



Work, Nonwork, and Sleep (WNS): a Review and Conceptual Framework

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Abstract

The current paper expands on traditional views of the work-nonwork interface to incorporate the critical component of sleep. We integrate past theoretical and empirical work from the sleep and organizational science literatures to inform a novel framework that will facilitate research evaluating associations among work, nonwork, and sleep, the three major areas of life. We propose that attitudes, behaviors, and states emerging in work and nonwork domains cannot be fully understood without taking into account upstream and downstream sleep quantity and quality effects. Rather, periods of sleep bookend engagement in work and nonwork roles. Thus, we propose the work, nonwork, and sleep (WNS) conceptual framework and, in doing so, identify specific, underlying resource mechanisms (i.e., human energy and time) operating both intra-individually and inter-individually. We also discuss contextual factors that act as predictors and moderators of these relationships. We suggest that a unifying framework explaining connections and underlying processes among work, nonwork, and sleep is necessary for applied psychology and management disciplines to significantly contribute to future research, intervention development and dissemination, and ultimately policy change. We provide a number of avenues for future investigation, including relevant special populations and methodological approaches. Although a plethora of work-nonwork theoretical frameworks exist, none have incorporated the third major area of life: sleep. We call for the expansion and acknowledgement of sleep, an important source of variance in everyday attitudes, behaviors, and states, and ultimately in long-term organizational, family, and individual health and well-being.

Keywords Work-nonwork interface · Work-family interface · Sleep · Resources · Theory

The intersection of work and sleep has become an increasingly important topic of investigation in the management and organizational psychology literature (e.g., Barnes, 2012; Basner, Spaeth, & Dinges, 2014). The Centers for Disease Control and Prevention estimate that approximately 83.6 million US adults

maintain less than 7 h of sleep per night (Liu et al., 2016). The federal government listed sleep health as a priority objective of their *Healthy People 2020* initiative and set a goal of increasing the proportion of adults who get sufficient sleep (i.e., at least 8 h for 18–21 year-olds and at least 7 h for individuals 22 and older) from 69.6 to 70.8%, a small improvement likely to result in large-scale implications. Adequate sleep is necessary for optimal day-to-day performance and functioning, in addition to the prevention of long-term chronic illness, mental health issues, and early mortality (Watson et al., 2015), outcomes that considerably affect our nation's workplaces, families, and overall well-being. Notably, organizational scholars have emphasized the need for public policy reform around sleep health (Barnes & Drake, 2015), future research to examine how workplace factors and sleep are ultimately bidirectionally related (e.g., Barnes, 2012; Crain et al., 2014; Mullins, Cortina, Drake, & Dalal, 2014), and future intervention work targeting upstream antecedents of sleep (e.g., Barnes, 2012; Crain et al., 2014).

One particularly promising area of investigation involves associations among work, nonwork, and sleep. A number of studies have consistently found relationships between work-family experiences and sleep outcomes (e.g., Barnes, Wagner,

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& Ghumman, 2012; Crain et al., 2014), in addition to work-nonwork experiences, more broadly, and sleep outcomes (e.g., Sonnentag, Binnewies, & Mojza, 2008). Indeed, work and nonwork (including family) are often prioritized over sleep, by both individuals and organizations alike (Barnes, Jiang, & Lepak, 2016). Although consensus recommendations indicate that a minimum of 7 h of sleep per night will result in optimal health and well-being (Watson et al., 2015), society tends to relegate sleep to a less important role when trying to balance work and nonwork demands (Barnes et al., 2012), which has deleterious short- and long-term consequences (e.g., Watson et al., 2015). However, it is important to clarify what we mean when we refer to *sleep*. We define sleep as having a two-part definition, in line with Barnes (2012). *Sleep quantity* represents the duration, or amount of time, an individual remains asleep, whereas *sleep quality* refers to how well one sleeps regardless of sleep duration. Sleep quality is typically measured by evaluating difficulty initiating sleep, maintaining a sleeping state throughout the night, and may also refer to the presence of wakefulness during the sleeping period (Barnes, 2012; Cappuccio, D'Elia, Strazzullo, & Miller, 2010; Harvey, Stinson, Whitaker, Moskowitz, & Virk, 2008; Olson et al., 2015).

The primary objective of this paper is to review and integrate the sleep and work-nonwork literatures in order to develop a more holistic understanding of processes connecting the three major areas of life. Despite the plethora of work-nonwork theories (e.g., Edwards & Rothbard, 2000; ten Brummelhuis & Bakker, 2012) and the extensive work-

nonwork literature (e.g., Allen & Martin, 2017), very little of this research considered the role of sleep quality and quantity. A unifying framework explaining connections and underlying processes among work, nonwork, and sleep is necessary to significantly contribute to future research, intervention development and dissemination, and ultimately policy change to improve worker well-being. Thus, we propose the comprehensive work, nonwork, and sleep (WNS) framework (see Fig. 1) to address this gap. We suggest that sleep quality and quantity influence work and nonwork, which then influence subsequent sleep quality and quantity via energy and time resources.

Novel Contributions of the WNS Framework

Periods of sleep act as bookends to work and nonwork domains. Work experiences, nonwork experiences, and interactions among the two areas of life are affected by prior sleep and subsequently affect future sleep (e.g., Barnes et al., 2012; Jacobsen et al., 2014; Williams, Franche, Ibrahim, Mustard, & Layton, 2006). However, this serial dependency among the three areas of life has rarely been conceptualized or evaluated within work-nonwork research. The majority of existing studies have investigated conflict or enrichment of the work and nonwork domains in isolation rather than in an integrated framework (c.f., Byron, 2005; McNall, Nicklin, & Masuda, 2010). Previous work-nonwork research has been ignoring

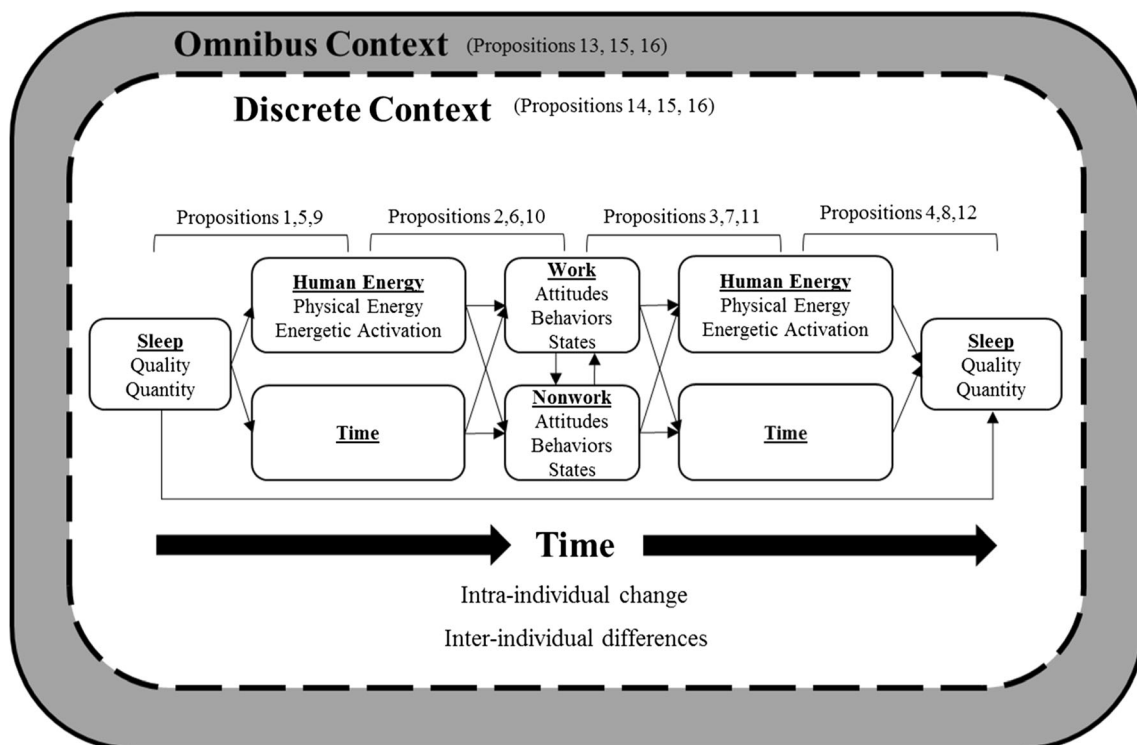


Fig. 1 Conceptual model of the work, nonwork, and sleep (WNS) framework

sleep as a significant source of variance in individuals' behavior in both the work and nonwork domains, while also failing to account for subsequent downstream effects on later sleep, an important determinant of optimal functioning, health, and well-being. We refer the reader at this point to Fig. 1. Conceptually, the majority of work-nonwork research to date has focused on relationships and processes within the limited middle portion of this figure, or how work and nonwork attitudes, behaviors, and states are connected. Thus, we expand on our understanding of these phenomena by incorporating upstream and downstream sleep quality and quantity, while also considering specific resources that link sleep to the work-nonwork nexus.

The vast sleep literature indicates that the amount and quality of sleep we obtain fundamentally influences our everyday behavior and experiences. For example, prior research has clearly established links exist between lack of sleep and negative emotion (e.g., van der Helm & Walker, 2009), perceptions of stress (e.g., Minkel et al., 2012), and decreased functioning on a variety of cognitive tasks, including attention, vigilance, and working memory (e.g., Lim & Dinges, 2010). Thus, at a basic level, effects of inadequate and insufficient sleep permeate behavioral processes, regardless of whether one is working or not, interacting with others, or operating in isolation. Our everyday experiences in turn also impact our ability to obtain quality sleep in optimal amounts. For example, strain from work and home have both been linked with detrimental sleep outcomes (e.g., Cropley, Dijk, & Stanley, 2006; Naseri-moaddeli, Sekine, Hamanishi, & Kagamimori, 2002; Troxel, Robles, Hall, & Buysse, 2007), whereas time spent working and engaging in leisure activities are also reciprocally related to time spent sleeping (Basner et al., 2014).

Among the studies that have investigated sleep in relation to work or nonwork, few have considered specific, underlying mechanisms by which sleep affects other nonwork domains or is affected by the nonwork domains. Based on Quinn, Spreitzer, and Lam (2012) discussion of human energy as a resource within organizations, we posit that work, nonwork, and sleep are ultimately connected via fluctuations in two specific types of human energy: physical energy and energetic activation. Furthermore, time has often been noted as an important resource in both general stress theories and work-family theories (e.g., Halbesleben, Neveu, Paustian-Underdahl, & Westman, 2014; ten Brummelhuis & Bakker, 2012) and work time is the primary life activity exchanged for sleep time (Basner et al., 2007, 2014). As such, we suggest that finite time resources that could be allocated to work or nonwork are lost when sleeping and this loss should affect work and life attitudes, behaviors, and states. We then make specific predictions regarding the relationships between work, nonwork, and

sleep both within and between people (i.e., both inter-individually and intra-individually). Specifying the nature of such processes is necessary for the development of future research and consequently the refinement of theory that fully explains the interconnectedness among work, nonwork, and sleep. From a practical standpoint, future research that finds empirical support for such mechanisms will be critical for intervention research. Understanding intervention targets and downstream processes is necessary for accurate design and evaluation of effective programs and policies (Kossek, Hammer, Kelly, & Moen, 2014).

Work, Nonwork, and Sleep Constructs: Prior Research

Among the potential mechanisms that can influence sleep outcomes, we emphasize social and environmental factors in the WNS framework. Prior research in the sleep, neuroscience, and chronobiology literatures has demonstrated an endogenous two-process model of sleep regulation, in which homeostatic and circadian processes interact to predict sleep. The homeostatic process, also known as “sleep drive,” describes that the propensity to sleep increases throughout the day and decreases during periods of sleep, whereas the circadian process relies on diurnal circadian rhythms (i.e., the “biological clock”) that influence the propensity to sleep depending on the time of day (e.g., Borbély, Daan, Wirz-Justice, & Deboer, 2016). We expand on this basic physiological and biological understanding of sleep by considering exogenous social and environmental factors in the WNS framework. For instance, although the need for sleep is foundational to human physiology, individuals often intentionally restrict sleep in order to accommodate other life demands, namely work and nonwork activities.

A number of studies have begun to investigate associations among work, nonwork, and sleep quality and quantity. Below, we review the literature and classify past research into three categories: (a) studies that have taken a *negative* perspective by incorporating work-nonwork variables that encompass the conflict or spillover between domains in relation to sleep outcomes, (b) studies that have taken a *positive* perspective by incorporating work-nonwork variables that encompass the enrichment or spillover between domains in relation to sleep outcomes, and (c) studies that have evaluated the relations between separate work variables, nonwork variables, and sleep variables, rather than work-nonwork measures (i.e., work-family conflict and spillover) that assume connectedness between domains. This last category represents those studies that are most in line with the propositions of the WNS framework.

Negative Work-Nonwork and Sleep Perspective

The majority of work-nonwork research to date that has incorporated sleep has focused on work-family conflict, a form of interrole tension that arises when the demands of work and family life are incompatible (Greenhaus & Beutell, 1985). Work-family conflict is bidirectional, and previous theory suggested that conflict can be time-, strain-, or behavior-based (Edwards & Rothbard, 2000). Additionally, a few studies evaluated negative spillover, or the transferring of mood, skills, behavior, and values from the family domain to work domain or vice versa (Edwards & Rothbard, 2000). This work-family conflict and negative spillover research has primarily conceptualized sleep quality and quantity as outcome variables.

Work-Family Conflict and Sleep Quality Work-to-family and family-to-work conflict have been negatively and concurrently associated with self-reported sleep quality (Nylén, Melin, & Laflamme, 2007; Sekine, Chandola, Martikainen, Marmot, & Kagamimori, 2006) and sleep complaints (Lallukka, Rahkonen, Lahelma, & Arber, 2010). A study by Crain et al. (2014) similarly indicated positive associations among measures of work-family conflict and self-reported sleep insufficiency and insomnia symptoms. Building from this cross-sectional work, Jacobsen et al. (2014) found both a positive association between work-to-family conflict and sleep insufficiency cross-sectionally as well as longitudinally over a 2-year time lag. Further, negative work-to-family and family-to-work spillover predicts insomnia longitudinally over 2 years (Vedaa et al., 2016). Other longitudinal research indicated that work-to-family and family-to-work conflict predicts women's use of sleep medication 5 years later (Lallukka et al., 2013). In a unique mediation study, Mäkelä, Bergbom, Tanskanen, and Kinnunen (2014) found that baseline work-family conflict acted as a mediator of the relationship between baseline business travel and sleep problems at a one-year follow-up. In comparison to these cross-sectional and longitudinal studies, Van Hooff, Geurts, Kompier, and Taris (2006) found that global work-family conflict is positively related to daily sleep complaints inter-individually.

Work-Family Conflict and Sleep Quantity In addition to sleep quality, sleep quantity has also been investigated in relation to work-family conflict, albeit less frequently. For example, prior research has found cross-sectional associations between work-family conflict and self-reported measures of sleep duration (Crain et al., 2014; Jacobsen et al., 2014), in addition to objective actigraphic measures of total sleep time (Crain et al., 2014). Moreover, Berkman et al. (2015) reported that family-to-work conflict is negatively associated with objective actigraphic total sleep time, whereas work-to-family conflict is positively associated with total sleep time. In contrast, Britt and Dawson (2005) conceptualized self-reported sleep

duration as an antecedent of work-family conflict, yet found a negative cross-sectional association with work-to-family conflict.

Positive Work-Nonwork and Sleep Perspective

In comparison to the negative work-nonwork research, very few studies have examined a work-nonwork positive spillover perspective, or the beneficial transfer of mood, skills, behavior, and values from family to work or work to family (Edwards & Rothbard, 2000), in relation to sleep. Williams and colleagues (Williams et al., 2006) found a positive association between positive family-to-work spillover and self-reported sleep quality. In contrast, Vedaa et al. (2016) found that positive work-to-family spillover predicted fewer self-reported symptoms of insomnia over a 2-year period. Thus, our understanding of sleep in relation to positive work-nonwork experiences is limited.

Work, Nonwork, and Sleep Perspective

Fewer studies to date have investigated separate work, nonwork, and sleep constructs in relation to one another. In one of the few studies to utilize such a conceptualization, Barnes et al. (2012) evaluated associations among work, family, and sleep time. Inter-individual results showed a negative, nonlinear relationship between work time and sleep time, and between family time and sleep time, such that stronger relationships were seen at high levels of work time rather than low levels of work time. The negative, nonlinear relationship between work time and sleep time was also replicated intra-individually. Furthermore, inter-individual and intra-individual results indicated a significant interaction between family time and work time on sleep time, such that the lowest levels of sleep time were found under conditions of high work and family time. Other research conducted by Geiger-Brown, Trinkoff, and Rogers (2011) found that adverse work schedules (i.e., shiftwork, night shiftwork, quick returns to work, mandatory overtime or on-call work, long work hours, weekend work) are negatively associated with sleep duration and quality and that this association does not change when accounting for home demands (i.e., caregiving roles, hours per week spent on housework, childcare, or chores).

Summary Taken together, these studies have demonstrated that work, nonwork, and sleep are interrelated. Although the majority of research has utilized work-family conflict or spillover measures, some research has examined sleep in relation to work variables or family variables separately (e.g., Kurumatani et al., 1994). In line with this last set of studies, we separate work, nonwork, and sleep as distinct but interrelated constructs, rather than using conflict or spillover. Taking this approach will further allow for the identification of the

specific mechanisms that connect work, nonwork, and sleep, and better explicate the processes involved.

Work, Nonwork, and Sleep Framework

Theoretical Background

Work-nonwork scholars have used a number of different theoretical perspectives to explain previously hypothesized associations among work, nonwork, and sleep constructs. These have included Hobfoll's (1989) conservation of resources theory (e.g., Crain et al., 2014; Jacobsen et al., 2014), Edwards and Rothbard's (2000) scarcity theory, and George's (2005) conceptualization of slack resources (e.g., Barnes et al., 2012), in addition to Meijman and Mulder's (1998) effort recovery model (e.g., Vedaa et al., 2016; Williams et al., 2006). Other work has specifically drawn upon Karasek's (1979) job demand-control model and Johnson and Hall's (1988) job demand-control-support model or Demerouti, Bakker, de Jonge, Janssen, and Schaufeli (2001) job demands-resources model (e.g., Mäkelä et al., 2014; Sekine et al., 2006), proposing a relationship among work characteristics, work-family conflict, and sleep.

Thus, theoretical perspectives represented in the sleep, nonwork, and work literature are numerous and diverse, with different, fairly broad theories being used to argue for the same relationships. Furthermore, none of these different theories explicitly address sleep as either an antecedent or outcome, but rather make general predictions regarding stressor-strain relationships or fluctuations in broadly-defined resources. As such, scholars interested in work, nonwork, and sleep relationships have been loosely applying theories or piecing together separate theories in an attempt to provide a theoretical rationale for their proposed relationships. We, like others (e.g., Ganster & Rosen, 2013), posit that such general theoretical application results in a limited ability to falsify a theory, and as such, a very general understanding of phenomena, rather than a thorough, detailed understanding of phenomena. In order to advance theory and empirical research regarding work, nonwork, and sleep, an overarching framework that explains how the specific areas of work, nonwork, and sleep interact to affect workers' behavior and outcomes is warranted.

Other theoretical work in the organizational sciences has investigated sleep, but has yet to explicitly and sufficiently include the role of the nonwork domain (e.g., Barnes, 2012; Mullins et al., 2014). Again, as a result, theory is often roughly applied, and thus specific predictions are difficult to accurately generate from the theoretical rationales ignoring the nonwork domain, resulting in work, nonwork, and sleep research potentially taking on more of an exploratory or inductive approach. Given that foundational relationships among these

variables have now been established, there is a strong need for a framework that specifically addresses associations among these constructs and the mechanisms involved with these processes.

The Central Role of Human Energy and Time Resources

Despite the numerous distinct theories used in previous work-nonwork-sleep research, there is one commonality: resources play a central role in linking these three areas of life. Resources broadly can be thought of as "anything that allows an actor to enact a schema" (Feldman & Worline, 2011, pp. 630), and Quinn et al. (2012, pp. 345) define schema as "a cognitive framework that people use to organize their understanding of a situation." A resource (i.e., sleep) can generate additional resources (i.e., energy and time). However, a common criticism of prominent resource theories, such as COR theory, is that definitions of resources tend to be broad and vague, such that almost anything may be considered a resource (e.g., Ganster & Rosen, 2013; Halbesleben et al., 2014). We address this limitation of the past literature by focusing on two types of specific resources, namely human energy and time, which are most relevant to work, nonwork, and sleep interactions.

Various lists, categories, and taxonomies of resources have been proposed by a number of stress theorists (e.g., Halbesleben et al., 2014; ten Brummelhuis & Bakker, 2012; Hobfoll, 1989). As previously mentioned, this leaves researchers with an all-inclusive and generic understanding of what could be considered a resource. Because our framework is specifically focused on resources that are generated by sleep, there is a need to identify and put forward specific resources that fluctuate in response to varying levels of sleep quality and quantity. Moreover, we are interested in resources that result fairly quickly and are necessarily proximal to sleep.

As we reviewed the numerous resources proposed by stress scholars, we first engaged in a process of elimination to determine which proposed resources *do not* theoretically vary in direct response to sleep. These primarily fell into the categories of macro resources (e.g., culture, policies), objects (e.g., owning a home), conditions (e.g., employment status, marital status), personal resources (e.g., experience, self-efficacy), and contextual constructive resources (e.g., rewards, autonomy, social support). Now, it is important to note that sleep may influence subsequent processes that in turn result in these resources more distally. Additionally, these resources may have an influence associations among work, nonwork, and sleep as higher-level contextual resources, which we discuss later in this paper. However, in trying to identify only those resources that directly result from sleep (i.e., mechanisms connecting sleep with work and nonwork), we were then left with the resource category that has generally been referred to as

“energies.” Theorists have defined this category as resources that are proximate to the self and somewhat fleeting (e.g., ten Brummelhuis & Bakker, 2012). These energies can be additionally thought of as resources that once used, cannot be used at a later point in time or for other purposes.

Of those energies that have been proposed, including for example, mood, physical energy, cognitive energy, time, and recovery experiences (e.g., Halbesleben et al., 2014; ten Brummelhuis & Bakker, 2012), we see physical and cognitive energy, mood, and time as being those relevant and foundational resources that should fluctuate in response to sleep, while also affecting later sleep. These energies have been more recently considered by Quinn et al. (2012) as subsumed under the umbrella category of *human energy resources*.

Human Energy Resources We conceptualize human energy as a specific type of resource that uniquely affects and is affected by sleep. Thus, we borrow from Quinn et al.’s (2012) hierarchical taxonomy of energy resource constructs to inform our model. Quinn et al. synthesize existing energy literatures and determine that there are two primary types of human energy, including physical energy and energetic activation. We propose that sleep quality and sleep quantity can be characterized as resources that generate the subsequent resources of human energy and energetic activation. Although Quinn et al.’s taxonomy of energy resource constructs helps to inform our framework, their larger proposed model, which is largely based on motivational principles and explains the micro-dynamics of resource fluctuation in organizational members, is less relevant to our framework. Our framework is broader, providing propositions for resource fluctuation across the areas of work, nonwork, and sleep. However, we suggest that such micro-processes of resource fluctuation proposed by Quinn et al. could be incorporated into future work in this area (see Table 1).

Thus, we describe next how Quinn et al.’s taxonomy informs the present framework. The first type of human energy is *physical energy*, which refers to “the capacity to do work,” with work representing the process by which an object changes position as a result of force being applied. Physical energy can be utilized through volitional acts (e.g., conscious thought or movement) or through the non-volitional functioning of bodily systems (e.g., breathing) and unconscious or automatic responses to environmental stimuli. Physical energy can be further classified as either potential energy (i.e., energy stored as glucose or adenosine triphosphate in the body for future use) or kinetic energy (i.e., energy possessed by an object in motion). Yet, as Quinn et al. pointed out, physical energy can generally be measured using self-report means in the organizational sciences. Within the sleep literature, a lack of physical energy is referred to as fatigue, or “a physiological state of reduced mental or physical performance capability” and can

result from a lack of sleep (Gander et al., 2017, p. 698). Regarding the temporal nature of the construct, Ricci, Chee, Lorandean, and Berger (2007) characterized fatigue as occurring along a continuum, as it can arise acutely in response to specific situations or can occur more pervasively and last over longer periods of time. Thus, we argue that physical energy (or its antithesis, fatigue) can vary *intra-individually* (i.e., variability within-people over time) and *inter-individually* (i.e., differences between people). For example, individuals may experience intra-individual change with low physical energy in the evening occurring from a particularly long work shift (i.e., within-person effect), whereas inter-individual variability may occur when some people have less physical energy on average than others (i.e., between-person effect).

The second type of human energy, *energetic activation*, represents feelings of “vitality, vigor, or enthusiasm” (Quinn et al., 2012, p. 342). In contrast to physical energy, energetic activation is not a physiological state related to human performance capability, but instead one’s perception that they are energized. Quinn et al. explained that energetic activation may take on multiple affective forms, including emotions that are fairly brief and have a particular target like a person or experience, moods that are longer-lasting and more diffuse, or dispositions that are more stable over time and represent individual’s typical energetic tendencies. Similarly, Barsade and Gibson (2007) distinguished between feeling states (i.e., discrete emotions and moods) and feeling traits (i.e., dispositional affect), which can be represented with an affective circumplex graph. Within this circular figure, there exists an x-axis, moving from low pleasantness to high pleasantness, and a y-axis, ranging from low energy to high energy. Moods can be captured with the pleasantness dimension, and dispositional affect can be assessed with either trait pleasantness or as positive affectivity and negative affectivity, a combination of pleasantness and energy dimensions (Watson, Clark, & Tellegen, 1988). Discrete emotions can be measured with a number of primary emotional constructs (e.g., joy, anger, fear) and are placed around the circumplex according to their characteristic pleasantness and energy. Drawing on the affective literature, we propose that variability in emotions can be measured intra-individually (i.e., within-day or day-to-day), whereas moods can be measured either intra-individually (i.e., day-to-day or week-to-week) or inter-individually, and dispositions inter-individually.

Time Resources Time has often been noted as an important resource in both general stress theories and work-family theories (e.g., Greenhaus & Beutell, 1985; Halbesleben et al., 2014; ten Brummelhuis & Bakker, 2012). Furthermore, work-family scholars have identified time-based conflict to be one of the three primary dimensions of work-family conflict, aside from strain-based and behavior-based conflict (e.g., Carlson, Kacmar, Wayne, & Grzywacz, 2006; Netemeyer,

Boles, & McMurrian, 1996). Robinson and Godbey (2010) defined time as being finite and having a zero-sum property, meaning that time spent sleeping cannot then be allocated to work or nonwork, and similarly, time spent doing work or nonwork activities, cannot then be spent sleeping. Intra-individually, 24 h in any given day is divided among the three areas of work, nonwork, and sleep. Inter-individually, time on average is also divided among work, nonwork, and sleep over the course of weeks, months, and even years. Given past research indicating that time is borrowed from sleep to accommodate work and family both intra-individually and inter-individually (e.g., Barnes et al., 2012), in addition to findings from nationally representative samples indicating that work time is the primary life activity exchanged for sleep time (e.g., Basner et al., 2007, 2014), we propose that time is a major resource that should be considered when evaluating the interplay among work, nonwork, and sleep.

Assumptions Underlying the WNS Framework

Now that we have defined human energy and time and before specifying our propositions, it is important to orient the reader to the framework and note a couple assumptions (see Fig. 1). We suggest sleep affects attitudes, behaviors, and states at work and nonwork, while work and nonwork attitudes, behaviors, and states affect sleep, through resource mechanisms. We define *attitudes* as an evaluation of a psychological object (e.g., person, event, etc.) based on beliefs, feelings, or past behavior (Byrne, 2015); *behaviors* as the volitional actions someone takes (e.g., performance); and *states* as psychological conditions someone experiences at a given time (e.g., motivation, burnout).

The Role of Time The first important underlying assumption of the WNS framework is that relationships among work, nonwork, and sleep unfold over time. Sleep is captured as both an antecedent and an outcome in Fig. 1 because work, nonwork, and sleep represent periods of activity through which individuals move over the course of their day and across days, months, and years. We use single-headed arrows in Fig. 1 and employ causal language throughout the remainder of the article to indicate the temporal nature of our propositions. Thus, our framework is not meant to represent correlational relationships or co-occurrences among constructs, but rather true causal processes that develop and unfold over time.

A key defining feature of the WNS framework is its applicability to studying both inter-individual differences and intra-individual change (for a review see Bolger, Davis, & Rafaeli, 2003). Inter-individual investigations influenced by the WNS framework might include, for example, researching whether people who have higher sleep quality on average also experience increases in physical energy and subsequently more work motivation. Inter-individual designs in this context

require time lags of weeks, months, or years. In contrast, intra-individual investigations, for example, might include whether individuals experience more physical energy on days following nights of good sleep quality, and subsequently, increased motivation that day. Intra-individual designs then require repeated sampling within day or over the course of days.

When designing studies to test the WNS framework, researchers should consider the appropriate time frame and whether the constructs of interest are best modeled at the inter-individual level, intra-individual level, or both. Although the framework, constructs, and relationships are generally applicable to both levels, two primary caveats exist. Regarding resource mechanisms, energetic activation can exist at both levels, but we argue that dispositions are most relevant to inter-individual research questions given their fairly stable existence, whereas moods may be relevant to either inter-individual or intra-individual research questions, and emotions are mostly relevant to intra-individual research questions, given they are brief and have a particular target. For a more thorough discussion of these affective constructs and their appropriateness at each level, see Ashkanasy and Dorris (2017). Second, work and nonwork attitudes, behaviors, and states can be relevant to either inter-individual or intra-individual research questions, but attitudes in most cases are likely most appropriate to be considered within an inter-individual framework, given that they tend to be more enduring, are characteristic of a disposition towards a person, situation, or object, and thus less subject to variation from day-to-day (Schleicher, Hansen, & Fox, 2011). However, we acknowledge that some studies have examined intra-individual variability in attitudes like job satisfaction. See Judge, Weiss, Kammeyer-Mueller, and Hulin (2017) for a thorough review.

Flexible and Permeable Boundaries The second important underlying assumption of the WNS framework is related to changes in the nature of work. Given increases in flexible scheduling, telework, and technology, we suggest that most individuals do not travel through these the three areas of life in a perfectly linear fashion (i.e., from sleep to nonwork to work to nonwork and back to sleep again) within a 24-h period. Consistent with the boundary management literature (e.g., Ashforth, Kreiner, & Fugate, 2000), we suggest that work, nonwork, and sleep boundaries can be *flexible* in that individual activities in each area do not necessarily have to be tied to a specific time or place (e.g., sleep only at home, work only at the office). Furthermore, work, nonwork, and sleep boundaries can also be *permeable* such that a given area can be interrupted by people and activities from other areas (e.g., an unexpected nonwork call at work, an intentional nap taken during a work break). Because this sequencing of work, nonwork, and sleep may be variable depending on the individual, their family situation, occupation, organizational culture, and other factors.

Sleep Quantity Versus Sleep Quality As previously mentioned, we also consider sleep quality separately from sleep quantity. Prior research suggests that sleep quality and quantity are empirically distinct constructs, with bivariate correlations among different measures of sleep quality and sleep quantity ranging in size from ± 0.07 – 0.18 (Barnes, Schaubroeck, Huth, & Ghumman, 2011; Crain et al., 2014). Barnes (2012) theorized that sleep quality and sleep quantity, although distinct, have similar effects on outcomes that are additive in nature. We also suggest that it is important for sleep research within the organizational sciences to use measures of *both* constructs because different antecedents are theoretically likely to influence quality and quantity to varying degrees. For example, although time spent at work and leisure activities has often been investigated as an antecedent of quantity (Basner et al., 2014), stress, rumination, and emotional reactivity have often been investigated in relation to quality (e.g., Baglioni, Spiegelhalder, Lombardo, & Riemann, 2010; Zoccola, Dickerson, & Lam, 2009). Thus, mechanisms influencing sleep outcomes are likely unique depending on the sleep construct of interest.

We argue that both sleep quantity and quality are critical to resource mechanisms. For example, although it is necessary to obtain sufficient amounts of sleep, if a 7- to 9-h period of sleep is interrupted by frequent awakenings, this should inhibit the generation of human energy resources the following day. On the other hand, if someone has high quality sleep, but only slept for 3 h in a 24-h period, this should also prevent sufficient resource generation. The importance of both sleep quantity and sleep quality has been demonstrated in Uehli et al.'s (2014) meta-analysis, which provided evidence that both sleep quantity and quality influence the rate of work injuries. As Barnes et al. (2011) and others have pointed out, most prior research in this area has seldom included both sleep quantity and sleep quality simultaneously in studies, which makes it challenging to disentangle which construct is more essential. Although prior work has emphasized sleep quality over sleep quantity, we recommend studying both sleep quantity and sleep quality to fully understand their relevance to physical energy and energetic activation resources, and under which conditions one construct has stronger effects than the other.

Human Energy and Time as Resource Mechanisms Connecting Work, Nonwork, and Sleep

Human Energy In the following sections, we provide a rationale for the role of two types of human energy—physical energy and energetic activation—within the WNS framework.

Physical Energy Resource Mechanism As seen in Fig. 1, we propose that sleep influences physical energy inter-individually and intra-individually. Both theory and basic empirical research about sleep provide evidence for the role of

sleep in conserving and promoting physical energy. Past sleep literature (e.g., Berger & Phillips, 1995; Jung et al., 2011) suggested that sleep serves to limit the energy resources utilized over the course of a 24-h period, whereas more recent theorists have significantly extended these ideas with the notion that limited energy resources are also allocated to important biological functions during sleep, such as development or growth, maintenance of physiological systems, and reproduction (e.g., Schmidt, 2014) and wake, such as regulation of endocrine and immune responses (e.g., Banks & Dinges, 2007). However, our review focuses less on these biological consequences and instead on attitudes, behaviors, and states in the work and nonwork domains.

Individuals who obtain sufficient and adequate sleep quantity and quality are more likely to possess enough physical energy for waking physical and cognitive activities, which could take place in either the work or nonwork domains. Regarding the influence of physical energy on work and nonwork attitudes, Myles' (1985) study found that sleep-deprived individuals engaging in bouts of exercise perceived greater exercise intensity than individuals who were rested, suggesting that sleepy individuals are more likely to perceive their work or nonwork (e.g., exercise, housework) activities to be more physically demanding and less enjoyable. Concerning work and nonwork behaviors, other studies with athletes indicate that sleep is positively associated with athletic performance both intra-individually and inter-individually (Fullagar et al., 2015; Mah, Mah, Kezirian, & Dement, 2011; Reilly & Edwards, 2007; Skein, Duffield, Edge, Short, & Münder, 2011). We suggest that these results can be generalized to individuals engaging in physical jobs (e.g., construction workers, firefighters, nurses) and physical nonwork activities (e.g., sports, caregiving). Additional performance studies indicate that individuals with insufficient sleep are more likely to engage in presenteeism and absenteeism, as well (e.g., Swanson et al., 2011), which can be explained by a lack of physical energy. Basic research studies that have found effects of sleep deprivation and sleep restriction on decrements in simple attention, complex attention, processing speed, working memory, and short-term memory inter-individually and intra-individually (e.g., Banks & Dinges, 2007; Lim & Dinges, 2010) are in line with organizational studies and theory linking sleep restriction with job performance and productivity (e.g., Barnes & Hollenbeck, 2009; Kuppermann et al., 1995; Rosekind et al., 2010). Further, a large literature exists providing evidence for increased work and nonwork accidents and injuries under conditions of less sleep (e.g., Leger et al., 2014; Watson et al., 2015). Lastly, consistent with Quinn et al. (2012), we propose that sleep loss could be linked with states like burnout and/or engagement at work or at home through a physical energy mechanism, given that

conceptualizations of burnout have included a physical fatigue component (e.g., Shirom, 2011), and engagement conceptualizations have included a vigor component (e.g., Schaufeli, Salanova, González-Romá, & Bakker, 2002).

Proposition 1: Sleep quality and quantity positively influence physical energy.

Proposition 2: Physical energy positively influences work and nonwork attitudes, behaviors, and states.

We also propose that work and nonwork attitudes, behaviors, and states can lead to increases or decreases in physical energy resources that can, in turn, impact sleep quality and quantity (see Fig. 1). Our review of the literature indicates that this mechanism of physical energy is rather complex and depends on whether individuals are (a) engaging in behaviors at work or home that lead to physiological arousal that could impair sleep or (b) engaging in physical activity specifically that could either impair or promote sleep.

Regarding the first situation, sleep scholars have theorized that cognitive hyperarousal facilitates the presence of disturbances during sleep and difficulty initiating sleep (e.g., Baglioni et al., 2010). We borrow from Watkins' (2008) discussion and definition of constructive and unconstructive repetitive thought, or the positive or negative thinking about oneself, their experiences, and/or the larger environment both attentively and repeatedly over time. We propose that work and nonwork attitudes, behaviors, and states can influence constructive and unconstructive repetitive thought, which in turn should negatively affect sleep quality and quantity if this cognitive process is engaged in close to bedtime. Some workplace research has found a link between work-related rumination and problem-solving pondering and sleep inter-individually (e.g., Querstret & Cropley, 2012). Further, Syrek, Weigelt, Peifer, and Antoni (2017) found that affective rumination mediates the link between unfinished work tasks and sleep impairment, both inter-individually and intra-individually.

Physiological arousal may also result from engaging with technology close to bedtime, given the harmful exposure to bright light that can delay circadian rhythms, in addition to the potentially physically arousing nature of technology use (e.g., Cain & Gradisar, 2010). In general, previous studies found a link between work and nonwork-related technology use, telepressure, and impaired sleep (e.g., Barber & Santuzzi, 2015; Schieman & Young, 2013), whereas recent research by Gradisar et al. (2013) found a more specific relationship between interactive technology (e.g., using computers) that is not found with more passive types of technology (e.g., television viewing). What is notable is that the majority of these studies related to technology use in the organizational literature

have been focused on inter-individual differences rather than intra-individual change.

Concerning the second scenario we mention above related to physical activity rather than physiological arousal, some research has found a relationship between physical demands at work and short sleep inter-individually (e.g., Trinkoff, Storr, & Lipscomb, 2001), and research with professional and Olympic athletes suggests that they experience poorer sleep quality compared to control individuals (e.g., Leeder, Glaister, Pizzoferrero, Dawson, & Pedlar, 2012). This seems to be in line with conclusions from Driver and Taylor (2000) that moderate exercise can be beneficial for sleep, while exhaustive exercise can be detrimental for sleep. We suggest that these results likely generalize to high intensity physically demanding jobs and home lives.

Proposition 3: Work and nonwork attitudes, behaviors, and states positively influence physical energy.

Proposition 4: Physical energy in turn influences sleep quality and quantity.

In summary, given propositions 1–4, we argue that physical energy acts as a mediator through which sleep affects work and nonwork attitudes, behaviors, and states, as sleep serves to generate physical energy that can then be put towards activities and efforts in both the work and nonwork domains. Furthermore, physical energy acts as a mediator through which work and nonwork attitudes behaviors, and states affect subsequent sleep. Engagement in work and nonwork roles depletes physical energy that promotes one's need for sleep, but this relationship may be rather complex with intense physical efforts potentially disrupting sleep. Additionally, engagement in work and nonwork roles may also facilitate physiological arousal that impairs subsequent sleep. We turn now to a discussion of the second human energy resource mechanism, energetic activation.

Energetic Activation Resource Mechanism As seen in Fig. 1, we propose that sleep influences energetic activation inter-individually (i.e., dispositions, moods) and intra-individually (i.e., moods, emotions). Past research supports the role of sleep in generating positive affective resources (Baglioni et al., 2010; Barnes, 2012; Mullins et al., 2014), and organizational scholars have theorized that sleep influences workplace outcomes through an affective mechanism (Barnes, 2012; Mullins et al., 2014). For example, sleep loss has been found to predict heightened emotional reactions to disruptive work events the following day (Zohar, Tzischinsky, Epstein, & Lavie, 2005). Our review of the literature indicates that job satisfaction is the primary work attitude that has been evaluated in relation to sleep quality and quantity at the inter-individual level, although affect has rarely been investigated as a mechanism (e.g., Karagozoglu & Bingöl, 2008; Yoon, Kook, Lee, Shin, & Kim, 1999). Other relevant workplace

behaviors that should be influenced by the generation of sleep-related positive affective resources include performance, creativity, helping behaviors, and fewer withdrawal behaviors (e.g., Brief & Weiss, 2002). A series of studies has begun to examine inter-individual and intra-individual associations between lack of sleep and unethical behavior that has been theorized to be linked through an affective mechanism (Barber & Budnick, 2016; Barber & Budnick, 2015; Barnes et al., 2011; Christian & Ellis, 2011). Relevant work states include goal orientation and motivation, as well as engagement (Barber, Grawitch, & Munz, 2012).

In addition to workplace behaviors, sleep quality and quantity have been shown to be related to a number of nonwork attitudes, behaviors, and states that should also be influenced through an affective mechanism. These include intra-individual life satisfaction (e.g., Paunio et al., 2009) and relationship satisfaction (Insana, Costello, & Montgomery-Downs, 2011). Friedman et al. (2005) also find that individuals with poorer sleep experience fewer positive interactions with others in general on average, while other studies find that, within couples, sleep is associated with relationship functioning (Hasler & Troxel, 2010).

Proposition 5: Sleep quality and quantity positively influence energetic activation.

Proposition 6: Energetic activation positively influences work and nonwork attitudes, behaviors, and states.

Energetic activation can also result from work and nonwork attitudes, behaviors, and states, as they can serve as a signal to individuals about their current state, thereby eliciting an affective reaction. Previous theory and research has made a case for the link between work and home attitudes, behaviors, states, and resulting affect. For example, Judge, Thoresen, Bono, and Patton (2001) theorized that job satisfaction predicts subsequent positive mood and Judge and Ilies (2004) relatedly found that daily job satisfaction influences subsequent positive mood at home. Similarly, Lyubomirsky, King, and Diener (2005) note that although there is substantial evidence for positive emotions leading to successful behavioral outcomes at both work and home (e.g., task performance, helping behaviors, communication), the traditional conceptualization has been that individuals who are more successful at work and outside of work in turn experience more positive emotions. Other research from the sleep field acknowledges the bidirectional nature between sleep disturbance and emotional outcomes (e.g., Baglioni et al., 2010), thereby indicating that work and nonwork attitudes, behaviors, and states that result in positive or negative affect can influence sleep quality and quantity.

Proposition 7: Work and nonwork attitudes, behaviors, and states positively influence energetic activation.

Proposition 8: Energetic activation positively influences sleep quality and quantity.

Given propositions 5–8, we conclude that energetic activation acts as a mediator through which sleep affects work and nonwork attitudes, behaviors, and states, as sleep serves to promote affective perceptions of energy, which in turn influence work and nonwork attitudes, behaviors, and states. Energetic activation also acts as a mediator through which work and nonwork attitudes behaviors, and states affect subsequent sleep. Positive attitudes, behaviors, and states in the work and nonwork domains can generate affective perceptions of feeling energized, which can either disrupt sleep or promote sleep. In the next section, we discuss the second primary resource mechanism of time.

Time Resource Mechanism In Fig. 1, we include time as a major resource mechanism affected by and affecting sleep. We suggest that time is most relevant to sleep quantity, rather than sleep quality. Finite time resources that could be allocated to work or nonwork are lost when engaging in the sleep domain and this loss should negatively affect work and nonwork attitudes, behaviors, and states. Conversely, however, obtaining adequate sleep quality and quantity is related to a host of positive neurobehavioral outcomes (e.g., Banks & Dinges, 2007), and so allocating time to sleep can result in increases in efficiency, productivity, and performance even if less time is allocated to actual work and nonwork activities. Thus, the relationship between sleep and time is complex. Regarding specific work attitudes, for example, individuals who spend more time sleeping may experience greater time pressure at work, and time pressure has been negatively related to job satisfaction (e.g., Linzer et al., 2000). However, time pressure and urgency at work are considered to be challenge stressors, which generally have positive effects on performance through decreased strains and increased motivation (e.g., LePine, Podsakoff, & LePine, 2005). Similarly, daily time pressure has been associated with increased work engagement, under conditions of high job control (Kühnel, Sonnentag, & Bledow, 2012), suggesting that more positive work states are also likely to be experienced when time is lost, under the right conditions.

We also propose that sleep affects nonwork attitudes through a time-based resource loss mechanism. For example, having leisure time (i.e., free time) has been noted as a strategy for increasing happiness (e.g., Tkach & Lyubomirsky, 2006). Zabriskie and McCormick (2003) found that leisure time spent with family members is the strongest predictor of family satisfaction for parents. Further, one of the most commonly reported barriers to physical activity is perceived lack of time (e.g., Brownson, Baker, Housemann, Brennan, & Bacak, 2001).

Proposition 9: Sleep quantity influences time.

Proposition 10: Time influences work and nonwork attitudes, behaviors, and states.

When sleep is considered an outcome, we propose that job attitudes, behaviors, and states that result in a prioritization of work time will lead to decreased sleep quantity. Previous studies have shown a positive relationship between job involvement and work interfering with family at the intra-individual level (e.g., Byron, 2005), and we suggest that job involvement should lead to work time similarly interfering with sleep. Other work has shown that individuals sacrifice sleep in exchange for work and family time, both inter-individually and intra-individually (Barnes et al., 2012), and inter-individual time use data suggests that work time is the primary activity exchanged for sleep time (e.g., Basner et al., 2007).

Allocating time resources to nonwork rather than sleep will likely also decrease sleep duration. For example, we would expect commitment to one's social relationships in the form of time spent with those individuals, in addition to commitment to exercise or other leisure activities, to decrease sleep time. Caregiving for children and/or an aging adult has also been associated with decreased sleep quantity inter-individually and intra-individually (e.g., Berkman et al., 2015; Castro et al., 2009; Kang, Matsumoto, Shinkoda, Mishima, & Seo, 2002). Other research indicated that time spent socializing, relaxing, engaging in leisure activities, and watching television is associated with less sleep inter-individually (e.g., Basner et al., 2007).

Proposition 11: *Work and nonwork attitudes, behaviors, and states influence time.*

Proposition 12: *Time influences sleep quantity.*

Given propositions 9–12, we conclude that time acts as a mediator through which sleep quantity affects work and nonwork attitudes, behaviors, and states, as sleep quantity both depletes the amount of time available for work and nonwork activities, while simultaneously improving human performance that could result in increased efficiency and/or increased time pressure. We also suggest that time acts as a mediator through which work and nonwork attitudes, behaviors, and states affect sleep quantity. Individuals who prioritize work and nonwork domains as a result of attitudes, behaviors, and states, are less likely to have adequate time for sleep.

The Role of Context

Building off of the detailed propositions 1–12, we acknowledge that the proposed effects among work, nonwork, and sleep do not occur within a vacuum, but rather are heavily influenced by contextual factors. We draw on Johns' (2006) discussion of the importance of context in the organizational sciences to motivate an additional set of propositions. Johns (2006, p. 386) describes context as “situational opportunities and constraints that affect the occurrence and meaning of organizational behavior as well as functional relationships

between variables.” Furthermore, Johns (2006) describes two specific levels of analysis, including the overarching *omnibus context*, in addition to the *discrete context* that is nested within the omnibus context.

The omnibus context refers to high level factors including (a) *who* is being studied in terms of demographic indicators or occupational characteristics, (b) *where* the study is taking place, as factors like national culture or economic climate can influence results, (c) *when* the study is being conducted, as indicators of time—like phase of organizational change or episode during the progression of a societal trend—can be powerful, and (d) *why* data are being collected, given that the reason may influence participant feelings of accountability in responding. Variables at the discrete level include (a) task variables, such as job demands, job autonomy, role ambiguity, and work schedule; (b) social variables, such as leadership, especially leadership related to sleep or work-life balance, workplace norms around the importance of sleep or recovery, and coworker support that could allow for more flexible shifts; and (c) physical variables, such as temperature, light, and work spaces that allow for napping.

In addition, context can also be understood within Watson et al.' (2015) biopsychosocial model of sleep duration drivers. Although this model is specific to sleep quantity, we believe it is a useful larger sleep-specific framework to understand the multitude biological, psychological, and social factors—at the societal, social, and individual level—that influence sleep. Societal (e.g., public policy) and social (e.g., family responsibilities) factors map onto Johns' omnibus and discrete contexts, respectively. Additionally, this model incorporates the role of the individual (e.g., genetics, health). However, we argue that individual differences play a less critical role than the human energy and time resources in the proposed framework. This is evidenced in prior studies that have controlled for a host of related variables. One example is Kessler et al.' (2011) study, which identified a work performance decrement equivalent to \$2280 annually for every employee with insomnia, even after controlling for 26 comorbid health conditions, age, gender, and years of education. Further, Berkman, Buxton, Ertel, and Okechukwu (2010) found that employees with managers that encouraged work-family balance slept nearly 29 min longer per day than those who did not receive this type of support from their managers, an effect that was found after controlling for age, gender, hourly wage, educational attainment, race/ethnicity, work site, hours worked per week, and night work. Therefore, we contend that human energy resources and time should meaningfully contribute to and be influenced by sleep above and beyond many individual factors that are known to influence sleep.

Drawing on Johns's (2006) and Watson et al.'s (2015) work, we include in Fig. 1 the omnibus and discrete contexts encapsulating lower level processes that occur between work,

nonwork, and sleep. Because there are numerous constructs that can be considered as elements of the omnibus and discrete contexts, we are not able to address all possible elements exhaustively or provide specific propositions regarding certain

constructs. Instead, we provide examples below for each of our propositions, and point the reader to Table 1, which provides a list of possible constructs for future studies testing the WNS framework.

Table 1 Relevant context constructs for testing the WNS framework

Construct	Variable
Omnibus context	
Who constructs	Demographics Race/ethnicity, gender, age, marital/partner status, caregiver status Income level Health status Access to healthcare Individual differences Genetics Personality Occupational characteristics Job title Supervisor status Tenure Commute time and method
Where constructs	Location Public policy Cultural indicators Economic indicators
When constructs	Phase of organizational change Episode during progression of societal trend (e.g., beginning of recession) Recent major life events (e.g., new parent)
Why constructs	Research study conducted by individuals internal to company Research study conducted by individuals external to company Union endorsement of study
Discrete context	
Task constructs	Work Job demands Job autonomy Role ambiguity Work schedule Schedule control Nonwork Nonwork demands Role ambiguity
Social constructs	Work Norms, culture, climate Policies, procedures Leadership, sleep leadership Family/nonwork-supportive organizational perceptions General supervisor support, oworker support Family/nonwork-supportive supervisor behaviors, coworker behaviors Aggression Nonwork General social support Family/spouse/partner/child support Aggression
Physical constructs	Work Temperature Lighting Nap areas Nonwork Temperature Lighting Bedroom environment

First, we propose that elements of the omnibus context can act as predictors of constructs included in the WNS framework (i.e., sleep, resource mechanisms, work/nonwork attitudes, behaviors, and states). For instance, research indicates that Mexican-born immigrants living in the USA tend to have better sleep habits than US-born Americans, likely due to a cultural emphasis on the importance of sleep and siestas, or naps (e.g., Seicean, Neuhauser, Strohl, & Redline, 2011).

Proposition 13: *The omnibus context influences sleep quality and quantity, resource mechanisms, and work/nonwork attitudes, behaviors, and states.*

Second, we propose that elements of the discrete context can act as predictors of constructs included in the WNS framework. For example, job demands have been associated with decreased sleep quality and quantity (e.g., Åkerstedt et al., 2002; de Lange et al., 2009).

Proposition 14: *The discrete context influences sleep quality and quantity, resource mechanisms, and work/nonwork attitudes, behaviors, and states.*

Third, we propose that elements of the omnibus context can influence elements of the discrete context, which can in turn influence constructs in the WNS framework. For example, the type of job someone has can predict whether they can have a flexible work schedule (e.g., Hale, 2014), which can in turn influence sleep (e.g., Tucker, Bejerot, Kecklund, Aronsson, & Åkerstedt, 2015).

Proposition 15: *The omnibus context indirectly influences sleep quality and quantity, resource mechanisms, and work/nonwork attitudes, behaviors, and states through the discrete context.*

Lastly, we suggest that elements of the omnibus or discrete context can act as moderators of the relationships proposed by the WNS framework. For example, the positive effect of sleep on human energy resources could be moderated by age, such that the relationship is stronger for younger adults compared to older adults, due to age-related changes in sleep quality and quantity (e.g., Pace-Schott & Spencer, 2011).

Proposition 16: *The omnibus context and discrete context moderate relationships among sleep quality and quantity, resource mechanisms, and work/nonwork attitudes, behaviors.*

Discussion

In summary, we propose the WNS framework as a holistic model that integrates the sleep and organizational literatures in order to stimulate future research that extends beyond the work-nonwork interface to incorporate sleep. Although the framework offers specific predictions related to the role of resource mechanisms, context is accounted for more broadly.

Future Directions

In the following section, we address a number of important directions for this area of research, while also providing a summary in Table 2. We highlight future research questions specific to theoretical processes, resources, context, methodology, and interventions.

Theoretical Process Questions The proposed framework is markedly serial in nature, with a specific focus on how sleep quality and quantity generate a chain of reactions in work and nonwork domains, which ultimately impact downstream sleep quality and quantity. However, it is important to point out that sleep, work, and nonwork may operate simultaneously to produce a given outcome, in a much more complex fashion. For example, Barnes et al. (2012) found that negative, nonlinear relationships between work time and sleep time are strengthened under conditions of high family time demands. We propose that other interactions among the three domains are likely, as well. For example, work attitudes, behaviors, and states may interact with nonwork attitudes, behaviors, and states to influence sleep outcomes. Additionally, human energy and time resources may interact to influence subsequent effects on work, nonwork, or sleep. Although we felt that such complexity was beyond the scope of this paper given the numerous interactions that could occur among the three areas of life and the resources that are generated by them, we urge researchers to further explicate these processes in future theoretical and empirical work.

Resource Questions In line with Barnes (2012), we ultimately believe that the constructs of sleep quantity and sleep quality should be studied in tandem. We propose that both sleep quantity and quality are necessary for human energy resources, and suggest that the resource mechanism of time primarily affects and is affected by sleep quantity, rather than sleep quality, although sleep quality may also be affected through alternative mechanisms or more complex processes involving multiple mechanisms. Sleep quantity and sleep quality may also interact as some researchers have considered moderating effects between these measures of sleep (e.g., Barber, Munz, Bagsby, & Powell, 2009; Barnes, Lucianetti, Bhave, & Christian, 2015). Future research should attempt to disentangle which specific resources and processes influence and are influenced by the distinct, yet related, constructs of sleep

Table 2 Summary of recommendations for future research

Research questions	Selected relevant references	Level of analysis
Theoretical process questions		
How do work, nonwork, and sleep simultaneously influence subsequent outcomes?	Barnes et al. (2012)	Inter-individual Intra-individual
Do interactions occur between two areas (e.g., sleep and work) to influence outcomes in the third area (e.g., nonwork)?		
Resource questions		
Does sleep quality have stronger effects on energetic activation resources than sleep quantity?	Barnes (2012); Sonnentag and Zijlstra (2006)	Inter-individual Intra-individual
Does sleep quantity have stronger effects on time resources than sleep quality?		
In what directions do physical energy resources influence sleep quality and quantity? Are nonlinear effects present?	Leeder et al. (2012); Barnes et al. (2012); Basner et al. (2007, 2014); Grondin (2010); Robinson & Godbey (2010); Strathman & Joireman (2005)	Inter-individual Intra-individual
In what directions do time resources affect work, nonwork, and sleep?		
How are shifts in human energy resources related to work attitudes, behaviors, and states, as well as sleep quality and quantity?	Bledow et al. (2011); Quinn et al. (2012)	Inter-individual Intra-individual
How do individuals consciously allocate resources and/or engage in certain actions to conserve, gain, or lose resources?	Vroom (1964); Quinn et al. (2012)	Inter-individual Intra-individual
What additional resource mechanisms besides human energy and time might exist? What is the strength of their influence in comparison to human energy and time?	Halbesleben et al. (2014); ten Brummelhuis and Bakker (2012)	Inter-individual Intra-individual
Context questions		
Which work-related variables affect sleep quality and quantity? For example, within the omnibus context, what are the work-tasks and social environment variables most strongly related to sleep quality and quantity?		Inter-individual
In the omnibus context, what HR policies are most effective for promoting sleep quality and quantity?		Inter-individual Intra-individual
Which sub-populations of workers (based on industry, occupation, or worker characteristics) are at higher risk for negative outcomes related to sleep? Samples for initial investigation include the following:		
• Shiftworkers	Drake and Wright (2017); Short, Agostini, Lushington, and Dorrian (2015); Smith et al. (2011)	Inter-individual
• Workers exposed to safety hazards	Gander et al. (2017); Weinger and Ancoli-Israel (2002)	
• Workers with specific work-family demands (e.g., young children, sandwiched generation, eldercare)	Allen and Finkelstein (2014); Fisher et al. (2016); Neal and Hammer (2017)	
• Workers with psychological disorders that may affect or be affected by sleep	Alvaro, Roberts, and Harris (2013); Peterson and Benca (2017); Ramsawh, Stein, and Mellman (2017)	
• Workers with chronic health conditions that may affect or be affected by sleep	Ancoli-Israel, Moore, and Jones (2001); Menefee et al. (2000)	
• Workers with certain genetic dispositions	Curtis et al. (2016); Shi et al. (2017)	
• Workers with certain personality dispositions	Hintsanen et al. (2014); Saksvik et al. (2011)	
Which sub-populations of workers may benefit from napping?	Ficca et al. (2010); Milner and Cote (2009)	
Methodological questions		
Are identical results found with objective and self-report measures of sleep quality and quantity?	Barnes (2012); Sadeh (2011)	Inter-individual Intra-individual
How do intra-individual results differ from inter-individual results across WNS propositions?	Bolger et al. (2003)	Inter-individual Intra-individual
Over what time period or study duration do we observe the strongest effects for the propositions presented in this article?	Ford et al. (2014)	Inter-individual Intra-individual
Intervention questions		
What Total Worker Health® interventions are most effective for improving sleep quality and quantity?	Schill & Chosewood (2013)	Inter-individual Intra-individual
What types of intervention components lead to sustainable effects over longer time lags?		

quantity and sleep quality. We also encourage organizational scholars to consider both short (< 7 h) and long (> 9 h) sleep durations as maladaptive, given some existing, yet inconclusive, sleep literature on this topic (e.g., Watson et al., 2015).

We have provided 16 testable propositions related to energy and time mechanisms connecting work, nonwork, and sleep, based on past theory and research. However, for five propositions, we were not able to make specific, directional hypotheses as multiple outcomes are likely to exist. First, proposition 4 states that physical energy influences sleep quality and quantity. Past findings from the exercise literature (e.g., Driver & Taylor, 2000) suggest that some nonlinear effects may be present whereby work behavior that requires moderate, but not low or high, physical depletion of resources is most ideal for maintaining adequate sleep quality and quantity. These associations may also depend on occupation type and job tasks, as regular physical energy depletion may lead to different outcomes if experienced less frequently, but more intensely.

Propositions 9–12 regarding time as a mechanism connecting work, nonwork, and sleep are also general and not directional. We suggest that directionality may depend on the participants' cognitive appraisal of time and how time is measured by the researchers. For example, reports of time spent engaging in an activity may have a different effect on work performance than subjective perceptions of time pressure experienced while doing the activity. Moreover, objective reports of time use can differ from subjective reports of time use (e.g., Robinson & Godbey, 2010). As such, future studies should utilize multiple constructs related to time, such as time use, time pressure, and time urgency, with both subjective and objective methods whenever appropriate. Future work in this area should draw on the sociology literature around time use (e.g., Robinson & Godbey, 2010), in addition to the social and cognitive psychology literature around perceptions of time (e.g., Grondin, 2010; Strathman & Joireman, 2005).

Although we discuss each of the human energy and time resource mechanisms in isolation, it is also likely the case that different resources are being gained and lost simultaneously within work, nonwork, or sleep areas and thus exert distinct influences on the subsequent area. These shifts in human energy resources may result in different outcomes depending on which resources individuals value and utilize most in a given setting. When testing the WNS framework, we urge investigators to measure multiple types of human energy and time resources and determine their relative effects on outcomes. It may also be the case that outcomes are dependent on the dynamic interplay among multiple shifting resources. For example, Bledow, Schmitt, Frese, and Kühnel (2011) affective shift model suggests that work engagement results from negative affect being followed by an upregulation of positive affect. Thus, shifts in resources should also be evaluated in connection to one another.

The WNS framework does not explicitly discuss the process by which individuals choose to consciously conserve, gain, or lose resources while residing within work, nonwork, or sleep areas. We see potential for integration with expectancy theory (Vroom, 1964), and its basic propositions that individuals are motivated when they perceive a connection between effort expended and resulting performance, when that performance should lead to a given outcome, and when that outcome should in turn result in some valued reward. The value placed on sleep is likely the result of individuals' perceptions of whether sleep results in human energy and time resources that in turn influence performance in the work or nonwork area and subsequently whether that performance leads to outcomes and rewards.

Lastly, although we believe that human energy and time are the resources most directly and proximally related to sleep and are thus the most appropriate resource mechanisms for consideration in this framework, there is potential for other resources mechanisms to play a role. We encourage researchers to test additional resources and pit them against human energy and time to further develop this framework and establish the role of these resource mechanisms. Additionally, we encourage researchers to use a variety of self-report and objective methods and measures when conceptualizing resources. For example, physical energy might be measured with objective neurobehavioral tests, such as the well-validated psychomotor vigilance task (e.g., Basner & Dinges, 2011) or self-reported measures of general fatigue or even work-related fatigue (e.g., Frone & Tidwell, 2015).

Context Questions Although the WNS framework was developed to explain interconnections among work, nonwork, and sleep for all working individuals, we also describe a few specific high-risk populations. We argue that researchers should collectively cast a broad net in terms of identifying samples for studies when testing WNS, by both evaluating WNS processes across occupations and samples (i.e., establishing generalizability), while also delineating for what groups or occupational samples WNS is particularly relevant and where certain aspects of WNS should be emphasized and/or revised depending on the sample. This level of understanding and theoretical clarification is necessary for future applied work in organizations where WNS propositions are used to design interventions or policies. Below, we specify those groups that should be prioritized in future research testing the WNS framework.

As global trends move towards a “24-hour society”—in which goods and services can be produced and consumed at any hour of the day—organizations have adapted to meet these demands by modifying work schedules to include all hours of the day (e.g., Moore-Ede, 1994). Although the use of shiftwork schedules, which deviate from the traditional 9:00 a.m. to 5:00 p.m. Monday to Friday workweek (e.g., Smith, Folkard, Tucker, & Evans, 2011), helps organizations

meet the needs of a round-the-clock market, meta-analytic evidence suggests that shiftwork has detrimental effects on sleep length (Pilcher, Lambert, & Huffcutt, 2000). In turn, shiftworkers are at a heightened risk for accidents and injuries on the job (Folkard, Lombardi, & Tucker, 2005), burnout (Wisetborisut, Angkurawaranon, Jiraporncharoen, Uaphanthasath, & Wiwatanadate, 2014), work-family conflict (e.g., Jansen, Kant, Kristensen, & Nijhuis, 2003), lower family satisfaction (e.g., Grosswald, 2004), lower overall marital quality (e.g., White & Keith, 1990), and experiences of “social marginalization” due to family and friend gatherings happening opposite of shiftworkers’ schedules (e.g., Costa, 2003; Harrington, 2001).

Additionally, individuals who work in occupations where workers, or others they serve, have a high safety risk warrant special consideration. Sleep and fatigue issues are especially germane to workers in operational settings like the airline industry (e.g., Gander et al., 2015), nuclear power plants (e.g., Paim et al., 2008), long-haul trucking (e.g., Mitler, Miller, Lipsitz, Walsh, & Wylie, 1997), railway (Härmä, Sallinen, Ranta, Mutanen, & Müller, 2002), and healthcare (e.g., Weinger & Ancoli-Israel, 2002). Workers in these settings are likely to experience resource loss across the three mechanisms, with decreases in physical energy resources likely being especially important, given previous robust findings of sleep restriction affecting elements of neurobehavioral functioning, such as lapses in attention and decreased working memory (e.g., Banks & Dinges, 2007). Furthermore, higher-level contextual influences should be taken into account when conducting research with these individuals. For example, despite current duty hour limits for medical residents in the USA (i.e., 80 h maximum weekly limit, with first year residents not able to exceed 16 h continuous shifts and more experienced residents not able to exceed 24 h continuous shifts; Accreditation Council for Graduate Medical Education (ACGME, 2011), guidelines are often not followed and residents intentionally misreport their hours due to the general opinion that duty hour limitations are detrimental for training, in addition to the noted culture in healthcare focused on unwavering commitment to patients (e.g., Fargen & Rosen, 2013; Philibert, Miller, Heard, & Holt, 2009).

Work-family research is predicated upon the notion that many workers have caregiving roles in the nonwork domain and that these family roles may conflict with, as well as enhance, work experiences. Such family roles may involve caring for children, parents or grandparents, spouses/partners, or other relatives. Nonwork demands and work-family conflict are particularly high for parents of young children (e.g., Allen & Finkelstein, 2014), and one of the hallmarks associated with caring for infants or young children is difficulty with obtaining sufficient sleep quantity and quality, regardless of one’s work status (e.g., Medina, Lederhos, & Lillis, 2009). This is especially pertinent for caregivers around a child’s birth, or for new

parents, as these transitional times are particularly disruptive to sleep (e.g., Gay, Lee, & Lee, 2004). Qualitative studies have revealed that first-time mothers not only experience disturbed sleep, but often feel underprepared with how to manage their sleep after their first baby is born (e.g., Barnes et al., 2008; Kennedy, Gardiner, Gay, & Lee, 2007). Further, the labor force participation rate of mothers with children under age 6 is 64.2%, and mothers of infants under age 1 is 58.1%. In other words, more than half of mothers of infants in the USA return to work before their baby is 1 year old. This trend related to sleepy mothers has significant implications for productivity, performance, and safety in the workplace (Rosekind et al., 2010). Additionally, having children is an antecedent to work-family conflict (e.g., Byron, 2005) and influences employees’ ability to achieve work-family balance and obtain healthy sleep. Caregivers also frequently report strains that are associated with resource depletion (emotional, physical, and time-based resources; e.g., Schulz & Beach, 1999; Ybema, Kuijer, Hagedoorn, & Buunk, 2002), which in turn should affect sleep.

According to the CDC, half of adults in the USA report having at least one chronic health condition and one in four adults report having multiple chronic health conditions (Ward, Schiller, & Goodman, 2014). The incidence of chronic health conditions also increases with age such that workers have an increased risk of developing health conditions as they get older (Grosch & Pransky, 2009). The National Alliance on Mental Illness (NAMI) reports that one in five adults in the USA experience mental illness (excluding substance abuse disorders) in a given year (NAMI, 2016). Relatedly, clinical sleep disorders (e.g., insomnia, sleep apnea) should also be considered. These disorders are also common in the USA; for example, one in three people report having symptoms of insomnia, and one in ten people meet the diagnostic criteria for clinical insomnia (Vaughn & D’Cruz, 2017). Poor sleep can be a symptom of a developing physical/mental illness or sleep disorder, an outcome of an illness, and can worsen the symptoms of physical/mental health problems (e.g., Colten & Altevogt, 2006; NAMI, 2016). We recommend that organizational scientists collaborate with clinicians from the medical field to conduct studies with these types of samples.

Although we contend that individual demographic differences (e.g., gender) are not central to the proposed framework, people with certain genetic and personality predispositions could be considered high-risk populations. For instance, there is evidence for a genetic basis of sleep-wake patterns, including timing, duration, and the development of sleep disorders (e.g., Dauvilliers, Maret, & Tafti, 2005; Shi, Wu, Ptáček, & Fu, 2017). Relatedly, there is emerging research that suggests that people with a genetic mutation (hDEC2-P385R) may require less sleep—between 4 and 6 h—to feel well-rested in the morning and have typical daytime functioning (He et al., 2009). However, population prevalence estimates of the occurrence of this mutation are unknown, and previous studies

have established that individuals generally tend to underestimate their own sleep-related impairment (e.g., Curtis, Williams, Jones, & Anderson, 2016; Van Dongen, Maislin, Mullington, & Dinges, 2003). As such, although there may be genetic differences in how much sleep someone needs and the types of sleep-related impairments they are predisposed to, most healthy adults require 7–9 h of sleep (Watson et al., 2015).

Personality has also been linked with sleep-related outcomes; people low in extraversion, agreeableness, and conscientiousness, and high in neuroticism, tend to report having poorer sleep (e.g., Hintsanen et al., 2014). There are also individual differences in whether someone is tolerant to shiftwork. For example, people who prefer mornings, are introverted, and have low flexibility are often less tolerant to shiftwork (see Saksvik, Bjorvatn, Hetland, Sandal, & Pallesen, 2011 for a comprehensive review).

Some researchers argue that napping can help to mitigate the negative effects of a poor night's sleep (e.g., Milner & Cote, 2009). Therefore, napping is one strategy that could be effective for some of the high-risk populations previously discussed. Prior work has shown that naps can be particularly effective for improving performance, vigilance, and reducing fatigue in shiftworkers and those that are employed in safety-sensitive industries (e.g., Ficca, Axelsson, Mollicone, Muto, & Vitiello, 2010; Sallinen, Härmä, Åkerstedt, Rosa, & Lillqvist, 1998; Smith, Kilby, Jorgensen, & Douglas, 2007). However, people often experience sleep inertia—an immediate feeling upon awakening of disorientation, grogginess, and decreased performance—so there should be a delay between the end of a nap and the start of a worker's shift (e.g., Milner & Cote, 2009; Tassi & Muzet, 2000). Other work has shown that naps are effective at reducing frustration and impulsivity (e.g., Goldschmied et al., 2015). However, workers with physical/mental health problems or sleep disorders (i.e., individuals for which it is typically harder to fall and stay asleep) may have adverse outcomes from napping, as naps have also been shown to disrupt nocturnal sleep and increase daytime sleepiness (e.g., Owens et al., 2010; Sharma & Andrade, 2012). In general, the literature regarding the benefits and drawbacks of naps is mixed (e.g., Dhand & Sohal, 2006; Irish, Kline, Gunn, Buysse, & Hall, 2015). Although naps may be beneficial for some people, there is limited evidence to provide general recommendations regarding naps, given that the effectiveness of napping depends on a host of factors (e.g., occupation, health status, individual differences).

These findings suggest that shiftworkers, workers in high-risk occupations, caregivers, people impacted by chronic illness, psychological disorders, and/or clinical sleep disorders, and individuals with certain predispositions (i.e., genetics or personality) have nuanced experiences pertaining to sleep, work, and nonwork. Relatedly, some of these high-risk populations may benefit from napping, whereas others may not. In

particular, we recommend a future focus on identifying the human energy and time resource mechanisms that link sleep with work and nonwork domains for these individuals. In addition, we encourage researchers to consider the influence of higher-level contextual resources that are critical to facilitating positive change for these groups.

Methodology Questions In testing the WNS framework, we encourage the use of both self-report and objective measures of sleep, mechanisms, and behavior in order to triangulate results. Organizational research has made less use of objective measures (e.g., Ganster & Rosen, 2013; Hurrell, Nelson & Simmons, 1998), and we believe that borrowing rigorous objective techniques would serve to better validate the WNS framework. For example, psychomotor vigilance testing often utilized in the sleep and fatigue science fields (see Van Dongen & Dinges, 2005) would be helpful for assessing cognitive energy resources. Additionally, some organizational researchers have begun to use actigraphy (e.g., Crain et al., 2014) and polysomnography (Barnes, Ghumman, & Scott, 2013) as objective measures of sleep quality and quantity (see Barnes, 2012 for a brief review). Finally, because slow wave sleep represents the key marker of sleep need, and core body temperature and melatonin are markers of the sleep-wake cycle (e.g., Borbély et al., 2016), advanced techniques (e.g., polysomnography, neuroimaging) are necessary for studying internal sleep processes; therefore, we also encourage organizational researchers to collaborate with scholars from sleep, cognitive science, and neuroscience disciplines.

We have developed the WNS framework to explain both intra-individual change (i.e., within-person processes that may fluctuate over time) and processes that occur between individuals over time. There is potential for researchers to collect parallel intra-individual and inter-individual data using different methods in order to determine whether results differ within individuals, across individuals, or both.

Both intra- and inter-individual designs can be employed to study changes over various time lags. For example, to capture events that occur within each day or across a series of days or weeks, daily diary or experience sampling methodology may be quite useful. These methods involve requesting that participants provide multiple self-reports on consecutive days during their typical daily experiences, thereby “capturing life as it is lived” (Bolger et al., 2003, p. 580). This method allows researchers to capture within-person processes using multiple observations over relatively short timeframes. Other research can examine intra-individual changes over longer periods of time, such as how sleep patterns vary over months or years.

Practical Implications

The WNS framework has important implications for organizations and individuals. At the organizational level,

acknowledgement of the interplay among work, nonwork, and sleep by top leadership should affect resultant policies and practices that influence performance, productivity, absenteeism, presenteeism, and healthcare costs. Furthermore, an understanding of the energy and time resources that are gained and lost by engaging in work, nonwork, and sleep, in addition to a consideration of contextual influences, could lead to the development of integrated Total Worker Health® initiatives that target the protection and promotion of worker well-being at multiple levels (Schill & Chosewood, 2013). For example, an organization could implement individual-focused time management training with an organizational-focused program that allows for scheduling of shifts to be more predictable. For individuals on the other hand, an appreciation of how work, nonwork, and sleep interact via resource mechanisms is likely to influence behavior change related to the investment, management, and preservation of resources deemed to be valuable for optimally engaging in both work and non-work roles.

When conducting sleep-related experiments in the workplace, we suggest organizational researchers carefully consider ethical issues that may arise with this work, in line with recommendations from Barber (in press). More specifically, we encourage organizational researchers to implement what Barber calls “positive sleep interventions approaches” whereby the study design involves the promotion of sleep, rather than “negative sleep intervention approaches,” whereby participants are restricted or even deprived of sleep. Barber provides five key ethical areas that should be taken into account by researchers and scrutinized by journal and grant reviewers, including participant vulnerability, informed consent, debriefing, managing risk in field designs, and minimizing risks/maximizing benefits.

Conclusion

The current paper extends traditional views of the work-nonwork interface that do not incorporate sleep. We call for the expansion and acknowledgement of sleep, an important source of variance in everyday attitudes, behaviors, and states to advance our understanding of work and nonwork experiences. In light of the burgeoning literature on sleep within the organizational sciences, it is an opportune time for the development of a comprehensive conceptual model elucidating the connections among the three major areas of life. We hope that the WNS framework will facilitate momentum in this area of research and help steer us closer towards a comprehensive understanding of individual, family, and organizational well-being.

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