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Role of triggers and dysphoria in mind-wandering about past, present and future: A laboratory study

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Abstract

To bridge the related but separate areas of research on mind-wandering and Involuntary Autobiographical Memory (IAM), the frequency and temporal focus of task unrelated thoughts about past, present, and future was compared in 19 dysphoric and 21 non-dysphoric participants, using a modified laboratory method for studying IAMs. Participants were stopped 11 times during a 15-minute vigilance task and recorded their thoughts at that moment. In both groups, most thoughts were spontaneous, task-unrelated, and triggered by irrelevant cue-words on the screen with negative words being more likely to trigger past memories and positive cues - thoughts about future. Both groups reported more past memories than current or future thoughts, but differences emerged in the type of future thought experienced: non-dysphoric participants reported more planning thoughts, and dysphoric participants more abstract hypothetical thoughts. The results suggest that some findings from IAM research regarding cues and the impact of dysphoria may be generalizable to mind-wandering.

Keywords: dysphoria, mind-wandering, involuntary autobiographical memory, future thinking, prospection, planning

1. Introduction

Mind-wandering has been referred to as task unrelated thought (Giambra, 1989), task unrelated images and thoughts (Giambra, 1993, 1995) or stimulus-independent thought (Teasdale et al., 1995) among other names (see Smallwood & Schooler, 2006). Everyday examples range from fantasising about a luxury yacht voyage whilst stirring soup to 'zoning-out' when reading a boring text (Schooler, Reichle, & Halpern, 2004; Singer, 1976).

One of the key characteristics of the phenomenon involves 'decupling' from one's immediate environment, or "a shift in the focus of attention away from the here and now towards one's private thoughts and feelings" (Smallwood, O'Connor, Sudbery & Obonsawin, 2007, p. 818). In addition, the incidents of mind-wandering are often unintended, i.e., they occur spontaneously. Sometimes people may not even be aware that their mind has wandered until they are stopped and asked what their thoughts were at that moment (Schooler, 2002; Smallwood et al., 2007). Finally, task unrelated thoughts are often considered to be stimulus independent, as they are thought to originate from internal rather than external sources (Stawarczyk, Majerus, Maj, Van der Linden, & D'Argembeau, 2011). Indeed, according to Singer (1993), "the human condition involves a continuing tension between processing information generated from the physical and social milieu and the continuous operation of centrally generated material from long-term memory in the form of reminiscences, wishes, current concerns, expectations and fantasies" (p. 100).

There is near universal agreement that mind-wandering is both common and frequent in everyday life with some studies suggesting that up to half of our waking lives are spent thinking about matters other than what is immediately before us (Killingsworth & Gilbert, 2010). There is, however, an ongoing debate about its nature and role in mental life (Mooneyham & Schooler, 2013; Smallwood, 2013) with some researchers arguing that mind-

wandering represents a failure of executive control which may be detrimental to ongoing activities (McVay & Kane, 2010), while others suggest that it represents the redirection of executive resources toward internal goals when they are not required for completion of an external task, and may therefore have an adaptive function (Klinger, 1999; 2013; Smallwood & Schooler, 2006). This view is also supported by evidence showing that during mind-wandering people are more likely to think about future plans and tasks than about current and past events (Baird, Smallwood, & Schooler, 2011).

Despite this tendency to prospect more often than retrospect, people do report thinking about the past during mind-wandering episodes (e.g., while sitting in a boring meeting, one may suddenly remember a skiing holiday in Switzerland). However, spontaneous remembering of past events without actively trying to remember anything has been termed Involuntary Autobiographical Memory (IAM) and studied as part of research on autobiographical memory with little overlap with research on mind-wandering (for exceptions see Finnbogadóttir & Berntsen, 2013; McVay & Kane, 2013; Vannucci, Batool, Pelagatti, & Mazzoni, 2014; Song & Wang, 2012). The aim of this paper is to take initial steps toward bringing together these two separate streams of research on mind-wandering and IAMs in the hope that this may provide interesting insights for both areas of research.

If IAMs are instances of mind-wandering (*cf*. Johannesen & Berntsen, 2010), then one would expect that similar findings would be obtained in both areas of research in relation to several important variables. This is clearly the case with respect to the effects of attentional demands of ongoing tasks on the occurrence of mind-wandering and IAMs as both are less likely to occur with cognitively demanding rather than undemanding ongoing tasks (e.g., Antrobus, 1968; Berntsen, 1996; Giambra, 1995; Kvavilashvili & Mandler, 2004; Schlagman & Kvavilashvili, 2008; Smallwood, Davies, Heim, Finnigan, Sudberry, O'Connor, & Obonsawin, 2004; Smallwood, Obonsawin & Reid, 2003). However, discrepant findings

have started to emerge with respect to several other variables. For example, research on IAMs, using both diary and laboratory methods has shown that the majority of IAMs (about 80-94%) are elicited by easily identifiable cues that are predominantly external rather than internal, and related to the central aspects of the content of IAMs (e.g., seeing balloons may elicit a memory about a particular birthday party) (Berntsen, 1996; Mace, Bernas, & Clevinger, in press; Mace, 2004; Mazzoni, Vannucci, & Batool, 2014; Schlagman, Kvavilashvili, & Schulz, 2007). Some studies have also shown the importance of verbal cues (both external and internal) in eliciting IAMs (Mace, 2004; Schlagman et al., 2007; Schlagman & Kvavilashvili, 2008).[1]

In contrast, very little is known about the cues that directly trigger mind-wandering episodes (but see McVay & Kane, 2013; Song & Wang, 2012), as participants are not asked to indicate if the thought they were having just before the probe was triggered by a particular cue (internal or external). Moreover, in the experience sampling study of Song and Wang (2012), which did query participants about the cues, it was found that although participants reported cues in 88% of thought probes, the percentage of internal cues (49%) was as high as external cues (51%), which is different from the predominance of external cues reported in the IAM literature (e.g., Berntsen, 1998; Berntsen & Hall, 2004; Schlagman et al., 2007; Schlagman & Kvavilashvili, 2008).

The lack of research on triggers is surprising given that Klinger's (1999; 2013) influential current concerns theory has consistently emphasised the importance of cues in eliciting mind-wandering. According to this theory, people's goals and current concerns sensitize them towards relevant external or internal cues which, upon encountering, automatically re-activate the goal related material in one's consciousness (Klinger, 1978; Klinger, Barta, & Maxeiner, 1980). A recent laboratory study by McVay and Kane (2013) tested this assumption by using an on-going vigilance task with verbal cues some of which

were based on the pre-screened 'current concerns' of participants. Collecting periodic thought probes shortly after the appearance of personally relevant cues, McVay and Kane (2013) found a 3-4% increase in mind-wandering relative to controls who were exposed to cue words with no personal relevance. Whilst a small difference, this offers preliminary evidence of the importance of environmental cues in mind-wandering, and their potential link to unfinished goals and underlines the need for further investigation in this particular area.

Discrepant findings have started to emerge also in relation to the temporal focus of task unrelated thoughts. Within mind-wandering research, there is increasing evidence in support of the idea that when participants report experiencing task unrelated thoughts during the ongoing laboratory tasks, they tend to indicate that their thoughts are more often about the future rather than past events (Baird et al., 2011; Smallwood, Schooler, Turk, Cunningham, Burns & Macrae, 2011; Stawarczyk et al., 2011). However, evidence from naturalistic studies is mixed, with two recent experience-sampling studies reporting the prospective bias (Poerio, Totterdell, & Miles, 2013; Song & Wang, 2012) but an earlier study by Klinger and Cox (1987) failing to find any differences between the frequency of thoughts about the past and future. Moreover, in a diary study by Finnbogadóttir and Berntsen, (2013) where participants recorded their involuntary thoughts about the past (i.e., memories) and the future during two separate 1-day periods, the number of recorded IAMs (M=22.61) did not differ from the number of recorded future thoughts (M=21.50) (see also Berntsen & Jacobsen, 2008).

Finally, different results have been obtained in relation to the effects of mood and depression on task unrelated thoughts and IAMs. Within mind-wandering research, several studies have reported a positive relationship between frequency of mind-wandering and measures of negative mood and dysphoria (Murphy, Macpherson, Jeyabalasingham, Manly, & Dunn, 2013; Smallwood, O'Connor, & Heim, 2005; Smallwood et al., 2007; Smallwood, O'Connor, Sudberry, Haskell, & Ballantyne, 2004, Experiment 1; Smallwood, Davies, et al.,

2004, Experiment 3). In addition, Smallwood and O'Connor (2011) showed that the induction of negative mood increased participants' tendency to mind-wander about their past rather than future.

These findings suggest that people with dysphoria and depression should experience higher frequency of IAMs than non-depressed controls. However, two studies on IAMs addressing this issue resulted in non-significant results. In a diary study by Watson, Berntsen, Kuyken, and Watkins (2013) clinically depressed and non-depressed participants had to record 10 IAMs (with a maximum of 2 IAMs per day to reduce the burden). Results showed that depressed participants took significantly longer (on average 30 days) to record 10 memories than non-depressed participants (14 days). This indicates that depressed groups did not experience IAMs more frequently than the non-depressed group although the possibility that they were less motivated to keep a diary could not be excluded. However, Kvavilashvili and Schlagman (2011) elicited IAMs under more controlled conditions using a laboratory method, developed by Schlagman and Kvavilashvili (2008), and found that participants with stable dysphoria (with the mean of 23.76 on Beck's Depression Inventory, range 16-42) did not report experiencing more frequent IAMs than non-dysphoric participants (with the mean depression score of 2.46, range 0-6).

These discrepant findings could be due to some important phenomenological differences between task unrelated thoughts studied within mind-wandering literature and research on IAMs. This, however, is unlikely given the universal agreement that some task unrelated thoughts reported by participants in mind-wandering experiments may refer to one's autobiographical past, reflected in the instructions and examples of IAMs given to participants in these experiments (e.g., Smallwood et al., 2011; Smallwood, Obonsawin & Reid, 2003).

An alternative and more plausible explanation for inconsistent findings emerging from the two separate literatures on mind-wandering and IAMs is the different methods used to study these phenomena. Indeed, the majority of research on mind-wandering is conducted in the laboratory, and participants are engaged in monotonous tasks and are intermittently stopped to report either the content of their thoughts at that moment, which will then be coded as task related or unrelated by researchers (e.g., Baird et al., 2011), or to categorise the thoughts as task related or unrelated without reporting the actual thought content (e.g., Smallwood, McSpadden, Luus & Schooler, 2008). Originally, simple vigilance tasks with shapes as stimuli were used (e.g., green circle) and required that participants responded to infrequent targets (e.g., three red squares) with a simple button press (Giambra, 1995). More recently, several variants of this method have been used, some of which have relatively high levels of cognitive demand. For example, in the Sustained Attention to Response Task (SART) (Robertson, Manly, Andrade, Baddeley, & Yiend, 1997) which has been used in a large number of studies, participants respond continuously to non-target stimuli (mostly digits) by pressing a button, whilst withholding a response to an infrequent target (e.g., Jackson, Weinstein, & Balota, 2013; McVay & Kane, 2009, 2013; Smallwood, Davies, et al., 2004). One reason why this task has become so popular is that it allows researchers to obtain behavioural indices of mind-wandering (e.g., errors of commission). Other ongoing tasks that have been used involve readings texts and encoding words (e.g., Reichle, Reineberg, & Schooler, 2010; Smallwood, O'Connor, et al., 2004). Very few studies have used more naturalistic methods such as thought sampling using paper and electronic diaries (Kane Brown, McVay, Silva, Myin-Germeys, & Kwapil, 2007; Killingsworth & Gilbert, 2010; McVay, Kane, & Kwapil, 2009; Poerio et al., 2013; Song & Wang, 2012).

In contrast, the vast majority of research on IAMs has been conducted using diary methods where participants are asked to keep a diary and record IAMs as and when they

occur in everyday life (e.g., Berntsen, 1996; Kvavilashvili & Mandler, 2004, Study 4; Mace, 2005). More recently, several lab methods have been developed to capture and measure IAMs under controlled conditions (Ball, 2007; Mace, 2006). For example, Schlagman and Kvavilashvili (2008) developed a method which tries to simulate the conditions in which IAMs occur in everyday life (i.e., being engaged in an undemanding task and being surrounded by stimuli that can act as incidental triggers). To achieve this goal, participants are required to detect an infrequent target slide with vertical lines from hundreds of non-target slides with horizontal lines (each presented for 1.5 seconds). In addition to lines, participants can see cue words in the centre of each slide (e.g. 'friendly boss,' 'missed opportunity,' or 'crossing the road'), which they are told are irrelevant to the vigilance task. Their task is to detect slides with vertical lines, and in addition, to stop the presentation by button press if at any point during the task they experience an involuntary memory from their past (self-caught method). Results from several studies show that, on average, participants report 6-7 memories during the 600-800 slide long presentations (range 0 – 30), and that the majority of recorded IAMs are reported to be triggered by irrelevant cue words presented on the slides (Kvavilashvili & Schlagman, 2011; Schlagman & Kvavilashvili, 2008).

Although there are some parallels between this task and simple vigilance or choice reaction tasks used in mind-wandering research, there are also clear differences, especially when compared to the SART. First, the number of targets is substantially lower (less than 1%) than in the tasks used in many mind-wandering studies (10-20%). This significantly reduces attentional demands of the ongoing task and induces relaxed state of mind, necessary for mind-wandering episodes. Second, and perhaps more important, it exposes participants to a steady stream of stimuli (positive, negative and neutral word phrases) that can trigger IAMs and possibly mind-wandering episodes in general (e.g., see McVay & Kane, 2013).

Taken together, these important differences between the methods suggest that tasks used in mind-wandering research are perhaps using less optimal conditions for the occurrence of task unrelated thoughts than diary and laboratory methods used in the IAM research, and this could potentially explain the discrepant findings obtained in relation to triggers, temporal focus and effects of mood.

1.1 Present Study

To examine the role of these variables on the nature and frequency of task unrelated thoughts, the present study combined the mind-wandering and IAM paradigms by using a modified version of the method developed by Schlagman and Kvavilashvili (2008). Specifically, dysphoric and non-dysphoric participants were engaged in a vigilance task that involved detecting infrequent vertical lines and being exposed to irrelevant cue words in the centre of each slide. However, unlike the Schlagman and Kvavilashvili (2008) method, in which participants have to stop the presentation to report the occurrence of an IAM (self-caught method), in the present study a probe caught method was used in which participants were stopped 11 times throughout the task and had to record their thoughts at that moment (*cf*. Vannucci et al., 2014). In addition, unlike previous studies on mind-wandering, participants had to report any triggers for their thoughts. At the end of the task, they classified the reported thoughts as either past memories, current thoughts or thoughts about the future.

Using this method, several important questions were addressed. The first question concerns the role of environmental cues in triggering off task thoughts. Although research on IAMs provides strong evidence for the importance of external cues in eliciting involuntary memories, the role of cues is less clear for task unrelated thoughts in mind-wandering with only two empirical studies that have directly addressed this question (McVay & Kane, 2013; Song & Wang, 2012). Based on findings on IAMs, it was predicted that the majority of

thought probes, classed as task unrelated, would be reported by participants as triggered by cue words presented on the screen during the vigilance task. An alternative prediction derived from the experience sampling study of Song and Wang (2012) is that the percentage of task-unrelated thoughts triggered by external cues would be smaller than reported in IAM studies.

Furthermore, there has been no research on emotional valence of cues for task unrelated thoughts. Laboratory studies of IAMs have shown that IAMs are more likely to be elicited by negative than neutral or positive cues (Kvavilashvili & Schlagman, 2011; Schlagman & Kvavilashvili, 2008). It is unclear, however, if this pattern extends to spontaneous task unrelated thoughts about the future or current situation. Based on diary studies of Berntsen and colleagues which showed that involuntary thoughts about the future were rated as more positive and idyllic than IAMs (Berntsen & Jacobsen, 2008; Finnbogadóttir & Berntsen, 2013), it was predicted that thought probes classed as future thoughts would be more likely to be reported to have positive than neutral or negative cues.

The second research question concerns the temporal focus of task unrelated thoughts. Although several laboratory studies of mind-wandering have found that participants report experiencing thoughts about future more often than thoughts about the past (Baird et al., 2011; Smallwood, Nind & O'Connor, 2009, Experiment 1), this prospective bias has not been found under all conditions, particularly those in which participants were exposed to verbal information, i.e., when reading texts (Smallwood et al., 2009, Experiment 2). This raises an interesting possibility that people have a tendency to prospect in an environment that is devoid of meaningful cues (e.g., words), but when such cues are present, as in case of diary studies of Berntsen and Jacobsen (2008) and Finnbogadóttir and Berntsen (2013), and experience sampling study of Klinger and Cox (1987) then this prospective bias may disappear. Therefore, while laboratory research on mind-wandering would expect to obtain the standard prospective bias in the present study, the findings from Berntsen and colleagues

and Smallwood et al. (2009) suggest that participants will be reporting equal numbers of thoughts about past and future.

The third research question concerns the frequency and nature of mind wandering in dysphoria. Existing findings from mind-wandering research suggest that in the present study dysphoric participants would report more task unrelated thoughts than non-dysphoric participants. In contrast, findings on depression and IAMs (Kvavilashvili & Schlagman, 2011; Watson et al., 2013) suggest that there may be no differences between the two groups. One possible reason for higher rates of task unrelated thoughts reported by dysphoric participants in some studies on mind-wandering is that fairly demanding ongoing tasks have been used such as the SART, encoding words, etc. Indeed, Smallwood et al. (2007) demonstrated increased mind-wandering in dysphoria when participants had to encode words for future recall but not when they had to simply shadow the words. Given that in the present study, a very undemanding vigilance task was used, and that Kvavilashvili and Schlagman (2011) did not find any group differences in the number of reported IAMs, it was predicted that dysphoric and non-dysphoric participants would experience equal numbers of memories, and by extension, present and future thoughts.

Two additional questions were addressed in relation to dysphoria. First, mood congruency effects were examined by comparing participants' pleasantness ratings of their recorded thoughts. In line with findings of Kvavilashvili and Schlagman (2011) on IAMs, it was predicted that dysphoric participants would rate both their past memories and future thoughts more negatively than non-dysphoric participants. Second, very few studies have examined the actual content of task unrelated thoughts including thoughts about the future (Baird et al., 2011; D'Argembeau, Renaud, & Van der Linden, 2011). However, results of a diary study of D'Argambeau et al. (2011), in which participants had to record 10 thoughts about the future over a period of 5 days, showed that the majority of recorded thoughts (70%)

were goal oriented and involved making decisions and planning upcoming tasks with only 11% of thoughts classed as thoughts or daydreams with no apparent purpose (e.g., fantasies, wishful thinking). In the present study, we wanted to replicate and extend this finding to dysphoric people by conducting a content analysis of future thoughts. Given depressed people's tendency to engage in abstract rumination about the causes of their symptoms (Nolen-Hoeksema, Wisco, & Lyubomirsky, 2008), it is possible that in comparison to control group they would be more likely to engage in abstract, hypothetical thinking about the future (e.g., *I wish I was financially more secure*) than in planning upcoming tasks (*I need to buy some ingredients for dinner on my way home this evening*).

Finally, we examined the specificity of recorded task unrelated thoughts. Although there is ample evidence for over general memory in depressed people who report repetitive rather than specific events when voluntarily recalling autobiographical memories, Kvavilashvili and Schlagman (2011) showed that this effect did not generalize to IAMs. In their study, dysphoric people's IAMs were as specific as those of non-dysphoric participants (see also Watson et al., 2013). Therefore, in the present study we examined specificity ratings of thoughts to see if this finding could be extended to dysphoric people's thoughts about the future as well.

2. Method

2.1 Design

A quasi-experimental, mixed design compared a number of variables associated with recorded past, current and future thoughts (within groups factor) in dysphoric and non-dysphoric individuals (between groups factor).

2.2 Participants

University students were recruited via mass email inviting completion of an online mood questionnaire (the Beck Depression Inventory, (BDI); Beck, Ward, Mendelson, Mock, & Erbaugh, 1961) to be considered for participation in a study on mood and concentration. Additional recruitment was conducted via online social networking and a human resources contact in a public sector organisation. Invitation to attend the laboratory session was limited to individuals scoring in the dysphoric (16-64) and non-dysphoric (0-9) range.[2] Of the 336 respondents to the mood questionnaire, 206 were invited to attend the laboratory session. Of those, 46 participants attended, but six were removed due to significant changes in their BDI score. The final sample therefore consisted of 40 participants, of which 19 were stable dysphoric (13 female) and 21 stable non-dysphoric (14 female). Participants were asked to complete the mood questionnaire again at the end of laboratory session (Table 1). A mean of 23.55 days elapsed between the first and second completions of the BDI (*SD*=17.83, range 6-72), and all participants' scores remained within the above mentioned low and high ranges for that period of time. The mean age of participants was 33.20 (*SD*=11.63, range 19-53), and the mean number of years in education was 16.86 (*SD*=2.78, range 11-23). There were no reliable differences between the dysphoric and non-dysphoric groups in terms of their age $t(38)=1.27$, $p=0.21$ or years in education $t(38)=-0.38$, $p=0.70$.

At the beginning and the end of the vigilance task, participants were also asked to rate their mood on a 9-point scale (1=*extremely negative*, 5=*neutral*, 9=*extremely positive*). Dysphoric participants gave a mean mood rating of 5.47 (*SD*=1.81) prior to the vigilance task, and a mean score of 5.53 (*SD*=1.54) after the vigilance task, whilst non-dysphoric participants had a mean score of 7.00 (*SD*=1.30) prior to the vigilance task and a mean score of 6.90 (*SD*=1.55) after the task. The results of a mixed 2 (group: dysphoric, non-dysphoric) x 2 (time: before and after the vigilance task) ANOVA showed the self-assessed mood scores of the dysphoric group to be reliably lower, as reflected in a strong main effect of group, $F(1,$

38) = 12.41, p=.001, η_p^2=.23. Neither the time of assessment nor the interaction between group and time showed a significant effect (both F<1).

2.3 Materials

2.3.1 Mood Questionnaire

The Beck Depression Inventory is a reliable 21-item questionnaire, designed to give a standard measure of behaviours indicative of depression (Beck et al., 1961). Each item consists of 4 to 6 statements that vary in severity. Participants were asked to choose which statement best represented how they had been feeling over the previous week. A corresponding score (from 0 to 3) was tallied for each item to determine a participants' overall BDI score. Individual scores in the present study ranged from 0 to 32 (see Table 1) but the highest possible score is 63. Higher scores indicate more severe depressive symptoms.

2.3.2 Vigilance Task

During the laboratory session participants completed a modified version of the computer-based vigilance task, originally developed by Schlagman and Kvavilashvili (2008). The task consisted of a 600-slide presentation, displayed on a laptop using SuperLab software. Most of the slides depicted arrangements of black, horizontal lines (non-target stimuli), but participants were asked to press the computer spacebar when arrangements of black, vertical lines (target stimuli) appeared. These target stimuli appeared 11 times throughout the 600 slide presentation, with a minimum of 40 and a maximum of 60 slides between each target. The slides were 21.5 x 12.5 cm in size and featured centrally oriented cue words or phrases in 18-point Arial font. All cue words had been previously rated by 8 independent coders as negative, positive or neutral, and all received at least 75% agreement (Schlagman & Kvavilashvili, 2008). Equal numbers of positive (n=200), negative (n= 200)

and neutral (*n*=200), cues were distributed throughout the presentation. Of the 11 target slides, 4 featured positive cues, 4 featured negative cues, and 3 featured natural cues. Slides were presented in a fixed random order, each appearing for 1500 milliseconds. At 11 fixed points during the presentation, the sequence of slides stopped and the message "Please stop and record your concentration and thoughts now" appeared on the screen. There were a minimum of 35 and a maximum of 70 slides between each stop trial.

2.3.3 Thought Questionnaire

Participants recorded their thoughts during the vigilance task with a pre-structured, two-page questionnaire based on a format used by Kvavilashvili and Schlagman (2011). At the top of the first page, participants were asked to give a brief description of their thoughts at the moment they were stopped, and indicate if the thought occurred spontaneously (i.e., simply popped into their mind) or whether they deliberately decided to think about it. If spontaneous, they were asked to indicate whether the thought had been triggered by the environment, by their own thoughts, or if there was no trigger. A blank space was provided to describe the trigger if identifiable. In the final two questions on the first page, participants were asked to indicate how much they were concentrating on the task when stopped (1=*Not at all,* 5=*Fully concentrating*), as well as the vividness of their thought on a 7-point scale (1=*Very vague, almost no image at all,* 7=*Very vivid, almost like normal vision*).

On the second page, which was completed after finishing the vigilance task, participants categorised their thoughts as a past memory, future event or current situation. If they chose a memory or future thought, they also estimated how far in the past it had occurred, or how far in the future they were projecting. Participants indicated on a 5-point scale how often they had experienced the thought prior to participation in the laboratory session (1=*Never*, 2=*Once or twice*, 3=*A few times*, 4=*Several times*, 5=*Many times*), and

rated the thought for pleasantness on a 5-point scale (1=*Very unpleasant*, 3=*Neutral*, 5=*Very pleasant*). The final question asked participants to indicate the specificity of their thought by ticking the box corresponding to one of three responses: One-off event; General thought about a repetitive event; General thought about an extended event.

2.4 Procedure

Participants were tested individually in a quiet location. When first welcomed into the laboratory, participants were reminded of the focus of the project (the effect of mood on concentration). The experimenter verbally confirmed the instructions in the information sheet: participants had to ignore slides depicting horizontal lines, but press the spacebar when they detected a slide with vertical lines. They were also told to ignore the words or phrases that appeared in the centre of the slides. Participants were set a practice trial which lasted one minute, and consisted of 37 non-target and 3 target stimuli, with no stop trials.

Once the practice trial was complete, participants were given the following verbal instructions to briefly illustrate the kinds of off-task thinking they might experience:

> As you can see this experiment is about people's attention and their concentration during fairly lengthy monotonous tasks. You might be familiar with the situation in which your thoughts wander off during an easy monotonous task (for example, driving). However, at critical points, such as when approaching roundabouts, you will need to pay attention to what you are doing again. Our study is interested in these fluctuations in concentration and thought during such monotonous tasks. In addition, we are also interested in the effects of verbal and non-verbal information on your concentration levels throughout the task. Hence, some participants will be detecting lines on the screen and other participants need to detect certain words. You have been allocated to the group that detects lines. Therefore, just ignore the words and concentrate on the lines.

> The main vigilance task is similar to the practice one but longer. In addition, the presentation will occasionally stop, and you will be prompted to record your concentration level and thoughts at the moment you were stopped.
>
> As you can see, although this task is quite simple, it can be difficult to maintain concentration. As with the driving example, your thoughts may drift to matters unrelated to the task. These thoughts can be about anything: the past, present or the future. They may be thoughts that pop into your mind spontaneously, or they may be something you have deliberately chosen to think about. It doesn't matter if your concentration and thoughts fluctuate in this way throughout the presentation, but please ensure that you write down the content of your thoughts at the exact moment you are stopped. Each time you are stopped by the presentation, you will be provided with a questionnaire to record your thoughts and assess your level of concentration.

Written consent was obtained, and participants were also asked to rate their current mood on a 9-point scale (1=*extremely negative*, 5=*neutral*, 9=*extremely positive*). Once this was complete, they were told that they could commence the presentation whenever they liked by pressing any computer key. When the first stop trial appeared, the experimenter immediately gave the participant a copy of the questionnaire to record a description of their thought. The experimenter explained each subsequent item on the first page of the questionnaire before the participant gave their response. Participants were asked to return the questionnaire to the experimenter once the first page had been completed, and told that they could begin the presentation again by left-clicking the laptop mouse.

At each subsequent stop trial, participants were given a new, blank questionnaire, which they returned to the experimenter upon completion of the first page. Once the vigilance task was finished, participants were asked to complete the second page of each questionnaire. The experimenter indicated that participants should review their responses on first side before

proceeding to the second side. As with the first side of the questionnaire, the researcher took time to explain each item before giving the participant an opportunity to respond. Questionnaires were given to the participant one by one, and returned to the researcher upon completion. Once both sides of all questionnaires were complete, participants were asked to rate their mood again on the 9-point scale, and complete the mood questionnaire (BDI).

3. Results

3.1. Data Coding and Analysis

Coding and analysis depended on the type of data used. For the items measured on a scale (e.g., concentration, vividness, rehearsal and pleasantness) the mean values were calculated for each type of thought reported by a participant (across the 11 stop trials), before being entered into the ANOVA. Dichotomous items or those with discrete categories (e.g., deliberate/spontaneous, trigger, specificity of the thought) were calculated as proportions. This is in line with previous research in this area (e.g., Berntsen & Hall, 2004; Kvavilashvili & Schlagman, 2011; Schlagman & Kvavilashvili, 2008). The alpha level adopted for determining significance of the results was set at 0.05.

3.2. Performance on Vigilance Task

All 40 participants successfully completed the vigilance task by detecting the majority of targets out of 11 presented (see Table 2). There were no group differences in the number of detected targets or reported concentration levels (p =.46 and p =.55. respectively), but dysphoric participants were marginally slower at responding to targets than non-dysphoric participants (p =.08).

3.3. Frequency and Type of Recorded Thoughts

Given that each participant was stopped 11 times during the vigilance task, the total number of thought probes was 40 x 11 = 440. However, due to a computer error, 6 probes were not recorded, resulting in 434 thoughts. In addition, on 17 occasions (11 of which were reported in the dysphoric group), participants indicated that their mind was blank at the time of being stopped reducing the number of valid thought probes to 417.

Before conducting the data analyses, all thoughts recorded by participants were independently coded by the first and second authors as either task-related or task-unrelated following the criteria used in mind-wandering research (e.g., Smallwood, Baracaia, Lowe & Obonsawin, 2003; Smallwood, Obonsawin & Reid, 2003). The majority of task related thoughts (86%) referred to so called task-related interference (TRI) rather than thoughts about detecting vertical lines. These consisted of any references to aspects of the vigilance task (e.g., *was wondering how many different patterns of lines are being used in this experiment; remember to press the space bar, but there are not many vertical lines*), any mention of the phrases on the screen (e.g., *air-loom was spelt wrong; just reading the words, trying to see if I can remember them*), or any reference to a state/emotion that arose in response to the vigilance task (e.g., *I'm feeling quite anxious about the words; the words go so quick, the sad ones stay with me, like oppressive regime*).[3] In contrast, task-unrelated thoughts were those which did not contain any explicit reference to the vigilance task and referred to either past (e.g., *childhood memory of going on holiday with my parents to a village in the Lake District*; *blue coat my wife tried on in the shop last week*), present (e.g., *thinking about my insecurities and weaknesses; thinking about my fiancée being abroad at the moment*) or future (e.g., *need to start my diet after the revision period; job interview I have next week*). Inter-rater reliability between the coders was very good (*Kappa=.90, SE=.03)*.[4] Out of 417 valid thought probes, 91 (22%) that were classed as task-related thoughts were removed, leaving 325 task-unrelated thoughts.

In addition, during each thought probe, participants indicated whether their thought had arisen spontaneously or deliberately. Spontaneous, task-unrelated thoughts (87%) far outnumbered deliberate thoughts (13%) (see Table 3), with no differences between the groups, $\chi^2(2, N=342)=2.99$, $p=0.22$). As spontaneous, task-unrelated thoughts were the primary focus of the present study, instances of deliberate thoughts were removed from further analysis, leaving a total of 283 thought probes.

Finally, of the 40 participants, four outliers (two in each group) were excluded from analyses because of the very low frequency with which they reported spontaneous, task-unrelated thoughts. One participant had not recorded any spontaneous thoughts (either task-related or task-unrelated) and the three others had only reported one spontaneous, task-unrelated thought, out of 11 thought probes collected. Between them, they accounted for 31 of 42 deliberate, task-unrelated thoughts reported in Table 3, which is 74% of all deliberate, task-unrelated thoughts recorded. With these participants removed, the final data set consisted of 280 spontaneous, task-unrelated thoughts in 36 participants (17 dysphoric, 19 non-dysphoric). All analyses reported below are based on these 280 thought probes.

3.4 Content of Recorded Thought Probes

3.4.1 Temporal Location of Thoughts

At the end of the vigilance task participants coded each of their recorded thoughts as past memories, future thoughts or thoughts about a current situation. In the dysphoric group, out of 130 task unrelated thoughts, 60 were classed as past memories (46%), 33 as thoughts about the future (25%) and 37 as current thoughts (29%). Out of 150 valid thought probes in the non-dysphoric group, 62 were memories (41%), 42 were future thoughts (28%) and 46 – current thoughts (31%). The mean frequency with which dysphoric and non-dysphoric participants reported each temporality of thought is presented in Table 4. The mean number

of each type of thought were entered into a 2 (group: dysphoric, non-dysphoric) x 3 (thought type: current, past memory, future) mixed ANOVA with repeated measures on the last factor. The results revealed a significant main effect of thought type, $F(2, 68)=4.24$, p=0.02 $\eta_p^2=0.11$. Pairwise comparisons indicated that the frequency of past memories was significantly greater than future thoughts ($p=0.01$) and current thoughts ($p=0.03$), but future and current thoughts did not differ from each other ($p=0.65$). Neither the main effect of group, nor the group by thought interaction, were significant (both $F_s<1$).

3.4.2 Content of Future Thoughts

A thematic content analysis (Smith, 2000) was conducted on thoughts categorised by participants as 'future thoughts' by two independent coders (the first and the second author) in two stages. Initially, both coders read the descriptions to derive super-ordinate themes or categories which, in their opinion, could encompass most of the recorded cases. This was followed by a discussion of these themes which resulted in three distinct categories referred to as 'future planning', 'thinking about an upcoming event' and 'thinking about a hypothetical event' (hereafter referred to simply as 'planning,' 'upcoming event' and 'hypothetical event'). The 'planning' label referred to any thought that was goal oriented, and reflected an intention to complete a particular activity (e.g., *must get a new duvet cover set*). 'Upcoming events' included all thoughts about scheduled future events that had not yet occurred, but around which no particular intention was expressed (e.g., *family dinner this weekend*; *how long until Christmas? Quite soon*). Finally, the third category included all thoughts that were hypothetical or speculative in nature (e.g., *would love to feel more settled financially, wishing for no money worries; feeling very scared if something happens to my sons; I wonder how would it look if you put red lipstick on a goldfish*). In the second stage, all

future thoughts were independently coded by the coders into these three different categories: Inter-rater reliability between the coders was good (*Kappa*=.69*, SE*=.06).

The mean frequency with which dysphoric and non-dysphoric participants experienced each type of future thought is presented in Figure 1. These were entered into a 2 (group: dysphoric, non-dysphoric) x 3 (future thought type: planning, upcoming event, hypothetical event) mixed ANOVA with repeated measures on the second factor. Results revealed a significant group by thought type interaction $F(2,68)=7.75$, $p=.001$, $\eta_p^2=.186$. Pairwise comparisons indicated that the non-dysphoric group experienced more planning thoughts than the dysphoric group (p=.045), whilst the dysphoric group experienced more abstract hypothetical thoughts ($p=.003$). There was no group difference in the number of upcoming events recorded ($p=.24$). Neither group nor type of future thought alone produced a significant effect (both $F_s<1$).

3.5 Frequency of reported triggers

The majority of reported thoughts in both dysphoric (83%) and non-dysphoric (86%) groups had an identifiable external trigger. Of these, the majority of triggers were words appearing on the screen, as was the case with 89% of thoughts reported by dysphoric participants, and 85% of thoughts reported by non-dysphoric participants. Words on the screen were more likely to elicit thoughts about the past and the future than the current situation, in both dysphoric $\chi^2(4, N=108)=20.20$, $p=.001$ and non-dysphoric $\chi^2(4, N=129)=13.58$, $p=.009$ groups (see Table 5).

3.6 Mood Congruency Effects

3.6.1 Emotional Valence of Reported Cues

Because participants reported the cue word appearing on the screen that triggered their thought, this enabled examination of cue valence as a function of thought temporality and dysphoria. Initially, all the analyses reported in this section included group (dysphoric and non-dysphoric) as a between subjects variable. Because none of these analyses resulted in the main effects of group (all F_s<1.6), and the group factor did not interact with cue valence (all F_s<1), the results reported below are based on one-way ANOVAs with cue valence (negative, positive and neutral) as a within subjects factor. In the initial analysis, the dependent variable was the number of negative, neutral and positive cue words that participants reported as triggers for their thoughts, regardless of their temporality. This resulted in a main effect of cue valence $F(2,68)=13.71$, $p=.001$ $\eta_p^2=0.29$. Post hoc comparisons revealed that the mean number of positive (M=2.34, SD=1.33) and negative (M=1.97, SD=1.42) cues was significantly higher than the mean number of neutral cues (M=1.06, SD=1.16), (both p=.001), but there was no difference in the frequency of negative and positive cues (p=0.19), indicating that generally both positive and negative cues were more effective in eliciting task unrelated thoughts than neutral cues.

This initial analysis was followed up by three, one-way ANOVAs with cue valence as a within subjects factor, conducted separately for memories, current thoughts, and future thoughts. Means are presented in Table 6. As this table shows, the main effect of cue valence emerged for each thought category, however, post hoc comparisons revealed somewhat different patterns. In the case of memories, pairwise comparisons revealed that the mean number of memories reported in response to negative cues was significantly higher than memories reported in response to neutral cues (p=0.001) but not positive cues (p=0.24). Reported memories with positive cues did not differ from memories with neutral cues (p=0.11). In contrast, post hoc comparisons for future thoughts indicate that the mean number of positive cues was significantly higher than both neutral and negative cues (both p=0.001),

which did not differ from each other (p=1.0). Finally, comparisons for current thoughts revealed both negative (p=0.03) and positive (p=0.008) cues were reported significantly more often than neutral cues, but there was no difference between them (p=0.85). These results seem to suggest that in both groups of participants, negative cues were more likely to produce past memories and positive cues were more likely to produce future thoughts.

3.6.2 Pleasantness of reported thoughts

To evaluate the hypothesis that dysphoric participants would rate their thoughts more negatively, we conducted three separate t-tests on participants' pleasantness ratings for current thoughts, past memories and future thoughts (see Table 7). Results indicated that dysphoric participants rated their past memories as significantly less pleasant than non-dysphoric participants, which replicates earlier findings of Kvavilashvili and Schlagman (2011). While the difference for future thoughts was in the same direction, it did not reach statistically accepted level of significance (p=.14). The difference between the groups for current thoughts was not significant.[5]

3.7 Additional Findings

Table 7 shows the results of t-tests comparing dysphoric and non-dysphoric participants on several other dependent variables separately for types of thought (memories, current and future thoughts). No statistically significant group differences were obtained for ratings of vividness, rehearsal, or the proportion of specific thoughts reported.

3.7.1 Timeframe

The majority of future thoughts were projections into the immediate future (less than one month), and very few future thoughts were about possible events in the distant future (more than one year). With regard to memories, the pattern was almost inverted. The majority of

memories were based on events occurring more than one year in the past, and fewer were based on events occurring within the previous month. This was the case in both dysphoric $\chi^2(2, N=90)=14.17$, $p=0.001$ and non-dysphoric $\chi^2(2, N=105)=20.02$, $p=0.001$ groups (Table 8).

4. Discussion

Although instances of IAMs can be considered a manifestation of mind-wandering (Johannessen & Berntsen, 2010), research in these two areas has proceeded largely independently from each other. In addition, discrepant findings have started to emerge concerning several important variables. The aim of the present paper was to shed some light on potential causes for discrepant findings by investigating mind-wandering with a modified version of a laboratory method for studying IAMs (Schlagman & Kvavilashvili, 2008). Using this method to study mind-wandering, the following questions were addressed: What is the role of environmental cues in triggering off-task thought? What is the relationship of thought content and temporal focus to the cues presented, and how is that relationship affected by dysphoria?

Several important findings emerged from the study. First, the present task elicited a high rate of mind-wandering, with 78% of all thought probes being task-unrelated and 68% being task unrelated and spontaneous. In addition, there was a predominance of past thoughts in that participants classed their reported thoughts significantly more often as thoughts about the past (i.e., as memories) than thoughts about present or future, which did not differ from each other. Second, the vast majority of task unrelated thoughts were reported to have been triggered by irrelevant cue words on the screen and cue valence interacted with the temporality of reported thoughts: negative cues were more likely to elicit past memories while positive cues were more likely to elicit thoughts about the future. The third set of findings concerns the effects of dysphoria on mind-wandering. Thus, dysphoric and non-

dysphoric participants did not differ from each other in the frequency of reported thoughts about the past, present or future. However, significant differences emerged in terms of the type of recorded future thought whereby dysphoric participants recorded more abstract hypothetical thoughts in comparison to non-dysphoric participants, and the latter reported more goal-directed planning thoughts. In addition, dysphoric participants rated their past memories as more negative than non-dysphoric participants, while the difference for thoughts about the future was in the same direction but did not reach acceptable levels of significance. Finally, no statistically significant group differences emerged for ratings of vividness and prior rehearsal or the specificity of reported thoughts. Below, we will discuss these findings as well as their implications for research on mind-wandering and IAMs.

4.1. Role of cues in triggering mind-wandering

One of the most important findings of the present study concerns the role of cues in eliciting mind-wandering episodes irrespective of their temporal focus. Thus, the incorporation of verbal cues into a monotonous vigilance task, combined with the removal of all demand characteristics (i.e., not indicating to participants that researchers were interested in a particular type of thought) reliably triggered thoughts about a personal past, imagined future or current situation. Moreover, our results showed, for the first time, that positive cues were more likely to trigger spontaneous thoughts about the future than thoughts about the past or present. In contrast, the finding that negative cues were more likely to trigger past memories (see also Kvavilashvili & Schlagman, 2011; Schlagman & Kvavilashvili, 2008) has clear evolutionary advantages as they may act as powerful reminders of negative events and, by doing so, help the individual to avoid potentially dangerous situations (*cf*. Schank, 1999).

These results replicate and significantly extend the earlier findings by Song and Wang (2012) and McVay and Kane (2013) on the role of cues in eliciting mind-wandering episodes.

They are also in line with the results of Berntsen and Jacobsen's (2008) diary study, which showed that 84% and 76% of recorded IAMs and spontaneous future thoughts were reported as being triggered by cues (with 52% and 34% of reported cues being external, respectively). Taken together, the results provide strong initial support for the "intriguing possibility that autobiographical associations with the current task environment have a potential to cue the disinterested mind" (p. 118, Smallwood, Nind et al., 2009), and open up interesting avenues for future research. For example, the findings concerning the cue valence need to be replicated and extended by examining other characteristics of cues (their frequency, modality, verbal vs. non-verbal, distinctiveness, etc.). More systematic research is also needed to study the relationship between cues and current concerns stipulated by Klinger's (1999; 2013) current concerns theory. Although McVay and Kane (2013) provided initial support for this relationship by showing 3-4% increase in task unrelated thoughts on probes preceded by current concern related words in comparison to neutral words, it is possible that some cues that are not directly linked to one's current concerns and goals can still elicit thoughts about the past and future. Indeed, in a study by Johannesen and Berntsen (2010), only 51% of recorded IAMs were related to participants' current concerns. In addition, external cues were reported more often for non-concern related IAMs than IAMs related to current concern, while internal cues were more often reported for the concern-related IAMs. This interesting pattern clearly needs further investigation.

4.2. Temporal focus of task unrelated thoughts

Another novel finding concerns the temporality of recorded thought probes. While the majority of studies on mind-wandering report that participants are more likely to prospect than retrospect during vigilance tasks, results of the present study showed that participants, irrespective of their mood, were more likely to think about the past than future. One possible reason for discrepant findings is the differences in the methods used. Although most studies

on temporal focus of mind-wandering have used ongoing tasks that were comparable to the low attentional demands of the vigilance task in the present study (e.g., simple choice reaction tasks or passive observation of stimuli, see Baird et al., 2011; Smallwood, Nind et al., 2009, Experiment 1), they all used meaningless stimuli (i.e., single digits) which could not have acted as triggers for task unrelated thoughts.

This important difference between the methods used raises an interesting hypothesis that when people are in an environment that is devoid of meaningful cues they are more likely to think about the future but when they are in stimulus rich environment (like in the present study) they are more likely to think about their past than future. One way to test this hypothesis is to compare the temporal focus of thought probes in a vigilance task with verbal cues presented on each slide (as in the present study) to an identical vigilance task with no verbal cues presented on the slides.

Another important variable to consider in conjunction with presence/absence of cues concerns the amount of attentional resources needed for the ongoing task. Research has shown that the frequency of future thoughts is diminished during an ongoing working memory task when compared to less demanding choice reaction time tasks (Smallwood et al., 2011; Smallwood, Nind, et al., 2009). Similarly, some fMRI studies of mind-wandering have also failed to demonstrate the significant prospective bias in thought probes, presumably because the scanner noise is making the ongoing vigilance more demanding than those used in standard mind-wandering experiments (e.g., Andrews-Hanna, Reidler, Huang, & Buckner, 2010; Mason et al, 2007). Therefore, future research needs to investigate more systematically the role of cues and task demands in eliciting prospective bias in task unrelated thoughts.

4.3. Dysphoria and mind-wandering

Previous research on mind-wandering has resulted in findings which show a positive relationship between participants' depression scores and their tendency to mind-wander (e.g., Murphy et al., 2013; Smallwood et al., 2005, 2007; Stawarczyk, Majerus, Van der Linden, & D'Argembeau, 2012). In addition, some studies have also shown that the induction of negative mood increases one's tendency to think about the past than future (Smallwood, Fitzgerald, Miles, & Phillips, 2009; Smallwood & O'Connor, 2011). These findings have been explained by the greater ease with which dysphoric participants 'decouple' from the immediate environment, to focus on internal thoughts and feelings (Smallwood et al., 2007). However, in the present study, no statistically reliable group differences were found in either objective or subjective measures of decoupling. Dysphoric and non-dysphoric participants reported similar levels of concentration on the task, and showed similar performance in terms of target detection and response time. Most important, they did not differ from non-dysphoric participants in the number of spontaneous task unrelated thoughts, and the predominance of thoughts about the past was present in both groups of participants.

How could one explain these discrepant findings? First, it should be pointed out that the relationship between levels of dysphoria and mind-wandering have not been reported in all mind-wandering studies (e.g., Marchetti, Koster, & De Raedt, 2012; Smallwood, Davies, et al., 2004, Studies 1 and 2). Second, the different findings are probably due to the divergent methods used. As pointed out earlier, several mind-wandering studies have used the SART or simple choice reaction time task, which do not contain any verbal material. This raises the possibility that dysphoric participants are more likely to experience task unrelated thoughts than non-dysphoric participants when the environment is devoid of meaningful stimuli. When such stimuli are present, however, they are not different from non-dysphoric participants, as shown by the results of our study on task unrelated thoughts and the study by Kvavilashvili and Schlagman (2011) on IAMs (see also Watson et al., 2013).

However, some mind-wandering studies have used tasks with meaningful stimuli (e.g., encoding words or completing word fragments) instead of vigilance tasks and have also shown positive relationship between levels of dysphoria and tendency to mind-wander (e.g., Smallwood, Obonsawin, Baracaia, Reid, O'Connor, & Heim, 2003; Smallwood et al., 2005). However, encoding words for subsequent retrieval is attentionally much more demanding task than the simple vigilance task used in the present study. It is therefore possible that dysphoric people, due to their reduced working memory capacity (see Christopher & MacDonald, 2005; Owens, Koster, & Derakshan, 2012), have difficulties maintaining task focus when they are engaged in attentionally demanding tasks but not when they are engaged in non-demanding tasks. For example, McVay and Kane (2009) found that people with low working memory capacity reported higher levels of mind-wandering during the attentionally demanding SART with verbal stimuli (see also Kane et. al., 2007). Further support for this contention comes from a study by Smallwood et al. (2007) who showed that dysphoric participants had higher levels of task unrelated thoughts during the word encoding task but not during the less demanding word shadowing tasks. Therefore, future research should orthogonally manipulate these variables (i.e., presence/absence of meaningful cues and task difficulty) when studying mind-wandering and its temporal focus in people with dysphoria and clinical depression.

Another novel finding that emerged from the present study in relation to dysphoria concerns group differences in the nature of thoughts about future. The fact that dysphoric participants reported more fanciful, hypothetical thoughts than non-dysphoric participants, and fewer goal directed planning thoughts suggests that the adaptive function of future oriented thought (D'Argembeau et al., 2011; Szpunar, 2010) is significantly compromised in dysphoria. This finding has interesting clinical implications, offering reasons for the success

of certain methods such as cognitive behavioural therapy in treating depression and dysphoria and suggesting a basis upon which such interventions might be reviewed and modified.

4.4. Implications of findings for research on mind-wandering

Findings of the present study have important implications for research on mind-wandering. In terms of theory, the results show that it may be necessary to reconceptualise our understanding of mind-wandering as stimulus independent. Although Klinger (2013) has consistently emphasised the role of triggers in eliciting mind-wandering episodes, this position has not been universally accepted in mind-wandering literature. The dominant view appears to be the one that considers mind-wandering as internally rather than externally generated. To emphasise this aspect of mind-wandering, Stawarczyk et al. (2011) proposed a framework that distinguishes the task unrelated thoughts that are stimulus independent (i.e., internally generated), so called SITUTs, from task unrelated thoughts that arise from environmental distracters or EDs (e.g., noise in the street). According to their framework, only the former are true instances of mind-wandering whereas the latter are not. If one adopts this position, then none of the task unrelated thoughts that were triggered by irrelevant cue words (i.e., distracters) in the present study would qualify as task unrelated thoughts. It is also interesting that Stawarczyk et al. (2011) reported similar patterns of results for SITUTs and EDs indicating that task unrelated thoughts instigated by environmental stimuli may be functionally equivalent to task unrelated thoughts that are internally generated.

Our results seem to indicate that mind-wandering is stimulus independent only once the task unrelated thoughts are set in motion, but that it is stimulus dependent in terms of identifiable cues that trigger these thoughts in the first place. This is in line with Klinger's (2013) theory and a process-occurrence framework recently proposed by Smallwood (2013) which makes an important distinction between the initial occurrence of task unrelated trains

of thoughts and the maintenance of such thought over time. According to Smallwood (2013), while our understanding of processes that maintain the internal train of thought has increased over the past years, "identifying the onset of self-generated mental activity must be a primary focus for future research into mind-wandering state" (p. 532) (see also McVay & Kane, 2013). More in depth investigation of various characteristics of external cues that may trigger mind-wandering episodes may be a particularly useful avenue in that direction.

In terms of methodology, the results of the present study show that participants reported being engaged in spontaneous task-unrelated thoughts in 68% of valid thought probes (in 283 probes out of 417), which is considerably higher than rates reported in other mind-wandering studies. In these studies, proportions of task unrelated thought probes typically vary between .14 to .29 in the non-verbal SART or fairly demanding word encoding tasks, and between .32 and .35 in less demanding (but non-verbal) choice reaction tasks or passive observing (Smallwood, Nind, et al., 2009; Smallwood, O'Connor, et al., 2004; Smallwood et al., 2011; 2007). Even when incorporating verbal stimuli in the standard SART, McVay and Kane (2013) still obtained lower rates of mind-wandering (.43 to .46 across 4 Experiments) than in the present study. It appears that it is a combination of rich stimulus environment together with a very undemanding ongoing task that produced high levels of mind-wandering in the present study. This means that the frequency of mind-wandering is somewhat underestimated by current laboratory research on mind-wandering that uses predominantly non-verbal stimuli and/or fairly demanding ongoing tasks.

4.5. Implications for research on involuntary autobiographical memories

Findings are also important for research on IAMs. They clearly show that the Schlagman and Kvavilashvili (2008) method with a simple vigilance task and constant stream of irrelevant verbal stimuli does reliably elicit IAMs in the absence of demand characteristics

(i.e., explicit instructions to record IAMs) and that under these conditions participants are more likely to experience past memories than thoughts about present or future.

However, one of the important differences between research on IAMs and mind-wandering is that in the latter, whether using laboratory vigilance tasks or a naturalistic experience sampling method, task-unrelated thoughts are often assessed by unpredictable thought probes which reduce the possibility of any bias and demand characteristics. By contrast, in diary studies of IAMs and in the laboratory method of Schlagman and Kvavilashvili (2008), participants are introduced to the concept of IAMs and are asked to record IAMs themselves whenever they realise they are having them (self-caught probe method). This arrangement may 'prime' participants to have more memories than usual and /or create a situation where only the most distinctive IAMs get noticed and recorded. To examine these issues Vannucci et al. (2014) manipulated instructions by asking participants to either report IAMs or any task unrelated thoughts during the vigilance task and the type of probes used (self-caught vs. experimenter-caught). Their results showed that more IAMs were recorded when participants were asked to report IAMs than any task unrelated thoughts. In addition, the number of IAMs was higher when the experimenter stopped the participants than when participants reported thoughts themselves. The latter finding indicates that participants probably had more IAMs than they were able to notice and that being stopped by the experimenter helped them realise at the time that the contents of their thoughts were memories of past events.

Similar findings have started to emerge from dairy studies of IAMs by showing that when participants are asked to record IAMs for shorter periods of time (e.g., just one day) they record about the same number of memories (see Finnbogadóttir & Berntsen, 2013; Rasmussen & Berntsen, 2011) than when they are asked to record memories for one week (e.g., see Schlagman, Kliegel, Schulz, & Kvavilashvili, 2009). This suggests that with shorter

periods of recording people become more attentive to the contents of their mind than when they are given longer periods of time for recording (see also Kamiya, 2014).

Finally, results of Vannucci et al. (2014) suggest that when the self-caught probe method is used, participants may be recording only a sub-class of memories which are phenomenologically different from other IAMs. Specifically, they showed that when participants knew in advance they had to report IAMs, the percentage of specific IAMs (memories of one off events not lasting longer than a day) was high (74.5%) and comparable to proportions reported by Kvavilashvili and Schlagman (2008) and in previous diary studies of IAMs (e.g., Berntsen & Hall, 2004; Berntsen, 1998; Schlagman et al., 2009). Surprisingly, the percentage of specific memories was much lower (59.5%) when participants did not know that IAMs were studied, i.e., when they had to report any task unrelated thoughts (some of which were later coded as memories). In the present study, which also used experimenter imposed rather than self-caught probes, we replicated this initial finding by showing that the percentages of specific IAMs in dysphoric and non-dysphoric participants were similarly low at 46% and 57.7%, respectively. Taken together, results of Vannucci et al. (2014) and the present study suggest that research on IAMs may have been studying only a sub-sample of all available involuntary memories. In order to address this issue it may be necessary for researchers of IAMs to adopt the experimenter-caught probing procedure when using both laboratory and diary methods of investigation (e.g., see Mazzoni et. al., 2014).

4.6. Conclusions

The present study employed a laboratory method from IAM research to study task unrelated thoughts about past, present and future, in an effort to integrate these related but separate areas of research. Several important findings were obtained that have implications for research on both mind-wandering an IAMs and open up interesting avenues for future

research. Most important, the findings indicate that mind-wandering research would benefit from using less demanding tasks which incorporate meaningful stimuli to be able to establish the onset of task-unrelated train of thoughts, while research on IAMs should adopt the probing techniques used in mind-wandering research to avoid demand characteristics and sample a wider pool of available memories.

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Footnotes

[1] However, being cue-dependent does not mean that IAMs are not task unrelated or spontaneous (*cf*. Berntsen, 1996). Indeed, remembering the birthday party may be completely unrelated to a task at hand (driving to supermarket) and is involuntary as long as there was no intention to remember anything at the time.

[2] Although it is customary to use a cut-off point of 9 and above on BDI to class participants as dysphoric or depressed (see Cox, Enns, Borger, & Parker, 1999), we followed the recommendation of Vredenburg, Flett, and Krames (1993) and used a cut-off point of 16 and above, which corresponds to moderate depression (Beck, 1967) and reduces the chances of participants being classed as non-depressed when tested a second time (see Zimmerman, 1986).

[3] The large number of TRIs was probably due to the undemanding nature of the vigilance task, which enabled almost perfect target detection without the necessity to engage in excessive monitoring. There were no reliable differences between the dysphoric and non-dysphoric groups in the frequency of reported TRIs, $t(38)=0.4$, $p=0.69$.

[4] There is considerable variability among researchers regarding what is considered good inter-rater reliability as measured by Cohen's Kappa. Landis and Koch (1977) considered a Cohen's Kappa of 0.60 and 0.80 to be substantial agreement and between 0.81 and 1.0 as perfect. For purposes of the present study, a Cohen's Kappa between 0.60 and 0.80 will be considered good, and above 0.81 will be considered very good.

[5] A content analysis was conducted to examine whether dysphoric participants recorded more past memories and future thoughts with objectively negative content (see Schlagman, Schulz, & Kvavilashvili, 2006). Similar to previous findings (Kvavilashvili & Schlagman, 2011), no group differences emerged.

Table 1

Mean BDI scores (Standard Deviation, Range) Before and After the Laboratory Session.

	Before Lab			**After Lab**		
	BDI	*SD*	*Range*	*BDI*	*SD*	*Range*
Dysphoric	22.16	6.03	16-32	20.47	4.12	16-30
Non-dysphoric	3.05	2.66	0-9	2.48	1.97	0-7

Table 2

Mean (Standard Deviation) Target Detection, Response Time and Concentration Rating in Dysphoric and Non-Dysphoric Groups, and Results of Independent Samples T-test.

	Dysphoric	**Non-Dysphoric**	***t***	***df***	***p***
Target Detection	10.65 (1.06)	10.84 (0.37)	-0.75	34	0.46
Response Time (ms)	790.62 (210.97)	687.53 (92.02)	1.86	21.36	0.08
Concentration Rating	3.48 (0.64)	3.64 (0.93)	-0.61	34	0.55

Table 3

Frequency (Percentage) of Spontaneous and Deliberate Task-Unrelated Thoughts as a Function of Group (Dysphoric vs. Non-Dysphoric).

Group	Spontaneous	Deliberate	Total
Dysphoric	131 (85%)	23 (15%)	154 (100%)
Non-dysphoric	152 (89%)	19 (11%)	171 (100%)
Total	283 (87%)	42 (13%)	325 (100%)

Table 4

Mean Number (Standard Deviation) of Thoughts Reported as a Function of Type of Thought (Past vs. Current vs. Future) and Group (Dysphoric vs. Non-Dysphoric).

Group	Past Memory	Current	Future Thought
Dysphoric	3.47 (1.84)	2.24 (1.48)	1.94 (1.48)
Non-dysphoric	3.32 (2.06)	2.37 (1.71)	2.21 (1.93)

Table 5

Frequency (Percentage) of Reported Triggers as a Function of Type of Thought (Past vs. Current vs. Future) and Group (Dysphoric vs. Non-Dysphoric).

		Type of Environmental Trigger		
	Type of Thought	*Words on screen*	*Other*	*Total*
Dysphoric	*Past Memory*	51 (98%)	1 (2%)	52 (100%)
	Current	22 (71%)	9 (29%)	31 (100%)
	Future Thought	23 (92%)	2 (8%)	25 (100%)
	Total	96 (89%)	12 (11%)	108 (100%)
Non-Dysphoric	*Past Memory*	55 (93%)	4 (7%)	58 (100%)
	Current	26 (68%)	12 (32%)	38 (100%)
	Future Thought	30 (91%)	3 (9%)	33 (100%)
	Total	110 (85%)	17 (15%)	129 (100%)

Table 6

Mean Frequency (Standard Deviation) of Reported Cues as a Function of Cue Valence (Negative, Positive, Neutral) and Temporal Focus of Reported Thought (Past Memory, Current Thought, Future Thought).

	Cue Valence			**ANOVA Results**			
Type of Thought	*Negative*	*Positive*	*Neutral*	*F*	*df*	*p*	η_p^2
Past Memory	1.42 (1.12)	1.10 (0.94)	0.71 (0.86)	4.74	2, 60	0.01	0.14
Current	0.71 (0.75)	0.75 (0.74)	0.29 (0.46)	3.75	2, 46	0.03	0.14
Future Thought	0.36 (0.58)	1.36 (0.79)	0.36 (0.58)	14.90	2, 42	.001	0.42

Note: Not all participants reported all types of thought (past, present, future) with cue words as the trigger. Because of this, 5 participants were removed from the analysis of past memories (*N*=31), 12 participants were removed from the analysis of current thoughts (*N*=24), and 14 participants were removed from the analysis of future thoughts (*N*=22).

Table 7

Mean Ratings of Pleasantness, Vividness, Rehearsal (Standard Deviation), and Mean Proportions of Specific Thoughts as a Function of Type of Thought (Past vs. Present vs. Future) and Group (Dysphoric vs. Non-Dysphoric). The Results of Independent Samples T-tests for each Temporality of Thought are Reported in the Right Hand Columns.

		Dysphoric	Non-Dysphoric	*t*	*df*[1]	*p*
Pleasantness						
	Past Memory	2.66 (0.96)	3.51 (0.84)	-2.77	32	0.009
	Current	2.70 (1.18)	3.06 (0.67)	-1.06	23.8	0.3
	Future Thought	3.16 (1.35)	3.76 (0.55)	-1.53	17.56	0.14
Vividness						
	Past Memory	5.28 (0.76)	4.76 (1.38)	1.39	27.13	0.18
	Current	4.43 (1.39)	4.33 (1.69)	0.17	30	0.86
	Future Thought	5.10 (1.12)	4.91 (1.55)	0.37	25	0.71
Rehearsal						
	Past Memory	3.27 (1.01)	2.65 (0.84)	1.95	32	0.06
	Current	3.28 (1.26)	2.60 (1.16)	1.57	30	0.13
	Future Thought	3.10 (1.05)	3.23 (0.98)	- 0.32	25	0.75
Specificity						
	Past Memory	46.46 (32.81)	57.72 (35.15)	- 0.96	32	0.34
	Current	36.46 (45.53)	61.14 (32.02)	- 1.77	30	0.09
	Future Thought	43.81 (41.30)	63.59 (32.71)	- 1.37	25	0.18

[1]Different degrees of freedom for memories, current thoughts and future thoughts reflect the fact that not all participants reported all three types of thought. Analyses for memories are based on 16 dysphoric and 18 non-dysphoric participants; analyses for current thoughts are based on 16 participants in each group; and analyses for future thoughts are based on 14 dysphoric and 13 non-dysphoric participants.

Table 8

Frequency (Percentage) of Past Memories and Future Thoughts as a Function of Mood Group and Temporal Distance from the Present.

	Dysphoric				Non-Dysphoric			
	< 1 Month	< 1 Yr	> 1 Yr	Total	< 1 Month	< 1 Yr	> 1 Yr	Total
Past Memory	15 (25)	15 (25)	29 (50)	59 (100)	28 (45)	9 (14)	26 (41)	63 (100)
Future Thought	20 (65)	6 (19)	5 (16)	31 (100)	30 (71)	11 (26)	1 (3)	42 (100)

Figure Caption

Figure 1: *Mean Number of Future Thoughts as a Function of Thought Type (Planning vs. Daydreaming vs. Upcoming Event) and Group (Dysphoric vs. Non-Dysphoric). Error Bars Represent +1SE.*