboratory studies reported roughly equivalent proportions of past- versus future-oriented off-task thoughts (Fransson, 2006; Mason et al., 2007a,b). Some studies using thought sampling in daily life situations also reported that future- and past-oriented daydreams did not differ in prevalence (Klinger, 1990). It is possible that this discrepancy among findings originates, at least in part, from the lack of precision in the method used to assess SITUTs (see above)—the future-oriented function of mind-wandering might have been concealed by the mix-up of other conscious experiences with SITUTs. For example, it might be that, in the absence of probes offering the possibility to report TRIs, some past and future thoughts that do not fit the typical definition of mind-wandering were mixed with SITUTs (e.g., reflecting upon past errors committed during the task or thinking about the end of the task).

		Stimulus-dependency	
		Stimulus-dependent	Stimulus-independent
Task-relatedness	Task-related	Being totally focused on the task currently being performed	Interfering thoughts related to the appraisal of the current task (Task-Related Interferences; TRIs)
	Task-unrelated	Sensory perceptions/sensations irrelevant to the current task (External Distractions; EDs)	Mind-wandering and daydreams (Stimulus-Independent and Task-Unrelated Thoughts; SITUTs)

Fig. 1. Conceptual division of ongoing conscious experiences occurring during tasks requiring sustained externally driven attention according to their "stimulus-dependency" and "task-relatedness" dimensions.

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