



Research paper

Where the depressed mind wanders: Self-generated thought patterns as assessed through experience sampling as a state marker of depression



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ABSTRACT

Background: Self-generated thoughts (SGTs), such as during mind wandering, occupy much of our waking life. Individuals with Major Depressive Disorder (MDD) are less in the “here and now” and prone to rumination. Few studies have looked at SGTs in depression using experience sampling methods and no study has so far investigated the specific contents of depressive SGTs and how they vary from one time point to another.

Methods: MDD patients (n=25) and matched healthy controls (n=26) performed an established mind wandering task, involving non-demanding number discriminations. Intermittent probe questions ask for participants' current SGTs, that is, how off-task the thoughts are, how positive or negative, self- or other-related, and past- or future-oriented.

Results: Multi-level modelling revealed that MDD patients engaged in more mind wandering than healthy controls. Their SGTs were predominantly negative and less positive, more self-related and past-oriented. Strongest predictor of depressive SGT was the decreased positive valence of thoughts. MDD patients' future and past-oriented thoughts were particularly more negative compared to healthy controls. Within MDD patients, the less positively valenced thoughts they had and the less variable these thoughts were, the more depressive symptoms they showed.

Limitation: No other measures of rumination and worry were used.

Conclusion: MDD patients show a very specific SGT pattern, possibly reflecting ruminative and anxious thoughts. This SGT pattern in depression might represent a useful state marker and even constitute an etiological factor of this debilitating disease, considering the importance of current SGT on and individual's cognitive processes and affective states.

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1. Introduction

Self-generated thoughts (SGTs) arise independently of external stimulation through the environment, and comprise experiences such as mind wandering, day-dreaming, rumination and planning (Smallwood, 2013). It is known that SGT forms a crucial part of human mental activity, occupying up to 50% of our waking mind (Kane et al., 2007; Killingsworth and Gilbert, 2010). Mind wandering occurs particularly when attentional and cognitive demands in relation to the external environment are low (e.g. Smallwood et al., 2004). Some studies have linked SGT such as

mind wandering to negative mood and unhappiness (Killingsworth and Gilbert, 2010; Stawarczyk et al., 2013), recent findings, however, suggest that it is crucial to consider ‘where the mind wanders’ and to look more specifically at the content of SGTs. For example, in healthy individuals, past-focused thoughts seem to be related to a reduction in positive mood, more depressive symptoms and increased cortisol levels after stress, while future-focused thoughts lead to an increase in positive mood and an attenuated stress response (Baird et al., 2011; Engert et al., 2014; Ruby et al., 2013a; Smallwood and O'Connor, 2011; Smallwood et al., 2007). Thus, SGT seems to represent a heterogeneous mental phenomenon with variable effects on human cognition, affect and behaviour (Andrews-Hanna et al., 2014).

Patients with depression are known to show considerable difficulties with staying in the “here and now”. Investigations have demonstrated that MDD patients tend to engage in maladaptive

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SGTs in the form of excessive rumination and worry (Nolen-Hoeksema, 1991, 2000; Watkins, 2008). Depressive rumination has been characterized as a mode of responding to distress which involves repetitively and passively focusing on symptoms of distress and on the possible causes and consequences of these symptoms (Nolen-Hoeksema, 2000). Worry, in contrast, has been described as a chain of negative uncontrollable thoughts and images, constituting an attempt to engage in problem-solving on issues with an uncertain outcome (Borkovec et al., 1983). While rumination and worry tend to correlate and share some similar features such as their repetitive nature, they have also been found to be statistically distinguishable (Nolen-Hoeksema et al., 2008). It has thus been proposed that rumination is more past and present oriented, focused on issues of self-worth, meaning and loss, whereas worry seems to be future-oriented, focused on anticipating threats (Nolen-Hoeksema et al., 2008; Watkins, 2008). While both rumination and worry have been associated with depressive symptoms, rumination seems to be more strongly related to depression (Hendriks et al., 2014; Hong, 2007). In MDD, rumination seems to represent a vulnerability marker for developing the disorder, and also shows a relation to the duration of MDD episodes and relapse probability (Nolen-Hoeksema et al., 2008). According to the cognitive model of depression, adverse early life events lead to internalization of negative self-referential schemas that subsequently bias information processing, in how stimuli are encoded, organized and retrieved (Disner et al., 2011). Therefore, these negative self-referential schemas might bias thoughts towards rumination of negative past experiences in depressive patients.

Previous research on rumination and worry in depression has been largely based on questionnaire and induction methods, which both have considerable limitations and lack ecological validity. Questionnaire methods rely heavily on retrospection which is often impaired in psychiatric populations. Most induction methods prompt participants towards rumination about certain subjects (thinking e.g. about the long-term goals you have set), which then is compared to distraction inductions, asking the participants to focus on non-self-relevant images (Nolen-Hoeksema and Morrow, 1993). However without no-intervention control conditions, the effects between the two different conditions are difficult to disentangle. More critically these induction methods do not capture momentary online thoughts. In contrast growing research on SGTs in healthy individuals suggests that if one wants to make more objective claims about the wandering mind in health or in depression one ought to investigate SGTs using online experience sampling measures. Such online-measures of SGTs would allow picking up disease specific SGT patterns in the moment when they actually occur, and are particularly useful in depression research as ecological momentary assessment avoids the recall bias toward negative memories and also allows for better generalization to real life. To our knowledge only one study looked at online SGTs in clinically depressed participants (Ottaviani et al., 2014). Using an experience sampling method this study categorized SGTs in depression as either normal mind wandering, on task thoughts or perseverative cognition, linking the latter to autonomic inflexibility in lower heart-rate variability. No study however has so far tried to objectively decompose the specific SGT contents in clinical depression, regarding the previously established temporal (past or future oriented), social (self or other related), and emotional (negative or positive) dimensions of SGT (Engert et al., 2014; Ruby et al., 2013a, 2013b). From a clinical perspective identifying the specific SGT pattern in depression seems of great interest, as such SGT pattern could function as a state marker of depression, which could potentially then be utilized as a measure of disease progression and therapeutic change, as well as helping better differentiation of mental disorders. In

addition it is unknown how these SGT contents in MDD patients relative to healthy controls vary over time, which could function as a good indicator of the repetitiveness of thoughts, inherent in rumination and also worry. This study thus aimed to comprehensively investigate the space of SGTs in depression in terms of amount, content and variability.

Based on clinical observation and description disordered thoughts in depression have been commonly conceptualized as rumination and worry. Such disordered thoughts in depression can however, considering the recent findings in mind wandering research possibly more accurately be described by pathological SGTs in depression. In this study we thus aimed to specifically investigate the online SGT contents and their variability in a sample of clinically depressed patients. We used an established non-demanding choice reaction time task (CRT) that allows spontaneous SGTs in participants. During this task participants are asked at random time points, first, how much they were on task, and, secondly, about the specific content of their thoughts (Engert et al., 2014; Ruby et al., 2013a, 2013b), such as questions asking if their thoughts were focused on certain temporal epochs (future or past), involved different referents (self or other) and varied in valence (negative or positive). This task is particularly useful as an objective online measure of the amount and specific content of SGTs, but also of their variability over time, as participants are asked about the SGTs repeatedly throughout the task. One index of thought variability is the fluctuation of thought ratings from one thought probe to the next, computed as the squared successive difference in ratings, which has been an established method in experience sampling studies (Ebner-Priemer et al., 2007; Jahng et al., 2008; Skirrow et al., 2014; Trull et al., 2008). Another index of variability represents the extremity of the thought ratings, calculated as the squared difference of each rating from the mean for that variable.

We first hypothesized that MDD patients relative to healthy controls would generally show more mind wandering, that is engage in more SGTs, being less in the ‘here and now’, and that these stimulus independent thoughts would be more negative, self, and past related in accordance with the cognitive model of depression and findings on increased rumination in depression. Secondly, we also hypothesized that MDD patients would think more about negative future events, possibly pointing to their tendency to engage in stronger worrying compared to healthy controls. Thirdly we expected that MDD patients would also show less variability and more rigid thought patterns compared to healthy controls, capturing the repetitive nature of their thoughts. Lastly we expected a relation between symptom severity and specific patterns in SGTs and their variability in depression.

2. Methods

2.1. Participants

25 patients with depression were recruited through the inpatient clinic of the Charité-Universitätsmedizin Berlin, or were referred to us by specialized clinicians (see Table 1). 26 healthy control (HC) participants matched to the patients in terms of years of education, age, and gender with no history of psychiatric or neurological disorders were recruited by public notices and from project databases of the Charité-Universitätsmedizin Berlin. Participants were assessed for mental disorders using the Structured Clinical Interview for the DSM-IV (American Psychiatric Association, 2000) and a diagnosis of acute state of depression was confirmed with no other primary diagnoses. All participants completed the Beck Depression Inventory (BDI, Hautzinger et al., 1995), and were also assessed with the Hamilton Depression Rating Scale (HAMD-17, Hamilton, 1960). Additionally, participants completed a measure of

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