Biological Psychology 107 (2015) 24–30

Contents lists available at ScienceDirect

Biological Psychology

journal homepage: www.elsevier.com/locate/biopsycho

# Cognitive rigidity is mirrored by autonomic inflexibility in daily life perseverative cognition

Cristina Ottaviani[a,*], Barbara Medea[b], Antonia Lonigro[a], Mika Tarvainen[c,d], Alessandro Couyoumdjian[b]

[a] IRCCS Santa Lucia Foundation, Rome, Italy
[b] Department of Psychology, Sapienza University of Rome, Italy
[c] Department of Applied Physics, University of Eastern Finland, Kuopio, Finland
[d] Department of Clinical Physiology and Nuclear Medicine, Kuopio University Hospital, Finland

ARTICLE INFO

*Article history:*
Received 28 October 2014
Accepted 26 February 2015
Available online 6 March 2015

*Keywords:*
Perseverative cognition
Mind wandering
Heart rate variability
Ecological momentary assessment

ABSTRACT

Mind wandering (MW) can be persistent and therefore has been included in the repetitive thinking conceptualization. In line with a dimensional view of psychopathology, we hypothesized the existence of a MW-Perseverative Cognition (PC) continuum, where the latter is characterized by a rigid and defensive pattern with attentional, behavioral, affective, and autonomic perseverative manifestations. Ambulatory heart rate (HR) and variability (HRV) of 42 participants were recorded for 24 h. Approximately every 30 min during waking, subjects reported their ongoing thoughts and moods using electronic diaries. MW was characterized by less effort to inhibit the thought and less interference with ongoing activities, absence of mood worsening, and higher HRV compared to PC. Worse sleep quality was predicted by higher levels of trait rumination and daily PC. Results suggest that MW and PC represent the functional and pathological ends of a continuum, respectively.

© 2015 Elsevier B.V. All rights reserved.

## 1. Introduction

Mind wandering (MW) can be persistent and repetitive and therefore has been included in the "repetitive thinking" conceptualization (see Watkins, 2008 for a review). While MW is commonly engaged in by all people, other forms of repetitive thinking, such as rumination and worry (i.e., Perseverative Cognition (PC); Brosschot, Verkuil, & Thayer, 2010) have been more linked to a clinical perspective and associated with mood and anxiety disorders, respectively (e.g., Hughes, Alloy, & Cogswell, 2008). Since these constructs have emerged in distinct research domains, they have rarely been considered together or directly compared. Moreover, several studies included rumination and worry in their conception of MW (e.g., Killingsworth & Gilbert, 2010), making it difficult to disentangle the effects of MW per se. In a previous laboratory study, we provided preliminary evidence that MW and PC lie on a continuum where flexibility plays a key role in determining if the process is adaptive or not in terms of health and well being (Ottaviani, Shapiro, & Couyoumdjian, 2013). The hypothesis for that study was grounded in Friedman and Thayer's model of anxiety (Friedman & Thayer, 1998), according to which vagal tone serves as a marker for physiological and psychological flexibility. The authors showed that panic disorder, a fear-related, stereotypic cognitive-behavioral-somatic complex that inhibits exploration of the environment, was associated with least vagal control of heart rate (HR) compared to an anxiety disorder such as blood phobia in which the stereotypic response is far less pervasive as it regards only one specific stimulus (i.e., blood). In line with this model, our laboratory study showed an association between cognitive rigidity and autonomic inflexibility as demonstrated by slower reaction times, highest intrusiveness, efforts to inhibit, and lower HR variability (HRV) during rumination and worry compared to MW. MW presents far fewer constraints than PC, as intuitively suggested by these constructs' names. The term "wandering" evokes a flow of thoughts that come and go, whereas the term "perseverative" evokes repetition of the same response over and over. Other researchers supported the view of MW as being more flexible compared to PC. For example, MW has been shown to involve control processes during easy tasks (Levinson, Smallwood, & Davidson, 2012) to facilitate creative problem solving (Baird et al., 2012) and to reduce temporal discounting (Smallwood, Ruby, & Singer, 2013), all important marks of cognitive flexibility. On the opposite end of the continuum, the tendency to experience PC is associated with reductions in objectively and

* Corresponding author at: IRCCS Santa Lucia Foundation, via Ardeatina 306, 00142 Rome, Italy. Tel.: +39 06 49917620.
*E-mail address:* cristina.ottaviani@uniroma1.it (C. Ottaviani).

http://dx.doi.org/10.1016/j.biopsycho.2015.02.011
0301-0511/© 2015 Elsevier B.V. All rights reserved.

subjectively assessed cognitive flexibility (Davis & Nolen-Hoeksema, 2000; Ruscio & Borkovec, 2004; Watkins, 2004).

In line with the predictions of Friedman and Thayer's Model (1998), the aim of the present study was to replicate our previous laboratory findings (Ottaviani et al., 2013) in a more ecological setting during participants' daily activities. Momentary assessment constitutes a powerful tool to capture the dynamics of experience and behavior over time and across settings, avoiding the error and bias associated with retrospection and enhancing ecological validity (see Shiffman, Stone, & Hufford, 2008 for a review). In the past decade, a number of ecological studies examined the effects of PC or MW on health and wellbeing but none directly compared these cognitive processes. Several studies (Brosschot, Van Dijk, & Thayer, 2007; Pieper, Brosschot, van der Leeden, & Thayer, 2007; Pieper, Brosschot, van der Leeden, & Thayer, 2010) monitored the relationship between spontaneous episodes of PC and ambulatory HR and HRV. We (Ottaviani, Shapiro, & Fitzgerald, 2011) found increases in HR during rumination episodes compared to non-ruminative periods but our study did not have HRV as an outcome variable. Pieper et al. (2007) showed that worry in daily life had substantial cardiac consequences in addition to the effects of stressful events, and this result has been replicated up to two hours after the worry episode ended and independently of ongoing worry, emotions, health behaviors, and physical activity (Pieper et al., 2010). The few ambulatory studies that included sleep data in their assessment further confirmed the maladaptive consequences of PC on health, suggesting an association between worrying in bed and higher HR and lower HRV (Weise, Ong, Tesler, Kim, & Roth, 2013). Moreover, the capacity of daytime worrying predicted lowered HRV during the subsequent night (Brosschot et al., 2007; Yoshino & Matsuoka, 2009).

The studies of MW using ecological momentary assessment are sparse (Carriere, Seli, & Smilek, 2013; Killingsworth & Gilbert, 2010; McVay, Kane, & Kwapil, 2009; Poerio, Totterdell, & Miles, 2013; Song & Wang, 2012; Unsworth, McMillan, Brewer, & Spillers, 2012) and none simultaneously recorded physiological activity. Most of these studies focused on the dysfunctional effects of MW on moods while some others investigated mood as a trigger instead of a consequence of MW. For example, McVay et al. (2009) demonstrated that MW occurs less often during happy mood. Consistently, Song and Wang (2012) showed that negative mood increases the likelihood of MW and influences its emotional valence. Moreover, Poerio et al. (2013), using a 7-day experience sampling technique, concluded that sadness tends to precede MW but not to follow it. The opposite view is supported by Killingsworth and Gilbert (2010) and Stawarczyk, Majerus, and D'Argembeau (2013) who provided evidence for the involvement of MW in predicting subsequent levels of momentary negative affect, up to the conclusion that "a wandering mind is an unhappy mind" (Killingsworth & Gilbert, 2010).

In line with our laboratory findings, we hypothesized to find higher cognitive (efforts to inhibit the thought) and behavioral (interference with ongoing activities) rigidity, mirrored by higher levels of autonomic inflexibility (lower HRV) during PC compared to MW assessed by an ecological momentary assessment. Given evidence that the maladaptive effects of PC are prolonged up to the subsequent sleep period, either in terms of quality of sleep (e.g., Zoccola, Dickerson, & Lam, 2009) or cardiovascular consequences (Brosschot et al., 2007; Yoshino & Matsuoka, 2009), our second hypothesis was to find an association between daily rumination and worry and worse quality of sleep, higher HR, and lower HRV during sleep. Based on our previous finding on the relationship between the occurrence of MW during the day and difficulties falling asleep the subsequent night (Ottaviani & Couyoumdjian, 2013), we expected to find a negative effect of daily MW on sleep quality but not on cardiovascular activity during the night. Lastly, we hypothesized that previous inconsistent findings on the effects of MW on mood were due to the inclusion of rumination and worry in the definition of MW. Indeed, the pathogenic consequences of PC on mood are well established (e.g., Response Style Theory; Nolen-Hoeksema, 2004). In light of our laboratory finding (Ottaviani et al., 2013), we expected that, when directly compared, PC and not MW would lead to mood worsening. Perseverative cognition has been conceptualized as a strategy to cope with perceived threats to goal attainment at a state level but can also be viewed as a dispositional tendency at a trait level (e.g., Moberly & Watkins, 2010; Verkuil, Brosschot, Gebhardt, & Thayer, 2010). Thus, together with the ecological momentary assessment of daily episodes of PC, we also tested the effects of trait rumination and trait worry on our outcome variables (efforts to inhibit the thought, interference with ongoing activities, HR and HRV during wake and sleep, quality of sleep, and mood).

## 2. Methods

### 2.1. Participants

University students and employees were invited to participate in a study on "what happens in your body when your mind wanders." Of the 50 subjects who agreed to participate in the study, 3 did not complete the ambulatory session and 5 were excluded due to excessive artifacts or inconsistent diary entries. The final sample was composed of 19 men (mean age 26.9 (5.9) years) and 23 women (mean age 26.5 (9.5) years). All subjects were Caucasian. Exclusionary criteria, assessed during a pre-screening questionnaire, were: diagnosis of psychiatric disorders (current and/or past), diagnosis of hypertension or heart disease, any other disease or use of drugs/medications that might affect cardiovascular function, obesity (body mass index >32 kg/m$^2$), menopause, use of oral contraceptives during the previous 6 months, and pregnancy or childbirth within the last 12 months. Participants were compensated (€25) for their time. The protocol was approved by the Bioethical Committee of S. Lucia Foundation, Rome, Italy.

### 2.2. Procedure

After eligibility assessment, participants came to the lab, read and signed the informed consent form, and were instructed about the use of the electronic diary implemented on a smart phone and the ambulatory HR device. The ambulatory device was attached to their chest, and they left the laboratory. After approximately 24 h of wearing the device, participants were asked to return it and the phone, complete a series of on line personality questionnaires, were debriefed, and received monetary compensation.

### 2.3. Electronic diary

Participants were provided with an electronic diary implemented on an Android phone via SurveyPocket (Questionpro.com) and KoBo (kobotoolbox.org). At random times (about every 25–35 min), the phone signaled participants that it was time to fill out the diary. The first page screen had definitions of MW, rumination, and worry that could be easily skipped if not needed. Each diary asked to report the ongoing cognitive process at the time of the signal (focused on the task, distracted by external stimuli, MW, worrying about a future event, ruminating about a past stressful event) and information on factors that may affect HR and HRV, including posture, physical activity, and food, caffeine, nicotine, and alcohol consumption since the last diary report. Stressors were assessed by asking participants whether they experienced one or more annoying or disturbing events in the preceding period (Yes/No). On each diary entry, participants also rated their current levels of feeling sad, happy, tired, anxious, and angry using a 5-point scale from 1 = Not at all to 5 = Very much. If participants reported MW, ruminating, or worrying in the first question, they were required to enter the following additional information: (1) duration of the cognitive process (0–5 min, 6–10 min, 11–20 min, 21–30 min); (2) how much they were trying to suppress the thought (from 1 = Not at all to 5 = Very much); (3) if the thought was interfering with their ongoing activity (from 1 = Not at all to 5 = Very much). By using the touch screen, responses could be made in a few minutes. Based on prominent approaches that include rumination and worry under the umbrella term of PC (reviewed in Brosschot et al., 2010), we collapsed reported ruminative and worrisome thoughts into this single category. A final total of 821 episodes (393 (217.7) of being on task, 305 (229.3) of MW, and 123 (214.2) of PC) were used in the analyses.

Upon awakening, participants were asked to fill out the PROMIS Sleep Disturbance-Short Form (Yu et al., 2011), implemented on the same Android phone.

### 2.4. Ambulatory recording

Heart rate was recorded as beat-to-beat intervals using a t6 Suunto Memory Belt (SuuntoVantaa, Finland). The Suunto Memory Belt has been shown to be a reliable

دریافت فوری ← متن کامل مقاله

ISIArticles
مرجع مقالات تخصصی ایران

✓ امکان دانلود نسخه تمام متن مقالات انگلیسی
✓ امکان دانلود نسخه ترجمه شده مقالات
✓ پذیرش سفارش ترجمه تخصصی
✓ امکان جستجو در آرشیو جامعی از صدها موضوع و هزاران مقاله
✓ امکان دانلود رایگان ۲ صفحه اول هر مقاله
✓ امکان پرداخت اینترنتی با کلیه کارت های عضو شتاب
✓ دانلود فوری مقاله پس از پرداخت آنلاین
✓ پشتیبانی کامل خرید با بهره مندی از سیستم هوشمند رهگیری سفارشات