aps ASSOCIATION FOR PSYCHOLOGICAL SCIENCE

Current Directions in Psychological Science
1–6

DOI: 10.1177/0963721417712269
www.psychologicalscience.org/CDPS
SAGE

The Social Side of Sleep: Elucidating the Links Between Sleep and Social Processes

Amie M. Gordon, Wendy Berry Mendes, and Aric A. Prather
University of California, San Francisco

Abstract
Sleep problems have become a public health epidemic with recent data suggesting that more than 69% of U.S. adults get less sleep than they need. Despite the important role that sleep plays in our lives, sleep as a variable of interest in interpersonal processes has been historically absent from the psychological literature. Recently, however, researchers have shed some light on the link between sleep and a wide array of social processes. This work illuminates the important role that sleep plays in our social experiences, from basic social perception to complex social interactions. We outline a working model for the bidirectional link between sleep and social processes, including underlying mechanisms, review the recent research that informs this model, and use it to elucidate important next steps to bring together sleep and social psychological research. We also address the pragmatics of measuring sleep for non–sleep researchers.

Keywords
sleep, social processes, social cognition, close relationships, social stress

Everyone sleeps. Everyone sleeps poorly sometimes. In fact, sleep problems are a public health epidemic. More than 69% of U.S. adults get less sleep than they need (National Sleep Foundation, 2014), and insufficient sleep is associated with elevated risk for a cadre of negative physical and mental health outcomes (for recent reviews, see Barnes & Drake, 2015; Buysse, 2014). Sleep research has, for the most part, separated sleep from the social context in which it occurs. Similarly, sleep has been largely neglected in social psychological research. Here we argue that such omissions have resulted in an important gap for both scientific fields and there is a pressing need to consider the links between sleep and social processes to gain a fuller, integrated understanding of both sleep and social phenomena.

We contend that the links between sleep and social processes are bidirectional—how well we sleep affects how we interact with the social world and how we interact with those around us affects how well we sleep. We present a working model (Fig. 1) tying sleep and social processes, provide research exemplars, and consider possible mechanisms, outlining a path for future work. We also address practical considerations of studying sleep for non–sleep researchers. We begin, however, with a brief overview of sleep to orient the reader.

Overview of Sleep

The average person spends roughly one-third of life asleep. Far from a monotonic experience, sleep is a dynamic process, cycling throughout the night from light to deep sleep. Sleep architecture can be categorized into two types: rapid eye movement (REM) and non-REM (NREM). REM occurs later in the cycle, which is typically associated with dreaming. NREM sleep consists of three stages, with stage 1 reflecting lightest sleep and stage 3 reflecting deep sleep, also known as slow

Corresponding Author:
Aric A. Prather, University of California, San Francisco–Psychiatry, 3333 California St., Ste. 465, San Francisco, CA 94118
E-mail: PratherA@chc.ucsf.edu

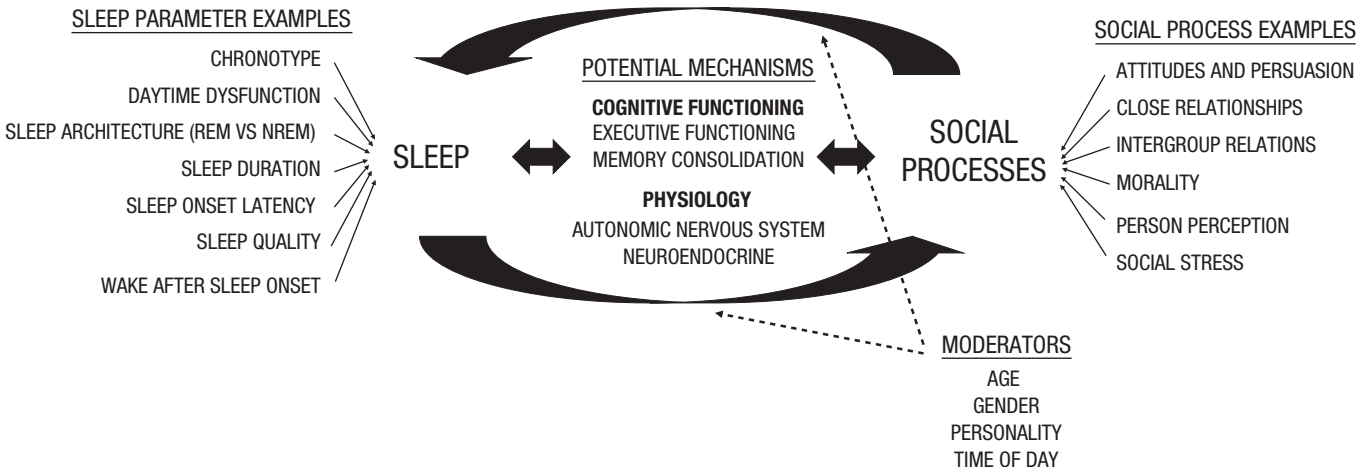

Fig. 1. Proposed model of bidirectional associations between sleep and social processes.

wave sleep. Sleep is often partitioned into several parameters, including total sleep time (i.e., sleep duration), sleep onset latency, wake after sleep onset (WASO), and sleep efficiency. Sleep onset latency reflects how long it takes someone to fall asleep, whereas WASO represents the time someone is awake after sleep begins. Sleep efficiency is the percentage of sleep obtained during a defined period of sleep opportunity. One's subjective perception of sleep quality is also meaningful, strongly predicting physical and psychological outcomes (see, e.g., Buysse, 2014). Circadian preference, or chronotype, can also have important effects on health and well-being. Chronotype reflects a person's biologically driven propensity to be more alert at night (an evening person) or in the morning (a morning person). These sleep variables offer useful insight into the unique aspects of sleep and may be applied to understanding the links between sleep and social processes.

Sleep and Social Processes: Research Exemplars

Emerging evidence suggests sleep is related to many aspects of our social lives. In Figure 1, we outline several social processes associated with sleep. Below, we provide three research exemplars pulled from our own research and areas of expertise: close relationships, person perception, and social stress.

Close relationships

In adulthood, beds are often shared with romantic partners. As such, sleep researchers have increasingly recognized the need to consider the dyadic nature of sleep (for reviews and a comprehensive model linking sleep to relationship functioning, see Troxel, 2010; Troxel, Robles, Hall, & Buysse, 2007; see also Rogojanski, Carney, & Monson, 2013). Outside of the bedroom, sleep also plays a role in how partners interact. People report sleeping worse after experiencing romantic conflict (Hicks & Diamond, 2011), and conversely, poor sleep is associated with greater conflict the following day (Gordon & Chen, 2014). Sleep also plays a role in the nature and resolution of romantic conflict—in one study, sleeping poorly the prior night was associated with less empathic accuracy, a lower ratio of positive to negative affect (self- and observer-rated), and less conflict resolution during a lab-based task (Gordon & Chen, 2014).

The effects of poor sleep appear to influence not only poor sleepers, but those they interact with as well—people experience deficits in empathic accuracy whether they *or* their partners are poorly rested (Gordon & Chen, 2014). More broadly, people tend to be less satisfied with their relationships if either they or their partners sleep poorly (Maranges & McNulty, 2016; Strawbridge, Shema, & Roberts, 2004). These dyadic effects highlight the social nature of sleep, particularly within close relationships.

Person perception

Sleep also plays a role in how we perceive others. Individuals are less accurate at identifying happiness and anger in pictures of strangers after sleep deprivation relative to when they sleep normally (van der Helm, Gujar, & Walker, 2010). They also perceive leaders as less charismatic (an important characteristic for effective leadership) compared to their well-rested counterparts (Barnes, Guarana, Nauman, & Kong, 2016). Sleep problems affect heuristic tendencies,

leading to more stereotyping and bias. For example, "morning people" engage in more social stereotyping at night than in the morning, whereas the opposite is true for "evening people" (Bodenhausen, 1990). Sleepier people are more likely to engage in racial stereotyping, including rating a job candidate as more qualified if the candidate has a White-sounding name as opposed to a Black-sounding name (Ghumman & Barnes, 2013). This effect of sleep on stereotyping is particularly pronounced among individuals with strong implicit racial biases. For decades researchers have worked to understand social bias and prejudice and uncover processes related to differential empathy toward in-group over out-group members. These studies suggest that lack of sleep may be a neglected factor in the literature.

Social stress

Stressful social situations, such as fighting with a spouse, experiencing discrimination, or feeling rejected, have been implicated in sleep problems. In one study, we found that relative to watching a neutral video, experiencing a social rejection before bed led to a later bedtime and fewer hours of sleep (as measured by actigraphy; Gordon, Flores, Mendes, & Prather, 2017). Related to this, perceived discrimination is associated with disturbed sleep, as measured by self-report and objective EEG recording (Beatty et al., 2011; Lewis et al., 2013).

In the other direction, poor sleep, whether acute or chronic, modulates how one processes and responds to stressors, including social stressors. Sleep-deprived participants (compared to non-sleep-deprived) exhibit enhanced amygdala activation and reduced activity in the prefrontal cortex (a brain region known for regulating emotional responses) when observing emotional faces (Yoo, Gujar, Hu, Jolesz, & Walker, 2007). Poor sleep also enhances links between amygdala activation in response to emotional stimuli and more general reports of perceived stress (Prather, Bogdan, & Hariri, 2013). In addition, sleep deprivation and poorer global sleep quality result in greater physiological responses (i.e., blood pressure reactivity and systemic inflammation) to a stressful social-evaluative task (Franzen et al., 2011; Prather, Puterman, Epel, & Dhabhar, 2014). Taken together, these findings suggest that sleep plays an integral role in individuals' affective and physiological reactions to social experiences, particularly stressful social experiences.

These research exemplars highlight the breadth of ties between sleep and social processes—when people sleep poorly they are less accurate at judging other people's expressions, quicker to rely on stereotypes, and are more susceptible to social stressors such as rejection and relationship conflict. Moreover, these negative social experiences portend poorer sleep, creating the possibility of a pernicious downward cycle not just for poor sleepers but for those who interact with them. While these three exemplars are illustrative, this is an emerging literature and many open questions remain about when and how sleep and social processes are linked.

Mechanisms: Neurologic and Physiologic Pathways

Many mechanisms likely underlie the links between sleep and social processes. Here we highlight two: executive functioning—particularly self-regulatory capacity and attentional focus—and physiologic arousal.

Executive functioning

One consequence of impaired executive functioning due to poor sleep (Durmer & Dinges, 2005) is reduced self-regulation. Poor sleepers have more difficulty overriding initial impulses (Krizan & Hisler, 2016) and depend more on automatic processing and less on effortful cognitions, such as relying on implicit racial biases (Ghumman & Barnes, 2013). Within close relationships, automatic processing often means responding selfishly to relationship issues (McNulty & Olson, 2015; Rusbult & Van Lange, 2003); this may explain why poor sleepers experience more difficulty resolving conflict. Reduced self-regulation may also explain the link between poor sleep and reactivity to social stressors; in one study, poor sleepers were less able to use cognitive reappraisal—a resource-intense emotion regulation strategy—to regulate their emotions after a stressful experience (Mauss, Troy, & LeBourgeois, 2013).

Reduced self-regulation also helps explain why social processes affect sleep. Getting adequate sleep requires self-regulation; people must turn off the television, leave the party, or quit working to go to bed. Some social experiences—such as arguing with a spouse or being the victim of discrimination—may be depleting, making it more difficult to engage in the self-regulatory behaviors necessary to get a good night of sleep.

Attention is another aspect of executive functioning that may help link sleep and social processes (Lim & Dinges, 2008, 2010). Poor sleep likely disrupts the ability to attend to subtle social cues due to a loss of "mental bandwidth" and thus reduces awareness of nuances during social interactions. For example, reduced attention might explain why poor sleepers rely more on heuristics and stereotypes during social

interactions rather than gathering, integrating, and updating held beliefs with new information.

Physiologic arousal

Core biological systems related to stress and emotion are inextricably linked to sleep, setting the stage for social experiences to influence later sleep. The autonomic nervous system, made up of the sympathetic (SNS) and parasympathetic nervous systems (PNS), activates during social experiences (Mendes, 2016), and directly affects the ability to fall and stay asleep. PNS activation is imperative for sleep onset and uninterrupted sleep; thus, any social experience that alters the PNS might quicken or delay sleep onset. For example, social experiences that induce positive moods might aid in increasing parasympathetic activity before bed, speeding up sleep onset and enhancing sleep quality. Conversely, interpersonal conflict, particularly right before bed, might increase SNS and decrease PNS, possibly delaying sleep onset and decreasing sleep quality.

Lack of sleep may also lead to dysregulated biological systems that impair social functioning. For instance, poor sleep can impair physiologic flexibility by blunting responses and poor vagal flexibility is linked to responding inaccurately to social stimuli (Muhtadie, Koslov, Akinola, & Mendes, 2015), such as difficulty reading emotional faces. Thus, it is likely that physiological arousal plays an important role in the recursive nature between sleep and social processes.

Executive functioning and physiologic arousal are viable mechanisms given their neurobiological roots and established links to social functioning. However, little work has explored these mechanisms. Moreover, these mechanisms focus on the impairment or dysregulation of systems as a result of poor sleep; considering the benefits of sleeping well reveals other possible mediators (e.g., memory consolidation; for a review, see Chambers, 2017). Uncovering these pathways will be a critical step in elucidating the social consequences of sleep. In addition, identifying moderators, such as age and culture (Fig. 1), will help pinpoint when and for whom sleep is linked with social processes, thus identifying populations that might benefit from intervention.

Measuring Sleep for the Non–Sleep Researcher

Measuring sleep outside of a sleep laboratory can be accomplished in several ways (see Table 1, which

Table 1. Measurement of Sleep

Measuring sleep	Summary	Benefits	Caveats
Polysomnography	Employs EEG to quantify second-by-second brain activity. Software and expert sleep technologists use these data to characterize sleep stages (NREM [Stages 1–3] and REM) across the night.	Gold-standard measure to quantify sleep. Provides in-depth measurement of sleep architecture. Concurrent measurement of cardiovascular psychophysiology is available.	Invasive. Requires intensive in-lab or in-home sleep study. Well-documented first night effect (i.e., sleep is bad the first night) requiring minimum of two nights of assessment.
Wrist actigraphy	Watch-like device that estimates sleep behavior via accelerometry. Can be worn over consecutive days/nights to provide estimates of sleep duration and continuity.	Provides objective estimates of sleep behavior. Unobtrusive for participant. Some models collect light-exposure data.	Requires multiple nights of assessment. Measures inactivity, which may not reflect sleep (e.g., watching a movie could be coded as sleep). Participant's reported wake/sleep time is often required for accurate scoring.
Sleep diaries	Brief questionnaires usually administered in the morning that ask about prior night's sleep/wake times, sleep onset latency, number of awakenings, subjective quality, etc.	Easily administered. Captures multiple aspects of the sleep experience (e.g., duration, quality); can combine with other psychological measures of interest in a short diary format.	Requires multiple nights of assessment. Subjective in nature and susceptible to retrospective report bias.
Sleep questionnaires	Often assessing "typical" sleep behavior, including overall quality, duration, frequency of sleep disturbances, and beliefs about sleep.	Easily administered. Likely captures "trait"-like tendencies related to sleep.	Subjective in nature and susceptible to retrospective report bias. May be influenced by more proximal than distal sleep experiences.

Note: NREM = non-rapid eye movement; REM = rapid eye movement.

includes pros and cons of various measures). Sleep can be measured behaviorally using actigraphs—wrist devices that rely on accelerometry and capitalize on the fact that individuals are immobile during sleep. Research grade devices are well-validated; however, we are on the cusp of a technological revolution in which personal fitness trackers may produce cheap, reliable sleep measurement. This technology paves the way for exciting work on the social nature of sleep via social network analyses (e.g., Mednick, Christakis, & Fowler, 2010). With "big data" on sleep patterns matched to social interactions via social sharing sites such as Facebook, we can plot the spread of poor sleep across networks.

In terms of self-reports, sleep diaries can be used to assess the duration and quality of people's sleep across a specified time frame, typically one to two weeks. Global sleep quality measures capture retrospective reports of multiple aspects of sleep, such as duration, quality and efficiency (e.g., the Pittsburgh Sleep Quality Index assesses seven aspects of sleep across the prior month; Buysse, Reynolds, Monk, Berman, & Kupfer, 1989). Other important aspects of the sleep experience, such as insomnia symptoms, chronotype, sleep hygiene, or beliefs and attitudes about sleep, can also be captured via self-report.

One reason that sleep may be overlooked is the difficulty in manipulating it. While readily achieved within a laboratory, a dedicated sleep lab is not a prerequisite for manipulation. Participants can be assigned to at-home partial sleep restriction (e.g., reduced sleep by an hour or two for a set period of time) and creative use of technology allows for compliance tracking during the assigned wake period. This type of sleep manipulation has the added benefit of increased ecological validity both in terms of the sleep environment (at home) and the type of sleep restriction (chronic and partial as opposed to acute and total, which may not have the same effects on social processes). The causal effects of sleep can also be tested through sleep extension; this might mean going to bed an hour earlier than usual or adding naps during the day. Although there are challenges to executing each of these approaches, they are surmountable for the researcher interested in the causal effects of sleep.

Even when sleep is not one's main interest, we urge researchers to consider measuring and accounting for sleep. Sleep differences may be adding unnecessary noise to social experiments. For example, people of different chronotypes differ in their response to social stimuli depending on the time of day the study is conducted (Bodenhausen, 1990), and insomnia is associated with error in survey responding, reducing reliability (Barber, Barnes, & Carlson, 2013).

Conclusion

Sleep, a core biological need, has far-reaching effects on social processes from basic social cognitions to complicated social interactions; however, little work has investigated the role of sleep in the social psychological realm. Sleep is an inescapable biological experience and understanding its place in our social lives can help us better understand the forces that affect our social processes and ultimately our health and well-being.

Recommended Reading

Barnes, C. M., & Drake, C. L. (2015). (See References). Considers the importance of sleep health for public health given its widespread consequences.

Buysse, D. J. (2014). (See References). A comprehensive argument considering the need to measure not just sleep problems but the positive side of sleep, which is highly relevant to the literature on sleep and social processes.

Kryger, M. H., Roth, T., & Dement, W. C. (Eds.). (2016). Instrumentation and methodology. In *Principles and practice in sleep medicine* (6th ed., pp. 1564–1671). St. Louis, MO: Elsevier. An introduction to the measures and methods for assessing sleep.

Troxel, W. M., Robles, T. F., Hall, M., & Buysse, D. J. (2007). (See References). A comprehensive review of the literature on the role of sleep in close relationships.

Declaration of Conflicting Interests

The authors declared that they had no conflicts of interest with respect to their authorship or the publication of this article.

References

Barber, L. K., Barnes, C. M., & Carlson, K. D. (2013). Random and systematic error effects of insomnia on survey behavior. *Organizational Research Methods*, *16*, 616–649.

Barnes, C. M., & Drake, C. L. (2015). Prioritizing sleep health public health policy recommendations. *Perspectives on Psychological Science*, *10*, 733–737.

Barnes, C. M., Guarana, C. L., Nauman, S., & Kong, D. T. (2016). Too tired to inspire or be inspired: Sleep deprivation and charismatic leadership. *Journal of Applied Psychology*, *101*, 1191–1199.

Beatty, D. L., Hall, M. H., Kamarck, T. A., Buysse, D. J., Owens, J. F., Reis, S. E., . . . Matthews, K. A. (2011). Unfair treatment is associated with poor sleep in African American and Caucasian adults: Pittsburgh SleepSCORE project. *Health Psychology*, *30*, 351–359.

Bodenhausen, G. V. (1990). Stereotypes as judgmental heuristics: Evidence of circadian variations in discrimination. *Psychological Science*, *1*, 319–322.

Buysse, D. J. (2014). Sleep health: Can we define it? Does it matter? *Sleep*, *37*, 9–17.

Buysse, D. J., Reynolds, C. F., Monk, T. H., Berman, S. R., & Kupfer, D. J. (1989). The Pittsburgh Sleep Quality Index:

A new instrument for psychiatric practice and research. *Psychiatry Research*, *28*, 193–213.

Chambers, A. M. (2017). The role of sleep in cognitive processing: Focusing on memory consolidation. *Wiley Interdisciplinary Reviews: Cognitive Science*, *8*, e1430.

Durmer, J. S., & Dinges, D. F. (2005). Neurocognitive consequences of sleep deprivation. *Seminars in Neurology*, *25*, 117–129.

Franzen, P. L., Gianaros, P. J., Marsland, A. L., Hall, M. H., Siegle, G. J., Dahl, R. E., & Buysse, D. J. (2011). Cardiovascular reactivity to acute psychological stress following sleep deprivation. *Psychosomatic Medicine, 73,* 679–682.

Ghumman, S., & Barnes, C. M. (2013). Sleep and prejudice: A resource recovery approach. *Journal of Applied Social Psychology*, *43*, E166–E178.

Gordon, A. M., & Chen, S. (2014). The role of sleep in interpersonal conflict: Do sleepless nights mean worse fights? *Social Psychological & Personality Science*, *5*, 168–175.

Gordon, A. M., Flores, A., Mendes, W. B., & Prather, A. A. (2017). *Counting black sheep: The effects of race-based social stress on sleep and nocturnal autonomic functioning*. Manuscript in preparation.

Hicks, A. M., & Diamond, L. M. (2011). Don't go to bed angry: Attachment, conflict, and affective and physiological reactivity. *Personal Relationships*, *18*, 266–284.

Krizan, Z., & Hisler, G. (2016). The role of sleep in self-regulation. In K. Vohs & R. Baumeister (Eds.), *The handbook of self-regulation* (Vol. 2, pp. 182–202). New York, NY: Guilford.

Lewis, T. T., Troxel, W. M., Kravitz, H. M., Bromberger, J. T., Matthews, K. A., & Hall, M. H. (2013). Chronic exposure to everyday discrimination and sleep in a multiethnic sample of middle-aged women. *Health Psychology*, *32*, 810–819.

Lim, J., & Dinges, D. F. (2008). Sleep deprivation and vigilant attention. *Annals of the New York Academy of Sciences*, *1129*, 305–322.

Lim, J., & Dinges, D. F. (2010). A meta-analysis of the impact of short-term sleep deprivation on cognitive variables. *Psychological Bulletin*, *136*, 375–389.

Maranges, H. M., & McNulty, J. K. (2016). The rested relationship: Sleep benefits marital evaluations. *Journal of Family Psychology*. Advance online publication.

Mauss, I. B., Troy, A. S., & LeBourgeois, M. K. (2013). Poorer sleep quality is associated with lower emotion-regulation ability in a laboratory paradigm. *Cognition & Emotion*, *27*, 567–576.

McNulty, J. K., & Olson, M. A. (2015). Integrating automatic processes into theories of relationships. *Current Opinion in Psychology*, *1*, 107–112.

Mednick, S. C., Christakis, N. A., & Fowler, J. H. (2010). The spread of sleep loss influences drug use in adolescent social networks. *PLoS ONE*, *5*, e9775.

Mendes, W. B. (2016). Emotion and the autonomic nervous system. In L. E. Barrett, M. Lewis, & J. Haviland-Jones (Eds.), *Handbook of emotions* (4th ed., pp. 166–181). New York, NY: Guilford.

Muhtadie, L., Koslov, K., Akinola, M., & Mendes, W. B. (2015). Vagal flexibility: A physiological predictor of social sensitivity. *Journal of Personality and Social Psychology*, *109*, 106–120.

National Sleep Foundation. (2014). Sleep in America poll: Sleep in the modern family. Retrieved from the National Sleep Foundation website http://www.sleepfoundation.org/sleep-polls-data/sleep-in-america-poll/2014-sleep-in-the-modern-family

Prather, A. A., Bogdan, R., & Hariri, A. R. (2013). Impact of sleep quality on amygdala reactivity, negative affect, and perceived stress. *Psychosomatic Medicine*, *75*, 350–358.

Prather, A. A., Puterman, E., Epel, E. S., & Dhabhar, F. S. (2014). Poor sleep quality potentiates stress-induced cytokine reactivity in postmenopausal women with high visceral abdominal adiposity. *Brain, Behavior, and Immunity*, *35*, 155–162.

Rogojanski, J., Carney, C. E., & Monson, C. M. (2013). Interpersonal factors in insomnia: A model for integrating bed partners into cognitive behavioral therapy for insomnia. *Sleep Medicine Reviews*, *17*, 55–64.

Rusbult, C. E., & Van Lange, P. A. (2003). Interdependence, interaction, and relationships. *Annual Review of Psychology*, *54*, 351–375.

Strawbridge, W. J., Shema, S. J., & Roberts, R. E. (2004). Impact of spouses' sleep problems on partners. *Sleep*, *27*, 527–531.

Troxel, W. M. (2010). It's more than sex: Exploring the dyadic nature of sleep and implications for health. *Psychosomatic Medicine*, *72*, 578–586.

Troxel, W. M., Robles, T. F., Hall, M., & Buysse, D. J. (2007). Marital quality and the marital bed: Examining the covariation between relationship quality and sleep. *Sleep Medicine Reviews*, *11*, 389–404.

van der Helm, E, Gujar, N., & Walker, M. P. (2010). Sleep deprivation impairs the accurate recognition of human emotions. *Sleep*, *33*, 335–342.

Yoo, S. S., Gujar, N., Hu, P., Jolesz, F. A., & Walker, M. P. (2007). The human emotional brain without sleep—A prefrontal amygdala disconnect. *Current Biology, 17*, R877–R878.