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Repetitive Thought Impairs Sleep Quality: An Experience Sampling Study

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Although previous research has suggested that presleep negative cognitive activities are associated with poor sleep quality, there is little evidence regarding the association between negative thoughts and sleep in real-life settings. The present study used experience sampling and long-term sleep monitoring with actigraphy to investigate the relationships among negative repetitive thought, mood, and sleep problems. During a 1-week sampling period, 43 undergraduate students recorded their thought content and mood eight times a day at semirandom intervals. In addition to these subjective reports, participants wore actigraphs on their wrists in order to measure sleep parameters. Analyses using multilevel modeling showed that repetitive thought in the evening was significantly associated with longer sleep-onset latency, decreased sleep efficiency, and reduced total sleep time. Furthermore, impaired sleep quality was significantly associated with reduced positive affect the next morning, and decreased positive affect was indirectly associated with increased repetitive thought in the evening. These findings suggest the existence of a self-reinforcing cycle involving repetitive thought, mood, and impaired sleep quality, highlighting the importance of cognitive and emotional factors in enhancement and maintenance of good-quality sleep.

Keywords: repetitive thought; self-focus; sleep; experience sampling; actigraphy

REPETITIVE THOUGHT, CONCEPTUALIZED as a "process of thinking attentively, repetitively or frequently about oneself and one's world" (Segerstrom, Stanton, Alden, & Shortridge, 2003, p. 909), is known to have deleterious influences on mental health. Repetitive thought is a relatively broad concept that encompasses depressive rumination and anxious worry (Watkins, 2008). Empirical studies have shown that these negative and self-focused perseverative thoughts are cognitive risk factors for various psychological problems; for example, the tendency to ruminate predicts future onset, maintenance, and exacerbation of depressive disorders (Just & Alloy, 1997; Kuehner & Weber, 1999; Nolen-Hoeksema, 2000; Nolen-Hoeksema & Morrow, 1991; Nolen-Hoeksema, Parker, & Larson, 1994). Furthermore, repetitive thought with negative content is a transdiagnostic phenomenon associated with a wide range of psychological and physiological maladjustments such as anxiety, substance abuse, eating and drinking problems, and sleep disturbances (Aldao, Nolen-Hoeksema, & Schweizer, 2010; Harvey, Watkins, Mansell, & Shafran, 2004; Nolen-Hoeksema &

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Harrell, 2002; Nolen-Hoeksema, Stice, Wade, & Bohon, 2007; Watkins, 2011).

In the literature on sleep disturbance and insomnia, repetitive thought has increasingly received attention as one of the critical factors that contributes to the maintenance and exacerbation of sleep problems. Psychological models of insomnia have proposed that excessive cognitive activities such as rumination and worry trigger physiological arousal and emotional distress, leading to the perception of sleep problems and genuine sleep deficits (Harvey, 2002; Harvey, Tang, & Browning, 2005). Supporting the link between rumination and sleep, surveys on unselected samples indicate that trait rumination is cross-sectionally associated with impaired sleep quality and insomnia (Carney, Edinger, Meyer, Lindman, & Istre, 2006; Fernandez-Mendoza et al., 2010; Thomsen, Mehlsen, Christensen, & Zachariae, 2003) and prospectively predicts future increases in sleep problems (Takano, Iijima, & Tanno, 2012). Experimental studies found that worry induced in the laboratory was associated with prolonged sleep-onset latency (SOL) for naps (Gross & Borkovec, 1982; Tang & Harvey, 2004), and that stress-related rumination had a negative impact on nighttime sleep quality in individuals with high trait rumination (Guastella & Moulds, 2007; Zoccola, Dickerson, & Lam, 2009). Among patients with insomnia, those with high rumination exhibited lower sleep efficiency and quality (Carney, Harris, Moss, & Edinger, 2010).

However, because these previous studies worked with repetitive thought as an experimental manipulation in a laboratory or conceptualized it as a stable, traitlike characteristic, little evidence exists for the association between sleep and repetitive thought as it occurs naturally in daily life. Daily life studies using diary techniques, or more intensive experience sampling methods (ESM; Csikszentmihalyi & Larson, 1987), have suggested that ruminative self-focus fluctuates over time in its association with moods, stress experiences, and avoidance (Dickson, Ciesla, & Reilly, 2012; Moberly & Watkins, 2008a, 2008b; Mor et al., 2010). With ESM, participants keep a portable digital device with them as they go about their regular daily activities and report their momentary feelings, thoughts, and environmental information in response to periodic prompts received from the device. The unique advantage of ESM is its ability to assess these moment-to-moment experiences in an individual's daily life, thus improving ecological validity and reducing vulnerability to recall bias (Myin-Germeys et al., 2009). Utilizing the advantages of ESM, the present study primarily aimed to observe repetitive thought in daily life and to model the associations among repetitive thought, mood, and sleep problems by testing the following three specific hypotheses.

Our first hypothesis stated that repetitive thought would predict impairment of nighttime sleep quality. Thought-content analyses of presleep cognitions have suggested that worrisome thoughts are associated with sleep disturbances and insomnia (Harvey, 2000; Watts, Coyle, & East, 1994; Wicklow & Espie, 2000). Although there is no clear evidence of the association between daytime repetitive thought and nighttime sleep, it is reasonable to expect that repetitive thought occurring in the evening would have a stronger influence on sleep than that which occurred in the morning or afternoon. Data show that variables assessed at temporally proximal points have a greater association than those measured distally, particularly in cases when the variables in question have moderate to low stability (Cole & Maxwell, 2003). As the present study assessed the flow of thoughts over the course of the day, we were able to identify the time of day at which repetitive thought would have the most deleterious effect on sleep quality.

Second, we hypothesized that disturbed sleep would negatively influence mood the following morning. The emotional effects of insufficient sleep and insomnia have been examined in a number of studies (Buysse et al., 2007; Durmer & Dinges, 2005); for example, sleep problems predicted future depression (Breslau, Roth, Rosenthal, & Andreski, 1996), and sleep deprivation was associated with mood disturbances such as increased fatigue or decreased vigor (Dinges et al., 1997). An ESM study showed that perceived sleep problems predicted reduced positive affect during daytime hours, although the adverse effect of impaired sleep was relatively weak for negative affect (Bower, Bylsma, Morris, & Rottenberg, 2010). These findings suggest the possibility that impaired sleep quality would contribute to mood disturbances the next day, particularly for positive moods.

Third, we hypothesized that disturbed moods in the morning would contribute to further repetitive thoughts the following evening. This hypothesis was examined to determine whether there exists a self-reinforcing cycle, wherein sleep problems induced by repetitive thought contributed to mood disturbances the following day, resulting in further repetitive thought in the evening. Regarding the relationship between repetitive thought and mood problems, one previous longitudinal survey (Nolen-Hoeksema et al., 2007) and an ESM study (Moberly & Watkins, 2008a) suggested that negative moods predict future rumination, and vice versa. Considering this mutual relationship between mood and repetitive thought, it was expected that mood disturbances in the morning