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Letting go of the present: Mind-wandering is associated with reduced delay discounting

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ABSTRACT

The capacity to self-generate mental content that is unrelated to the current environment is a fundamental characteristic of the mind, and the current experiment explored how this experience is related to the decisions that people make in daily life. We examined how task-unrelated thought (TUT) varies with the length of time participants are willing to wait for an economic reward, as measured using an inter-temporal discounting task. When participants performed a task requiring minimal attention, the greater the amount of time spent engaged in TUT the longer the individual was prepared to wait for an economic reward. These data indicate that self-generated thought engages processes associated with the successful management of long-term goals. Although immersion in the here and now is undeniably advantageous, under appropriate conditions the capacity to let go of the present and consider more pertinent personal goals may have its own rewards.

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1. Introduction

Almost half of waking thought involves self-generated, stimulus-independent mentation that is unrelated to events taking place in the “here and now” (Klinger, 1978a; 1978b, Killingsworth & Gilbert, 2010) and the theoretical interpretation of such *mind-wandering* has become an important question in cognitive science (McVay & Kane, 2010; Smallwood, *in press*; Smallwood & Schooler, 2006). As we spend so much time engaged in self-generated thought, one important question is how this experience relates to the choices that people make in daily life.

One line of argument suggests that during self-generated thought, consciousness becomes decoupled from perception, providing an opportunity to guide behavior using internally-represented plans and goals (Antrobus, Singer, & Greenberg, 1966; Barron, Riby, Greer, & Smallwood, 2011; Baumeister & Masicampo, 2010; Baumeister, Masicampo, & Vohs, 2011; Smallwood, Baracaia, Lowe, & Obonsawin, 2003; Smallwood, Brown, et al., 2011). Reports of task-unrelated thought (TUT) obtained during the performance of non-demanding tasks support the hypothesis that off-task thought can be a process that aids the preparation for future events: under these conditions, TUT is often future-focused, taking the form of autobiographical planning (Baird, Smallwood, & Schooler, 2011, Smallwood et al., 2009, Smallwood, Schooler, et al., 2011; Smallwood et al., 2011). In similar circumstances, TUT has been implicated in creativity (Baird et al., 2012), consolidation of self-memories (Smallwood et al., 2011) and is associated with larger working memory capacity (WMC, Levinson, Smallwood, & Davidson, 2012).

Mind-wandering has also been linked to poor performance on the tasks of the moment; TUT often leads to errors in complex tasks such as reading (McVay & Kane, 2011b; Smallwood, McSpadden, & Schooler, 2008) and is also frequent in groups of individuals who exhibit cognitive deficits under laboratory conditions (such as ADHD; Shaw & Giambra, 1993). These

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results have led to the suggestion that mind-wandering, when trying to concentrate on an external task, results from a failure to inhibit an interfering internal thought using the process of executive control (McVay & Kane, 2009, 2010, 2011a, 2011b).

Based on the different views on the mind-wandering state described above, it is possible to derive contrasting predictions on how self-generated thought could relate to the choices that people make to navigate through the social world in which they exist. As mind-wandering allows cognition to be devoted to the consideration of personal objectives that extend beyond the current moment, TUT could be associated with processes that are important for making choices that are beneficial over the long term. In contrast, because mind-wandering can lead to worse performance in tasks of the moment, it may reflect a general source of cognitive interference that would hinder successful decision-making.

To test how self-generated thought relates to decision-making processes, we examined the relation between individual variations in TUT and the capacity to resist the temptation of a small immediate economic reward in order to receive a larger reward at a later date in the future. When faced with such a choice, a tendency to opt for the smaller immediate reward over a larger future reward is known as delay discounting (DD). As selecting the smaller sooner reward reflects a situation when a choice is made because of immediacy rather than absolute value, DD is thought to be detrimental for making decisions that are beneficial in the long run (for a review see Peters & Buchel, 2011). For example, developmental studies have revealed that children who discount rapidly have problems in cognitive control in later life (Eigsti et al., 2006). In adults, rapid DD is associated with health problems (Chabris, Laibson, Morris, Schuldt, & Taubinsky, 2008), substance abuse (Bickel & Marsch, 2001) and lower credit ratings (Meier & Sprenger, 2012). Together these different lines of evidence suggest that DD “underlies a wide variety of disadvantageous behaviors” (Bickel & Marsch, 2001, page 260) in part because it makes it harder to make choices that benefit an individual over a long period of time.

1.1. Study aims

By assessing the relationship between DD and TUT, we hoped to determine how mind-wandering relates to the balance of short versus long term choices that an individual makes. By virtue of its association with poor performance, TUT may be linked to more extensive DD (i.e. an exaggerated preference for an immediate reward). Alternatively, mind-wandering's association with the process of planning and goal preparation suggests that TUT could predict less extensive DD (i.e. a reduced preference for an immediate reward). We also assessed the context dependency of the relationship between DD and TUT. Prior studies have demonstrated that TUT in less attention-demanding tasks are associated with higher WMC while this is not the case for tasks with greater attentional demands (Levinson et al., 2012). To explore the context dependency of any relationship with DD, TUT was therefore measured in both a simple choice reaction time (CRT) task and a more attention-demanding working memory (WM) task.

2. Methods

A community sample of 94 right-handed participants from the database of the Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany were recruited for this experiment (Mean age = 29 years, Age range 19–38 years, 49 females). All of them were native German speakers, had normal or corrected-to-normal vision, no history of psychiatric or neurological conditions and no history of substance abuse. Five participants were subsequently excluded from analysis due to extreme scores on either the CRT, the WM or the DD tasks.

2.1. Experimental session

The experimental session lasted 2 h and was divided into three blocks (block order counterbalanced across subjects). Participants were allowed to make short breaks between the blocks if desired. One block consisted of performing two tasks in which mind-wandering was measured; another block consisted of DD measurements. A number of other tasks were measured during the third block and will be described elsewhere.

All the participants gave written consent before the beginning of the experiment and were remunerated at least 16 € for their participation (8 € per hour of participation plus an additional reward depending on their performance during the DD task). E-prime 2 was used for stimulus presentation.

2.2. Delay discounting

In the DD block, participants performed in a counterbalanced order a DD task as well as a valuation task. The aim of the DD task was to obtain a measure of participants' preference for smaller immediate rewards compared to larger later rewards. The valuation task was used to control for participants' overall preferences for large future monetary rewards. The DD task lasted approximately 10 min and trial presentation was subject-paced. On each trial, participants had to make a choice between two options: a smaller but immediate reward and a larger but later reward. The immediate and later options were presented left or right from a central fixation cross, in a counterbalanced order to avoid repetitive behavior.

The immediate reward was fixed and consisted of 10 €. The amount of the later reward and the delay at which it could be received varied across trials. Seven different delay periods (ranging from 1 day to 180 days) and seven amounts of money

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