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Energy at work: A measurement validation and linkage to unit effectiveness

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Summary We introduce the notion that the energy of individuals can manifest as a higher-level, collective construct. To this end, we conducted four independent studies to investigate the viability and importance of the collective energy construct as assessed by a new survey instrument—the productive energy measure (PEM). Study 1 ($n = 2208$) included exploratory and confirmatory factor analyses to explore the underlying factor structure of PEM. Study 2 ($n = 660$) cross-validated the same factor structure in an independent sample. In study 3, we administered the PEM to more than 5000 employees from 145 departments located in five countries. Results from measurement invariance, statistical aggregation, convergent, and discriminant-validity assessments offered additional support for the construct validity of PEM. In terms of predictive and incremental validity, the PEM was positively associated with three collective attitudes—units' commitment to goals, the organization, and overall satisfaction. In study 4, we explored the relationship between the productive energy of firms and their overall performance. Using data from 92 firms ($n = 5939_{\text{employees}}$), we found a positive relationship between the PEM (aggregated to the firm level) and the performance of those firms. Copyright © 2011 John Wiley & Sons, Ltd.

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Introduction

The concept of *energy* has long occupied a prominent role within both biological and psychological theories of human functioning (Ryan & Frederick, 1997), with its roots going back as far as ancient Asian cultural traditions (Peterson & Seligman, 2004). Nevertheless, individuals' energy in the context of work has only recently emerged as a focal topic (e.g., Quinn, 2007; Quinn & Dutton, 2005; Schwartz, 2007). Interest in energy at work has increased along with the mounting emphasis on promoting positive rather than merely preventing negative psychological states (Luthans & Avolio, 2009). Despite growing scholarly interests, however, advocates of the energy at work concept (Cameron, Dutton, & Quinn, 2003) lament that much of the existing literature remains speculative and prescriptive. Taking the issue a step further, others have acknowledged that "while the term energy is pervasive in much of organizational life, it is also a highly elusive concept in that context" (Cross, Baker, & Parker, 2003, p. 51) and "it [energy] is a construct that organizational scholars use but seldom define" (Quinn & Dutton, 2005, p. 36). It has likewise been suggested that a limitation in this line of research is a lack of valid and reliable measurement devices (Cameron, 2007; Cameron & Caza, 2004).

The present paper seeks to advance the nascent literature on workplace energy by empirically demonstrating that the energy *collectively* experienced by individuals at work can have a measureable impact on organizationally

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relevant criteria. We, thus, adopt a multilevel perspective, which suggests that workplace energy should be studied in its social context. That is, we recognize that the existing literature on energy at work shares a common constraint, namely, a prevailing assumption that energy is solely an individual-level phenomenon. This is potentially problematic because scholars have known for quite some time that individuals working within bounded organizational contexts encounter homogenous situational factors that can lead to shared interpretations and collective response tendencies (e.g., Kozlowski & Hattrup, 1992). Building from this base, we report on the development of an instrument designed to tap workplace energy as a collective phenomenon. Hence, we add to the individual-level perspective by developing and validating our proposed measure (dubbed the productive energy measure [PEM]) at the unit level of analysis. Before we turn our attention to collective energy, however, we start by briefly reviewing the (individual) energy literature, noting key ideas and concepts.

What is Energy at Work?

According to *Webster's Revised Unabridged Dictionary*, energy encompasses an individual's general capacity for acting, operating, and producing an effect. As such, organizational scholars have traditionally viewed energy as a psychological or intraindividual phenomenon. Quinn and Dutton (2005) defined individual-level energy as "a type of positive affective arousal, which people can experience as emotion—short responses to specific events—or mood—longer lasting affective states that need not be a response to specific events" (p. 36). Shirom's (2003a) major contention is that vigor-at-work reflects individuals' core affect. He reasoned that vigor "is closer to a mood state in that it lasts longer than momentary emotions; however, because it is contextualized in the work situation … it [is] an affect" (Shirom, 2010, p. 70).

Although focusing on core affect is important, we contend that "energy-as-affect" is an unnecessarily narrow area of study. Put another way, we follow Quinn and Dutton (2005) and Shirom (2003a, 2010) insofar as positive affective arousal is an important source of energy, but we also recognize that core affect is only one of the "three most salient domains of energy that humans possess"—the others being cognitive energy and physical–behavioral energy (Shraga & Shirom, 2009, p. 272). We, therefore, suggest that the energy-as-affect perspective would benefit from an expanded view that captures all three energy domains: emotional arousal (e.g., *feeling* of excitement), cognitive alertness (e.g., *desire* to focus attention), and purposeful behavior (e.g., *investment* of physical resources).

Why is the study of energy at work important?

Being positively energized at work has far-reaching implications for employees and offers organizations a competitive advantage. Dutton (2003) maintained that energy is the "fuel that makes great organizations run," describing it as a renewable resource that benefits both organizations and its members (p. 7). For example, positive affect and emotional arousal inherent in feeling energized increases employees' creativity (Atwater & Carmeli, 2009) and efficiency of thought (Fredrickson, 2001). An energetic focus allows employees to think constructively about work-related problems and concentrate on the tasks at hand (Lykken, 2005). And finally, the intensity and volume with which "energized" employees invest physical resources support their desire to realize organizational objectives (Spreitzer, Sutcliffe, Dutton, Sonenshein, & Grant, 2005). Consequently, energy at work resonates with the "positive movement" in organizational behavior or with the ways in which organizational members facilitate extraordinary performance outcomes (Spreitzer & Sonenshein, 2004).

Why focus on collective energy?

Multilevel scholars (e.g., Kozlowski & Klein, 2000; Mathieu & Chen, 2011) have suggested that individual-level models are often too simplistic to accurately capture organizational phenomena. Accordingly, an individual-level focus on energy may be a cause for concern because it ignores the fact that most contemporary work environments require individuals to align with a work group, team, and/or the organization (Mathieu, Maynard, Rapp, & Gilson, 2008). Thus, because it ignores the social milieu in which individual employees navigate, we suspect that much of the existing research has limited its ability to explain the energy at work phenomenon. In other words, a benefit of exploring energy as a collective construct is that it creates the potential to model emergent effects (i.e., bottom-up processes; Kozlowski & Klein, 2000). For example, by aggregating individual members' energy into a higher-level variable, we can establish a collective energy analog that captures contextual influences that are not a part of the construct when operationalized at the individual level (Bliese, 2000; Kozlowski & Klein, 2000). Such a notion is also consistent with that of Bruch and Ghoshal (2003) and Jansen (2004) who asserted that an emphasis on collective-level energy holds the potential to provide a more complete understanding of energy in organizational settings. To the authors' knowledge, however, no empirical study has explored the collective energy concept or its associations with relevant outcomes.

Conceptualization and Definition of Collective (Productive) Energy

We define collective energy (henceforth *productive energy*) as the shared experience and demonstration of positive affect, cognitive arousal, and agentic behavior among unit members in their joint pursuit of organizationally salient objectives.

Productive energy is multifaceted

Scholars (e.g., Cameron et al., 2003; Dutton & Ragins, 2007; Jansen, 2004; Kahn 1990, 1992) have advanced theoretical models supporting our contention that both affective and cognitive arousal indicate fundamental tendencies that are connected with purposeful work behavior. Initial qualitative research conducted by Baker, Cross, and Wooten (2003) has likewise observed that energy is "not merely affect or liking," with their study interviewees reporting experiences of cognitive vividness ("I am sure I literally think better and faster") as well as behavioral ("willingly staying late to resolve important matters") aspects of energizing relationships (p. 340). Bruch and Ghoshal (2003) found that managers described "energetic" work in terms of positive emotional arousal, engaged intellectual capabilities, and purposeful action taking. Moreover, these initial findings are consistent with evidence for the "broaden-and-build" hypothesis (Fredrickson, 2001). This research (e.g., Fredrickson & Branigan, 2005) has shown positive emotion to build psychological and physical resources by enlarging one's scope of attention (e.g., fostering creativity) and broadening behavioral repertoires (e.g., exploring and assimilating new information). Notably, Fredrickson (2003) suggested that her broaden-and-build theory may not only produce individuals who function at higher levels but also produce collectives that function at higher levels.

On the basis of theoretical and empirical grounds, we find positive affect to be a critical element of energy, but we also recognize that it does not encompass the totality of a positively energized work context. Hence, by considering affect, cognition, and behavior as complementary energy components (Bruch & Ghoshal, 2003; Shraga & Shirom, 2009), we deviate from existing research that defines energy as an emotional experience and nothing more. We also note that our approach is not at odds with the energy-as-affect view; rather, it both incorporates the affective dimension and extends it by considering the two additional energy domains (viz., cognitive and behavioral) identified in the literature (e.g., Shraga & Shirom, 2009).

Affective energy refers to members' shared experience of positive feelings and emotional arousal due to their enthusiastic assessments of work-related issues (Quinn & Dutton, 2005). *Cognitive energy* refers to the shared intellectual processes that propel members to think constructively and persist in search of solutions to work-related problems, including the mental faculties to focus attention, shut out distractions, and have a desire to make "good things" happen (Lykken, 2005). *Behavioral energy* reflects members' joint efforts designed to benefit the

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organization (Spreitzer & Sonenshein, 2004); it encompasses the pace, intensity, and volume with which members purposefully invest physical resources (e.g., Spreitzer et al.,2005).

Productive energy as an emergent phenomenon: similarities and distinctions between energy as an individual versus collective construct

We take a multilevel position on energy, conceptualizing it as both an individual-level and a collective-level phenomenon. We, therefore, recognize the need to discuss the nature of its *emergence* (Kozlowski & Klein, 2000) or how the lower-level parent construct (i.e., individual-level energy) materializes to form a collective construct (i.e., productive energy). In doing so, we consider two key issues: function and structure (Morgeson & Hofmann, 1999).

The function of productive energy

Function refers to the anticipated effects or outputs of productive energy. We adopt the composition modeling principle of isomorphism—defined as the "coalescence of identical lower-level properties … to yield a higher-level property that is essentially the same as its constituent elements" (Kozlowski & Klein, 2000, p. 16). As such, productive energy is similar to individual-level energy in its content (e.g., same dimensions across levels). We thus anticipate energy to perform the same theoretical function across different levels of analysis (i.e., functional equivalence) as it references the same content and has the same meaning (Morgeson & Hofmann, 1999). In other words, because energy is assumed to maintain a similarity in conceptual meaning across levels, it is also more likely to have similar relationships with other variables in the nomological network.

The structure of productive energy

Energy differs in terms of underlying structure across analysis levels. In other words, energy manifests in markedly distinct ways when viewed from the individual-level versus higher levels of analysis. Individual-level energy manifests at the intraindividual level via biological and psychological processes (Peterson & Seligman, 2004; Ryan & Frederick, 1997), whereas productive energy is theorized to emerge at higher levels of analysis (e.g., organizational subunits) via mutual dependence and interindividual interaction. This difference suggests that although individual-level and collective-level (viz., productive) energy share some similarities (i.e., functional equivalence), they are not similar in structure.

On the basis of previous theory and research suggesting that the characteristics of individuals denote *elemental content* (i.e., raw material of emergence; Kozlowski & Klein, 2000), productive energy's theoretical foundation is believed to lie in the affect, cognition, and behavior of individual unit members (Quinn & Dutton, 2005), which—via interaction processes—is amplified and manifests as a higher-level, collective construct (Morgeson & Hofmann, 1999). In adopting this perspective, we suggest that energy is not a private experience but rather a social one; for example, a routine conversation becomes charged with enthusiasm and excitement, turning an everyday encounter into an "energizing" interaction (Quinn, 2007). These positive exchanges may, in turn, fuel positive and purposeful responses from others (e.g., being proximally close to an energetic coworker affects others' energy levels). This patterning of mutual interaction (also known as a double interact; see, e.g., Morgeson & Hofmann, 1999) is the basic building block upon which productive energy is constructed (Dutton & Heaphy, 2003); however, additional emergence mechanisms include common exposure to the same events (i.e., shared sense-making; Kozlowski & Klein, 2000), emotional and cognitive contagion processes (Barsade, 2002; Gibson, 2001), and behavioral integration (Bandura, 2001).

In keeping with this logic, and remaining consistent with multilevel theory of bottom-up processes (see, e.g., Kozlowski & Klein, 2000), we envisage productive energy as a shared or emergent phenomenon that is common to all members of a work unit. Accordingly, productive energy falls into the category of an emergent state (Marks, Mathieu, & Zaccaro, 2001) or a collective construct that reflects the affective, cognitive, and behavioral properties of units as a whole. A further characteristic of emergent states is that although they have mutable qualities (as a function of context,

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inputs, and outcomes), many such variables tend to stabilize over time. In this respect, when organizational entities demonstrate productive energy and when organizational leaders and key constituents recognize and legitimize these actions (see, e.g., Luthans & Avolio, 2009), they can become self-reinforcing in the sense that they have an amplification quality (Cameron et al., 2003; Spreitzer et al., 2005). Consequently, rather than just consume resources, energized unit members are also producing resources that fuel the systems in which they are embedded (Porath, Spreitzer, & Gibson, 2010). This logic is consistent with the argument that Morgeson and Hofmann (1999) put forward. They contended that a collective construct "assumes an a posteriori permanence that can subsequently influence individual and collective action" and, thus, has "a reality that is partly independent of the interaction that gave rise to it" (Morgeson & Hofmann, 1999, p. 253).

Hypothesis 1: There are three distinct dimensions of productive energy. Each dimension contributes to an overall construct of productive energy (studies 1, 2, and 3).

Hypothesis 2: Productive energy, as demonstrated by a statistically significant intraclass correlation (ICC) coefficient, is distinct from its individual-level construct (studies 3 and 4).

Productive energy and related constructs

Collective motivation

Researchers have defined work motivation in various ways and have applied countless theories to explain both individual-based and group-based performance (see, e.g., Chen & Kanfer, 2006; Pinder, 2008). Notably, a unifying theme that emerges from this research is the integral role of cognitive processes (Judge & Ilies, 2002; Latham & Pinder, 2005; Locke & Latham, 1990). As Barrick, Stewart, and Piotrowski (2002, p. 43) explained, the centrality of these cognitive processes is highlighted by Mitchell's (1997) widely applied definition of motivation: "those psychological processes involved with the arousal, direction, intensity, and persistence of voluntary actions that are goal directed."

The motivation and productive energy definitions reveal clear conceptual similarities. As collective constructs, both can be classified as emergent states. Also, both constructs involve the mobilization of a unit's members and, thus, are assumed to have important implications for unit effectiveness. Collective motivation and productive energy also have some distinctions. Whereas the majority of motivation models are based on a cognitive framework, productive energy considers members' cognitive processes as well as affective and behavioral resources. This suggests that productive energy is a broader concept than motivation; that is, the cognitive nature associated with the motivation process is one among three defining contributors to productive energy. In this way, we contend that when work units are energized, they are similarly motivated. Nevertheless, given that productive energy also involves unit members' positive feelings and agentic behavior (and motivation does not; Locke & Latham, 2004), it seems reasonable to expect that a work unit can be motivated and not productively energized.

Collective efficacy

The conceptualizations of collective efficacy and productive energy are assumed to be complementary but distinct. Bandura (2001) defined *collective efficacy* as a group's belief that its members have the capability to organize and execute shared courses of action. The productive energy construct is similar to collective efficacy because both constructs involve a heightened sense of confidence that will not only help unit members persevere during hard times but also facilitate the attainment of shared goals. On the other hand, collective efficacy is a belief, whereas productive energy consists of members' affect, behavior, and cognitions.

Group cohesion

Productive energy and cohesion are likely to be positively related—in part, because *cohesion* reflects members' tendencies to stick together in the pursuit of shared objectives and/or for the satisfaction of members' affective needs (Carron & Brawley, 2000). Hence, both constructs tap into positive social interactions and high-quality

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exchanges. We also suspect that the two constructs are different in that productive energy captures more than the cohesive (e.g., affective) bonds among a work unit's members. Finally, whereas research has shown that high cohesion can have performance benefits and detriments (Kozlowski & Bell, 2003), we assume that productive energy is generally a desirable emergent state.

Collective autonomy

An autonomous work unit is characterized by the high level of discretion afforded to its interdependent employees. Conceptually (e.g., Deci & Ryan, 2000), autonomy and productive energy may similarly influence unit effectiveness because of the motivational benefits associated with enriched tasks, from members' capability to rapidly respond to work demands and from gains involving members' synergistic work efforts. Yet, we contend that autonomy and productive energy are different insofar as a work unit can experience high levels of productive energy and still have a directive supervisor providing the leadership.

Collective exhaustion

The exhaustion of work unit members involves a depletion of coping resources, emotional fatigue, and mental weariness (Shirom, 2003b). Collective exhaustion would seem to share some overlap (albeit negatively correlated) with productive energy's positive emotional arousal dimension. Nevertheless, collective exhaustion involves negative, low-intensity emotions whereas productive energy's affective dimension connotes positive, high-intensity emotions. With regard to this latter point, prior research suggests that these affective states are independent of one another (Diener, Smith, & Fujita, 1995). Given that collective exhaustion is limited to members' affective experiences, we suspect that it will have a small to moderate (negative) relationship with productive energy.

> *Hypothesis 3:* Productive energy will be positively related to but distinct from the collective constructs of motivation, efficacy, cohesion, and autonomy and negatively related to but distinct from collective exhaustion (study 3).

Productive energy and unit effectiveness

Unit effectiveness is a multifaceted construct (Cohen & Bailey, 1997; Hackman, 1987; Mathieu et al., 2008) with an emphasis on both internal criteria (e.g., members' *affective reactions*) and external *performance* (e.g., quality and quantity). Recognizing that both internal and external criteria represent viable and conceptually important outcomes of productive energy, we included both in the present study.

We investigated whether productive energy would increase three internal criteria—commitment to the organization, commitment to shared goals, and satisfaction with the job—as they are vital to a unit's functioning (e.g., Mathieu et al., 2008) and the organization's overall success (e.g., Harter, Schmidt, & Hayes, 2002; Ostroff, 1992). Although no empirical evidence relating productive energy to these internal criteria is accessible, we predicted that energized work units are likely to report being committed to the organization and its goals and being satisfied with their work. For example, a productively energized unit is anticipated to achieve organizational objectives in new and better ways, and it does so by strengthening the high-quality connections among its members (Dutton & Heaphy, 2003). As Dutton and Ragins (2007) and Quinn (2007) explained, energized connections (i) enable members to engage more fully in their individual roles, (ii) encourage members to work more cooperatively to ensure that unit goals are met, and (iii) strengthen members' commitments to their units and the organization. In addition, when unit members enjoy positive interactions with one another, basic needs are being fulfilled and, by extension, feelings of satisfaction increase (see, e.g., Dutton, 2003). On this basis, we expected that the higher the level of productive energy within units, the greater the chance that members, on the whole, will be (i) committed to its goals, (ii) committed to the organization, and (iii) satisfied in their jobs.

> *Hypothesis 4:* Productive energy will be positively related to the collective attitudes of goal commitment, organizational commitment, and job satisfaction (study 3).

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We also wished to explore how productive energy operates in concert with the established and conceptually related constructs. Thus, we proceeded to investigate whether productive energy can account for unique variance in the collective attitudes beyond what is captured by the related constructs.

> *Hypothesis 5:* Productive energy will be positively related to the collective attitudes after controlling for the effects of collective motivation, efficacy, cohesion, autonomy, and exhaustion (study 3).

Finally, as reasoned above, we expected productive energy to be related to external performance. Organizational members who are productively energized are more likely to engage in knowledge creation activities that benefit not only their unit but also the organization as a whole. Further, one might predict that rather than withdrawing from a challenging situation, such as one in which unit members are unable to resolve work-related problems, productively energized units will escalate their efforts in search of innovative solutions. It is also likely that high levels of productive energy facilitate organizational goal attainment because employees invest more effort in their work, which in turn may lead to higher levels of overall firm performance. As an example, Dutton (2003) stated that energy “contributes to making organizations and the people within them extraordinary” (p. 6). Others have likewise suggested that a firm’s human capital may be the ultimate determinant of its performance (Cameron, Bright, & Caza, 2004; Ployhart & Moliterno, 2011; Ployhart, Weekley, & Ramsey, 2009).

> *Hypothesis 6:* Productive energy will be positively related to firm performance (study 4).

Development of the Productive Energy Measure

We generated an initial set of items following in-depth interviews (ranging in length from 90 to 120 minutes) with 50 experienced corporate executives (senior and middle-level managers) drawn from a US headquartered company. We asked interviewees to describe specific phases or moments when their constituents worked in an energetic (and lethargic) fashion (e.g., What made the situation [un]lively? What feelings and/or behaviors were salient during this moment? Can you describe how persons interacted?). We evaluated the interview data and devised items from these responses. We supplemented these items by culling items from published sources (e.g., Van Katwyk, Fox, Spector, & Kelloway, 2000) that we modified and included in the item pool. Finally, each author independently generated items on the basis that the items were believed to reflect the productive energy content domain as described in Baker et al. (2003) and Bruch and Ghoshal (2003).

We created a pool of 38 candidate items. Each item referred to the work unit as a whole (i.e., a referent-shift composition model; Chan, 1998). Three doctoral candidates independently reviewed the 38 items for clarity. On the basis of their suggestions, we eliminated or rephrased items (reducing the item pool to 29 items). We then conducted a content adequacy assessment (cf. MacKenzie, Podsakoff, & Fetter, 1991; Van Katwyk et al., 2000). This assessment resulted in an initial set of 17 items for the proposed PEM.

Study 1

Procedures and sample

All employees with a company e-mail address received an electronic message from the chief executive officer describing the study and providing an internet link to a portal where they could complete the web-based survey. In all, 2208 employees chose to voluntarily respond to the 17 PEM items for an overall response rate of 28 per cent.

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The US sample was composed of 5 per cent division-level managers, 5 per cent business area managers, 27 per cent team leaders, and 63 per cent non-managerial employees. The majority of respondents (88 per cent) were between 30 and 60 years old, and 79 per cent indicated an organizational tenure of 5+ years.

Level issues

The level of measurement and analysis in study 1 is at the individual-level. As Kozlowski and Klein (2000) noted, when the theoretical origin of a shared property is the individual, the data collected to assess the proposed construct should match their level of origin. Hence, because productive energy is believed to originate in the affect, cognition, and behavior of individual unit members, we felt it necessary to first evaluate the quality of the factor structure of PEM by using data that best reflect the construct's origin—the individual.

Results of Study 1

We examined the underlying structure of the PEM by using both exploratory (EFA) and confirmatory (CFA) factor analyses because this analytic approach provides for an overall improved and more reliable factor structure (Gerbing & Hamilton, 1996). We randomly divided respondents into two subsamples of roughly equal sizes: we used subset I ($n = 1115$) in the EFA and subset II ($n = 1093$) in the CFA.

Preliminary item-level tests

Following Hinkin (1998), we used EFA to create a more parsimonious representation of the initial set of 17 items. The EFA yielded a three-factor solution explaining 57 per cent of the common variance. Each factor clearly reflected one of the three *a priori* dimensions. After we eliminated items with loadings of less than 0.40 and items that exhibited cross-loadings greater than 0.32 (Osborne & Costello, 2004), 14 items remained. The retained items loaded on their intended factor 0.45 and above.

Next, we computed each item's corrected item-total correlation (CITr; the correlation between an item and the sum of the remaining items on the same subscale). We compared each CITr value with the correlation obtained between the respective item and scores computed for the other energy dimensions. Comparisons suggested that one behavioral item might be problematic because of high correlations with nontargeted subscales. The 14-item PEM was reliable ($\alpha = .88$). Cronbach's alpha for the five-item affective dimension was .90, for the five-item cognitive dimension alpha was .77, and for the four-item behavioral dimension alpha was .61.

Test of Hypothesis 1

We predicted that the PEM would reflect a second-order factor structure with the three energy dimensions serving as latent indicators of the second-order productive energy construct. To evaluate the fit of a more restricted model (such as a second-order factor structure) relative to its corresponding correlated-factors first-order model, Marsh and Hocevar (1985) developed the target coefficient (T). In the present instance, the second-order factor structure and the corresponding first-order model with three correlated factors are equivalent in terms of their ability to fit the data (Marsh & Richards, 1987). Such a "just-identified" model is due to the number of covariance terms fixed to zero (3), which is the same number of parameters needed to define a second-order factor. As a result, the T coefficient will always yield the upper limit value of 1.0. Following Marsh and Richards (1987), we therefore evaluated other indicators of model fit: (i) the factor loadings for the first-order factor onto the second-order factor contribute significantly to the second-order factor and (ii) the correlations among the first-order factors are sufficiently high.

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On the basis of CFA, a second-order model (using the 14 items from the EFA) yielded a strong fit to the observed data: comparative fit index (CFI) = 0.99, Tucker–Lewis index (TLI) = 0.99, and the root mean square error of approximation (RMSEA) = 0.051, with a confidence interval (CI, 90 per cent) = 0.045 to 0.057. Items loaded on their intended dimension (average factor loading = 0.66), all of which are statistically significant with t-values ranging from 8.36 to 36.87. One behavioral energy item exhibited a standardized factor loading (0.31) of less than 0.40; it is the same behavioral item identified as potentially problematic in the CITr comparisons. The three energy dimensions loaded significantly (t-values ranging from 18.31 to 19.73) on the second-order factor, with an average loading of 0.78. The three energy dimensions also correlated with each other (average $r = .47$) and with the second-order factor (average $r = .77$).

We then examined the fit of four alternative models (merging dimensions onto a common latent variable) to ensure the discriminant validity of the dimensions comprising productive energy. As shown in Table 1, results demonstrated that each alternative model was a significantly worse fit to the observed data. Hence, CFA results support Hypothesis 1.

Study 2

Hinkin (1998) has recommended that Cronbach's alpha for a new measure should not fall below a .70 threshold (p. 113), yet the reliability reported for the behavioral subscale in study 1 was $\alpha = .61$. To address the low reliability, we included two additional behavioral items that we developed to better tap the theoretical domain of interest. In total, we administered 16 items (14 initial PEM items + 2 new items) to respondents of study 2.

Procedures and sample

Study 2 data collection procedures were identical to those of study 1. Of the employees invited to participate, 660 completed the 16 PEM items for a response rate of 57 per cent. The US sample (from an independent organization) consisted of 7 per cent sector and business area managers, 27 per cent line-managers or team leaders, and 66 per

Table 1. Studies 1 and 2: comparison of alternative confirmatory factor analysis models.

Model	χ^2	df	$\Delta\chi^2$ (Δdf)	AIC index
Study 1 ($n = 1093$)				
Hypothesized (second-order model)	281.8	74	—	371.8
One factor	1068.6	77	786.8(3)**	1152.6
Two factor—model 2 (cognitive + affective combined)	833.2	76	551.4(2)**	919.2
Two factor—model 3 (behavioral + affective combined)	633.2	76	351.4(2)**	719.2
Two factor—model 4 (cognitive + behavioral combined)	440.7	76	158.9(2)**	526.7
Study 2 ($n = 660$)				
Hypothesized (second-order model)	285.5	74	—	375.5
One factor	774.5	77	489.0(3)**	858.5
Two factor—model 2 (cognitive + affective combined)	657.3	76	371.8(2)**	743.3
Two factor—model 3 (behavioral + affective combined)	648.5	76	363.0(2)**	734.5
Two factor—model 4 (cognitive + behavioral combined)	293.6	76	8.1(2)*	379.7

Note. AIC = Akaike information criterion; df = degrees of freedom. When comparing AIC values for two competing models, the model with the lowest AIC value reflects the best fitting model (Browne & Cudeck 1989).
*$p < .05$; **$p < .01$.

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cent non-managerial employees. The majority of respondents (84 per cent) were between 30 and 60 years old, and 68 per cent reported an organizational tenure of 5+ years.

Level issues

Given the modifications to the PEM (i.e., additional items), we re-examined the underlying factor structure of PEM at its theoretical origin. Thus, the level of measurement and analysis is at the individual level.

Results of Study 2

Preliminary item-level tests

CIT*r* comparisons indicated two behavioral items (viz., the problematic item from study 1 and a new item developed for study 2) that exhibited strong empirical overlap with nontargeted subscales. We removed both items from the behavioral energy subscale. The affective and cognitive subscales continued to yield a homogenous and unique item set per dimension. The revised PEM was reliable ($\alpha = .89$). Cronbach's alpha for the dimensions were .89 for affective (five items) energy, .74 for cognitive (five items) energy, and .73 for behavioral (four items) energy.

Test of Hypothesis 1

Using CFA, we attempted to cross-validate the factor structure of PEM. Consistent with study 1, fit of the second-order model was excellent: CFI = 0.99, TLI = 0.99, and RMSEA = 0.066, with a CI (90 per cent) = 0.058 to 0.074. Each item loaded strongly on its intended dimension (average factor loading = 0.68). All three energy dimensions loaded strongly on the general productive energy factor, and both first-order and second-order factor loadings are significant with *t*-values ranging from 11.32 to 27.18. The three energy facets are significantly correlated with each other (average $r = .59$) and correlated with the second-order factor (average $r = .85$). The alternative model comparisons (Table 1) suggest that the hypothesized model is the best fit to the observed data. As in study 1, Hypothesis 1 is supported.

Study 3

A potential shortcoming of studies 1 and 2 is that both focused on the measurement properties of PEM at the individual-level of analysis. In study 3, we reconcile this concern by continuing the construct validation process at the work-unit level.

Research setting and data transportability

We collected data in two waves. We administered the time 1 and time 2 surveys (6 months later) to employees nested in 145 departmental units (from a single organization) across five countries. The five countries, respective sample sizes, and response rates for time 1 are as follows: France ($n = 462$, 24 per cent), Sweden ($n = 179$, 57 per cent), Switzerland ($n = 941$, 55 per cent), the UK ($n = 412$, 42 per cent), and the USA ($n = 664$, 48 per cent). At time 2, they are as follows: France ($n = 450$, 22 per cent), Sweden ($n = 267$, 76 per cent), Switzerland ($n = 969$, 53 per cent), the UK ($n = 436$, 35 per cent), and the USA ($n = 534$, 38 per cent).

Given the multinational nature of the host organization's workforce, it was necessary to translate all study materials into multiple languages (e.g., German, French, Swedish), and we did so by contracting a professional translation. Linguists followed a double-blind back-translation strategy when translating items from English to the target language. Almost half of the respondents (44 per cent) completed surveys in English (time 1 = 45 per cent, time 2 = 42 per cent), 28 per cent were completed in German (time 1 = 28 per cent, time 2 = 29 per cent), 18 per cent were completed in French (time 1 = 18 per cent, time 2 = 18 per cent), and 8 per cent were completed in Swedish (time 1 = 7 per cent, time 2 = 10 per cent). The remaining 2 per cent of surveys were completed in other languages (i.e., Italian or Spanish).

Recognizing the importance of establishing measurement equivalence when drawing data from multiple nations (Schaffer & Riordan, 2003), we examined both cross-national and cross-language equivalence (defined as invariant factor loadings; Cole, Bedeian, & Feild, 2006) of the PEM and other study measures. Multigroup CFA results indicate that all measures are equivalent across the five country samples and four language groups. Thus, cultural and linguistic differences are not a threat to the present research.

Data collection procedures and sample characteristics

We invited all firm employees (time 1, $N = 6337$; time 2, $N = 6819$) to participate. We employed a web-based data collection methodology that allowed respondents to choose the survey language in which they were most comfortable in conversing. For potential respondents who did not have a company e-mail address or computer access (e.g., off-site staff), we delivered identical paper-and-pencil surveys via internal company mail. We made available multiple versions of the paper-and-pencil surveys (e.g., the English version and one to three other languages). We conducted measurement equivalence tests to ensure that the measures were comparable across modes of administration (Cole et al., 2006).

Time 1 sample

Of the 2658 employees who participated (response rate = 42 per cent), 2440 completed a web-based survey and 218 completed a paper-and-pencil survey that respondents subsequently mailed directly to one of the researcher's university address. The sample is composed of 10 per cent upper level managers, 27 per cent line-managers and team leaders, and 63 per cent non-managerial employees. The majority of respondents (83 per cent) were male; 84 per cent were between 30 and 60 years old, and 68 per cent reported an organizational tenure of 5+ years.

Time 2 sample

Of the 2679 employees who participated (response rate = 39 per cent), 2502 completed a web-based survey and 177 completed a paper-and-pencil survey. The sample is composed of 5 per cent upper level managers, 32 per cent line-managers and team leaders, and 64 per cent non-managerial employees. They were primarily (81 per cent) male; 80 per cent were between 30 and 60 years old, and 70 per cent reported an organizational tenure of 5+ years.

Level issues

The level of measurement is at the individual level (i.e., individual unit members responded to survey items), and the level of analysis is at the work unit. In study 3, we focused on departmental units as they were the most stable operational element in the host organization. As such, we used an "identifier" to match individuals nested in work units over time. Roughly 30 per cent of the respondent samples chose not to report unit membership. We excluded these data from the ensuing analyses. As a result, the time 1 sample consisted of 1688 respondents nested in 138 departments; the time 2 sample consisted of 1889 respondents nested in 126 departments. We used these data in

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aggregate-level factorial validity (Hypothesis 1), statistical aggregation (Hypothesis 2), and convergent discriminant-validity (Hypothesis 3) assessments. Predictive (Hypothesis 4) and incremental (Hypothesis 5) validity hypotheses required that we match departments' time 1 and time 2 data. We successfully linked department-level (averaged) scale scores for 119 work units (average unit size was 12 members and 15 members, respectively). Tests indicated no significant differences between the average scale scores for the matched 119 units versus the 26 excluded units providing data at only one measurement point.

Measures at time 1

With the exception of the affective energy dimension, responses were on a five-point continuum ranging from 1 (strongly disagree) to 5 (strongly agree). We used a referent-shift composition model for all study measures.

Productive energy ($\alpha_{unit} = .87$)

We used the final 14-item measure (Appendix).

Other conceptually related constructs

We assessed *collective motivation* ($\alpha_{unit} = .75$) by adapting three items from the internal work motivation scale (Hackman & Oldham, 1980) and combining these items with three adapted items from the motivational orientation inventory of Barrick et al. (2002). We gauged *collective efficacy* ($\alpha_{unit} = .81$) by using four-items developed by Riggs and Knight (1994). We assessed *cohesion* ($\alpha_{unit} = .93$) using four-items from a cohesiveness measure (Riordan & Weatherly, 1999). We tapped *collective autonomy* ($\alpha_{unit} = .87$) with four-items taken from Kirkman and Rosen (1999). We measured *collective exhaustion* ($\alpha_{unit} = .90$) by adapting Maslach and Jackson's (1981) nine-item exhaustion measure.

Internal effectiveness criteria at time 2

Survey 2 assessed units' collective attitudes, otherwise known as internal effectiveness criteria (cf. Mathieu et al., 2008). The 6-month temporal separation between the measurement of the PEM and criteria served two purposes: (i) it allowed the emergent phenomena time to manifest (Kozlowski & Klein, 2000) and (ii) it minimized common-method concerns (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003).

Goal commitment ($\alpha_{unit} = .84$)

We gauged members' commitment to shared goals by modifying Hollenbeck, Klein, O'Leary, and Wright's (1989) four-item measure.

Organizational commitment ($\alpha_{unit} = .86$)

We assessed the extent to which unit members felt emotionally attached and engaged in their organization by using five items from an affective commitment measure (Porter, Steers, Mowday, & Boulian, 1974).

Job satisfaction ($\alpha_{unit} = .68$)

We tapped members' overall feeling about their job with three items developed by Brayfield and Rothe (1951).

Sample covariate

It was anticipated that cultural differences may have an effect on the study's focal variables (e.g., Schwartz, 1999). Peterson and Smith (1997) suggested that *country* is a useful culture delimiter. Accordingly, we assessed whether units were located in (i) USA, (ii) UK, (iii) France, (iv) Switzerland, and (v) Sweden.

Results of Study 3

Table 2 presents the means, standard deviations, and intercorrelations for all variables.

Hypotheses tests

As in prior studies, we used CFA to compare the fit of the second-order model with the fit of four alternative factor structures (i.e., Hypothesis 1). We computed CFAs using aggregated ($n = 138$ departmental units) data. The second-order factor structure was a superior representation of the aggregated data: CFI = 0.99 and TLI = 0.99. The RMSEA was 0.093, with a CI (90 per cent) = 0.074 to 0.113. Given that the unit-level sample size is less than 250, we interpreted the RMSEA cautiously (Hu & Bentler, 1999; see also, Jackson, 2003). First-order factor loadings ranged from 0.39 to 0.84, and their t-values ranged from 3.84 to 8.83 ($p < .01$). Second-order factor loadings ranged from 0.73 to 0.93, and their t-values ranged from 5.96 to 6.91 ($p < .01$), demonstrating that each first-order factor is a valid indicator of the higher-order productive energy factor. First-order factors correlated with each other (average $r = .51$) and with the second-order factor (average $r = .82$).

We then examined the fit of four alternative models to ensure the discriminant validity of the dimensions comprising productive energy. As before, model comparisons included merging dimensions onto the same latent variable. In Table 3, we summarize the alternative models, report the test results pertinent to each, and indicate that each of the alternative models is a worse fit ($p < .05$) to the observed data. All in all, results support Hypothesis 1; that is, productive energy is comprised of three distinct dimensions, and each dimension contributes to an overall construct.

Hypothesis 2 posited that productive energy is empirically distinguishable from its individual-level counterpart. The ICC1 value (using department as the independent factor) associated with PEM = 0.07 (ANOVA F [137, 1549] = 1.89, $p < .01$) exceeds the commonly applied 0.05 threshold (Bliese, 2000). Further, this result indicates that inter-member variance is significantly smaller within units than between units (Chen, Mathieu, & Bliese, 2004). The ICC2 value for PEM = 0.47. Although the ICC2 value is less than optimal, it was not entirely unexpected given that the units were nested within a single organization (Bliese, 2000; George, 1990) and relatively small in size

Table 2. Study 3: descriptives and correlations among variables in work units with matched time 1 and time 2 data.

			r								
Variable	*M*	*SD*	1	2	3	4	5	6	7	8	9
1. Productive energy (T1)	3.47	0.24	—								
2. Cohesion (T1)	3.80	0.36	.56	—							
3. Coll. autonomy (T1)	3.08	0.41	.28	.16	—						
4. Coll. exhaustion (T1)	2.76	0.35	−.22	−.31	−.35	—					
5. Coll. efficacy (T1)	3.74	0.33	.58	.63	.15	−.20	—				
6. Coll. motivation (T1)	3.89	0.23	.65	.50	.28	−.23	.53	—			
7. Goal commitment (T2)	3.80	0.32	.46	.32	.20	−.25	.42	.42	—		
8. Organizational commitment (T2)	3.20	0.38	.32	.17	.20	−.11	.26	.34	.64	—	
9. Job satisfaction (T2)	3.61	0.35	.37	.23	.33	−.20	.26	.22	.60	.63	—
10. USA (versus. others)	0.18	0.38	.25	.14	.05	−.14	.29	.32	.34	.57	.28
11. UK (versus others)	0.17	0.38	−.03	.00	−.35	.30	.09	−.06	.12	−.06	−.09
12. France (versus others)	0.22	0.41	−.05	−.21	.03	.19	−.31	−.32	−.37	−.21	−.01
13. Switzerland (versus others)	0.31	0.46	−.14	.07	.03	−.26	−.06	.04	.04	−.08	−.11
14. Sweden (versus others)	0.13	0.33	.01	−.01	.25	−.05	.03	.04	−.12	−.22	−.05

Note: $n = 119$ departments; T1 = time 1; T2 = time 2; Coll. = collective; SD = standard deviation.
Correlations greater than $|.17|$ are significant at $p < .05$.

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Table 3. Study 3: comparison of alternative confirmatory factor analysis models.

Model	χ^2	*df*	$\Delta\chi^2$ (Δdf)	AIC index
Time 1: Unit-level data ($n = 138$)				
Second-order model	162.3	74	—	252.3
One factor	236.1	77	73.8(3)**	320.1
Two factor—model 2 (cognitive + affective combined)	218.4	76	56.1(2)**	304.4
Two factor—model 3 (behavioral + affective combined)	216.5	76	54.2(2)**	302.5
Two factor—model 4 (cognitive + behavioral combined)	171.4	76	9.1(2)*	257.4

Note: AIC = Akaike information criterion; *df* = degrees of freedom. When comparing AIC values for two competing models, the model with the lowest AIC value reflects the best fitting model (Browne &, Cudeck, 1989).
*$p < .05$; **$p < .01$.

(Newman & Sin, 2009). If our average unit size was comparable with the one in Ostroff's (1992) ($M = 40.7$) study, the ICC2 value for productive energy would have been 0.75. Finally, median $r_{wg(j)}$ (James, Demaree, & Wolf, 1984) using a rectangular null distribution was 0.87. Although no strict guidelines for $r_{wg(j)}$ exist (Lance, Butts, & Michels, 2006), the observed value exceeds a common rule of thumb used to aggregate individual responses (i.e., 0.70 or greater; Chen et al., 2004). Consistent with Hypothesis 2, productive energy appears to be an emergent phenomenon. That is, energy referenced at the unit level considers the context or social environment in which individuals work and is distinct from the attributes of those individuals.

With respect to the other conceptually similar measures and study criteria, all one-way ANOVAs were statistically significant. ICC1 values ranged from 0.03 to 0.13, with an average across all measures of 0.07. ICC2 values ranged from 0.26 to 0.69, with an average across all measures of 0.47. Although there are no strict standards of acceptability for ICC1 or ICC2 values, we recognize that the ICC2 values are below common "rules of thumb" but are consistent with prior research (e.g., Schneider, White, & Paul, 1998). The median $r_{wg(j)}$ values using a rectangular distribution ranged from 0.62 to 0.88, with the average $r_{wg(j)}$ median value of 0.77. Considering the overall pattern of results, one can see that there is sufficient unit-level variability and within-unit agreement to suggest that the proposed higher-level analyses will yield meaningful results.

Hypothesis 3 predicted that productive energy would be related to the other conceptually similar constructs; however, the empirical associations should not be so high as to suggest empirical redundancy. As shown in Table 2, convergent validity correlations (using aggregated data) are in line with expectations. PEM most strongly correlated with motivation ($r = .65$), less so with collective efficacy ($r = .58$) and cohesion ($r = .56$), and weakest, yet still significantly, with autonomy ($r = .28$) and exhaustion ($r = -.22$).

We also computed the variance-extracted estimate for PEM (Fornell & Larcker, 1981) and assessed discriminant validity at the unit level (Anderson & Gerbing, 1988). The PEM variance-extracted estimate is 0.53, demonstrating that the proportion of variance explained by the PEM is greater than the variance due to measurement error. We then used chi-square difference tests to compare the fit of a correlated six-factor measurement model (PEM + the other five collective constructs) with the fit of alternative models that constrained a correlation between two constructs to 1.0 (Anderson & Gerbing, 1988). Results show that the freely estimated model is a significantly better fit to the data. Additional support for the non-redundancy between constructs is offered by the CIs around the latent correlations (φ); in no instance did any of the 95 per cent CIs contain the value of 1.0 (Anderson & Gerbing, 1988). Results are in line with Hypothesis 3.

Hypotheses 4 and 5 considered relationships between productive energy and the collective attitudes (i.e., internal effectiveness criteria). Whereas Hypothesis 4 posited direct positive relationships, Hypothesis 5 suggested that productive energy would explain variance in the criteria above-and-beyond that explained by the conceptually related constructs. As we stated in Hypothesis 4, productive energy positively predicted (beyond country covariates) goal commitment ($\beta = .46$, $\Delta R^2 = .21$, $p < .01$), organizational commitment ($\beta = .32$, $\Delta R^2 = .11$, $p < .01$), and job satisfaction ($\beta = .37$, $\Delta R^2 = .14$, $p < .01$). In regard to Hypothesis 5, incremental-validity results for PEM are also supportive (Table 4). The PEM accounted for 4.9 per cent of the variance in goal commitment ($\beta = .35$, $p < .01$) above the 35.5 per

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Table 4. Study 3: hierarchical regression analyses of internal effective criteria (time 2) on productive energy and theoretically related constructs (time 1).

	Collective attitudes								
	Goal commitment			Organizational commitment			Job satisfaction		
	ΔR^2	β	D	ΔR^2	β	D	ΔR^2	β	D
Block 1[a]	.21**			.31**			.07		
UK		−.08			−.42**			−.23*	
France		−.47**			−.60**			−.24*	
Switzerland		−.17			−.50**			−.28*	
Sweden		−.31**			−.58**			−.26*	
Block 2	.15**			.10**			.15**		
Cohesion		−.10	6.1		−.15	11.2		.00	5.5
Coll. autonomy		.14	16.0		.24**	41.0		.29**	40.4
Coll. exhaustion		−.06	8.1		.07	1.3		−.02	6.2
Coll. efficacy		.13	14.7		.02	3.2		.06	7.5
Coll. motivation		−.04	11.7		.06	13.5		−.18	6.9
Block 3	.05**			.02*			.04*		
Productive energy		.35**	43.3		.24*	29.8		.33*	33.5

Note. $n = 119$ departments; D = rescaled dominance; Coll. = Collective.
We report only final regression models.
[a]We used USA as the referent.
*$p < 0.05$; **$p < 0.01$.

cent accounted for by block 1 (i.e., country covariates) and block 2 (i.e., conceptually similar constructs); 2.2 per cent of the variance in organizational commitment ($\beta = .24$, $p < .05$) above the 40.9 per cent accounted for by blocks 1–2; and 4.4 per cent of variance in job satisfaction ($\beta = .33$, $p < .05$) above the 21.5 per cent accounted for by blocks 1–2.

Supplementary analyses

LeBreton, Hargis, Griepentrog, Oswald, and Ployhart (2007) recommended that creators of a new measure should not only show incremental validity but also determine the new measure's importance, relative to existing constructs in regression equations. Such a test is possible using dominance analysis (Johnson & LeBreton, 2004). Results (denoted as D in Table 3) demonstrated that productive energy is the most important predictor of goal commitment; it dominated all other predictors by accounting for 43 per cent of the variance in goal commitment. Results for organizational commitment indicated that across all possible predictor combinations, autonomy ($D = 41$ per cent) and PEM ($D = 30$ per cent) outperformed the remaining predictors. This finding reveals that despite the small incremental validity of PEM ($R^2 = .02$), when simultaneously compared with the other predictors, productive energy emerged as one of the two most important explanatory variables of organizational commitment. We obtained a similar result for job satisfaction; both autonomy ($D = 40$ per cent) and PEM ($D = 34$ per cent) completely dominated all remaining predictors.

Study 4

Study 3 focused on relationships between productive energy and internal effectiveness criteria. Results supported our expectations using a sample of departmental units from a single organization, but questions remain regarding

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the degree to which productive energy may also manifest at other higher levels of analysis and whether it relates to external effectiveness criteria. The objective of study 4 was to address both questions.

Procedures and sample

Participants were employees of firms located in Germany. We asked each firm ($n = 92$) to invite all employees (via e-mail solicitation) to complete a web-based survey that included the final 14-item PEM. If necessary, firms installed personal computers (in public areas) with access to the World Wide Web to help ensure employee coverage (i.e., employees without a company e-mail address). We invited, in total, 15 024 employees, with 5939 choosing to complete the PEM for a response rate of 39.7 per cent. The typical employee participant had no managerial responsibilities (71 per cent), and roughly half were male (52 per cent). The majority of respondents (70 per cent) were between 30 and 60 years old, and 61 per cent reported an organizational tenure of 4+ years.

After 1 month, key informants (i.e., senior level executives, heads of human resources) provided a perceptual rating of their firm's performance and reported on firm size and age. We did not request demographic data on key informants out of concern to keep the survey brief.

Level issues

The level of measurement for the PEM is at the individual level (i.e., individual members responded to survey items), and the level of analysis is at the firm level.

Measures

Productive energy ($\alpha = .95_{\text{firm}}$)
We used the final 14-item (German) measure.

Firm performance
We asked key informants to respond to a single-item, "Compared to rival firms in your industry, the current performance of your firm is …" (1 = far below average; 7 = far above average). Not only has prior research indicated that single-item measures will suffice when the construct being measured is unambiguous to the respondent (Wanous, Reichers, & Hudy, 1997) but also empirical evidence has demonstrated that single-item measures are valid and may be used to gain insight into operational and organizational performance (Combs, Crook, & Shook, 2005; Wall et al., 2004; Wanous & Hudy, 2001).

Sample covariates
At the firm level of analysis, researchers often collect data on firm size and firm age to capture "other" organizational factors that might covary with independent and dependent variables (Rogers & Wright, 1998). We collected data relating to these firm-level characteristics as study controls.

Results of Study 4

Test of Hypothesis 2 and 6

Supporting Hypothesis 2, an ANOVA using *firm* as the independent factor shows that there is between-firm variance in productive energy, $F(91, 5692) = 6.12$, $p < .001$. The ICC1 = 0.08, ICC2 = 0.84, and median $r_{wg(j)}$ value

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(using a rectangular null distribution) = .84, coupled with the ANOVA result, indicate that productive energy is capturing emergent firm-level properties that are distinct from its individual-level parent construct. The higher ICC1 and ICC2 values obtained in study 4 suggest that between-firm differences for the aggregate energy construct are greater relative to the single-firm sample used in study 3 (cf. Chen et al., 2004, p. 291).

Hypothesis 6 predicted that higher levels of productive organizational energy would be positively related to overall firm performance. Results suggest a positive association between productive energy and firm performance ($\beta = .24$, $\Delta R^2 = .06$, $p < .05$) beyond the firm-level covariates of size and age. Hypothesis 6 received support.

General Discussion

We sought to advance understanding of the energy at work concept by responding to calls for the development of measures designed to meaningfully assess positive constructs (e.g., Cameron & Caza, 2004; Luthans & Avolio, 2009; Spreitzer & Sonenshein, 2004). To this end, we developed a new instrument, tagged the PEM, and provided initial evidence of its construct validity. In doing so, we provided conceptual clarity about what energy is, how it materializes as a collective phenomenon, and how it might influence unit's internal and external effectiveness.

With empirical evidence supporting the psychometric properties of PEM, we proceeded to tackle a key assertion: energy benefits both individuals and employer organizations (Dutton, 2003, p. 7). Notably, our findings are in line with Dutton's remarks. As reported in study 3, members of productively energized units were committed to achieving shared goals, attached to and involved in the organization, and were more likely to be satisfied with their jobs (even when controlling for a battery of established constructs). Study 4 demonstrated that the productive energy of firms is positively associated with firm performance. Considered together, our findings clearly contribute to the nascent body of research on workplace energy by demonstrating that the energy collectively experienced has a measureable impact on organizationally relevant criteria.

This study also makes practical contributions. Given the empirical evidence presented, organizations may wish to monitor productive energy levels to ensure that the energy attributes are being properly nurtured. Managers or human resource professionals can easily accomplish this task because the PEM consists of 14 self-report items that one can administer in a variety of settings and contexts and interpret using basic statistical techniques. Through repeated assessments (e.g., after establishing a baseline), organizations attempting large-scale change initiatives might also use PEM scores to diagnose where energy levels are most depleted within an organization. For example, knowing whether work units are "productively energized" might inform practitioners to needed interventions and/or respite periods during change transformations.

Limitations and future research directions

The current study's contributions should be interpreted in light of its potential limitations. One issue that warrants discussion is the extent to which common-method variance (CMV) may have influenced the findings in our study 3. We offer three reasons why CMV is not a major limitation of this study. As recommended by Podsakoff et al. (2003), we first employed a procedural remedy to control for CMV. More specifically, we separated the measurement of the PEM and criterion variables by introducing a lengthy time lag (24 weeks). Second, discriminant-validity analyses described as part of our analyses affirmed that the PEM was empirically distinct from other collective constructs assessed in study 3. The existence of CMV would have resulted in fewer latent factors (Podsakoff et al., 2003). Third, we followed procedures outlined by Williams, Cote, and Buckley (1989) to determine the likelihood of CMV in our study 3 data. Using CFA and unit-level data, we created a nine-factor measurement model (i.e., the PEM , the conceptually related [five] constructs, and the collective [three] attitudes)

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and examined the potential increase in model fit when taking into account a latent common methods factor (Williams et al., 1989). Results showed that adding a method factor to the measurement model did improve model fit, $\Delta\chi^2(34) = 120.8$, $p < .01$. Yet, the variance extracted by this common methods factor was only .23, falling well below the .50 threshold that is suggested to indicate the presence of a substantive influence (Fornell & Larcker, 1981). Although we acknowledge that CMV may be present in our study 3 data, it is unlikely to have been a serious enough problem to disparage hypotheses testing.

We also note that our use of key informants to assess firm performance (in study 4) may have introduced random measurement error and reduced the performance variable's reliability (Gerhart, Wright, McMahan, & Snell, 2000), but the implication is diminished significance levels in testing and not biased estimates. Moreover, because we cannot demonstrate that our perceptual measure is a valid predictor of more "objective" external performance, one could argue that different results might be obtained for other performance outcomes (e.g., firm growth). Although the use of key informants to provide perceptual ratings of firm performance does not invalidate our findings (see, e.g., Wall et al., 2004), future studies including objective metrics of operational and organizational performance would provide confidence in the robustness of our results. A remaining limitation is the potential for content deficiency, which is always a concern when developing a new measure (Hinkin, 1998). Future research that attempts to sample the construct domain even more broadly by expanding the items included in the PEM would help to determine if additional items add value in terms of reliability and validity.

Aside from these concerns, the present analysis suggests other interesting directions for future research. Thus far, we have conceptualized productive energy as an emergent phenomenon that is relatively stable because of the reinforcing nature of members' mutual interactions and the presence of organizational characteristics (e.g., leaders). In doing so, we have only considered productive energy from a between-units perspective. It seems possible that there may be particular periods in which it is critical for units to produce concentrated bursts of energy, for example, when working on an important group project or when facing a pressing deadline. It is conceivable that future research might benefit from a within-units approach that focuses on the dynamic and mutable aspects of productive energy. This dynamic or within-units view may offer insights into the performance episodes of work units over shorter periods. In this respect, a longitudinal (i.e., repeated measures) design would allow one to address questions like "Does an upward change in productive energy lead to increased performance or do performance changes increase/decrease productive energy?" Alternatively, support may be found for reciprocal relationships. Consequently, we advocate future research that takes this complementary perspective.

We also examined predictive relationships at a single-level of theory and analysis. As Kozlowski and Klein (2000) explained, when tackling previously unexplored phenomena, researchers "may find it helpful to initially act as if the phenomena occur at only one level of theory and analysis. In this way, a theorist temporarily restricts his or her focus, putting off consideration of multilevel processes for a period" (p. 13). Although the single-level model was appropriate for our stated objectives, a unique contribution will integrate the PEM into a more complex multilevel framework. Future research should, therefore, include cross-level effects from unit-level productive energy to individuals' psychological capacities (e.g., individual-level energy, engagement, flow) and relevant criteria. Finally, we assumed that mutual interaction is the basic building block upon which productive energy is constructed, but we did not explicitly assess interaction processes. Future research that advances and tests a model linking such processes with productive energy and its outcomes would be worthwhile. In a similar fashion, it would be interesting to explore the within-unit factors (e.g., composition, interdependence, task type) that influence the emergence of productive energy.

Conclusion

To conclude, Locke (2007) observed that to have lasting value, a concept must gradually develop from an accumulating body of evidence. Thus, despite encouraging results, we acknowledge that this research is only a first step and look forward to future research that replicates and extends the ideas introduced here. Indeed, we hope that the new measure proves useful to those interested in studying energy in the workplace and facilitates the much needed empirical research into this important phenomenon.

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APPENDIX

Final 14-item productive energy measure
Affective dimension[a]
People in my work group feel excited in their job.
People in my work group feel enthusiastic in their job.
People in my work group feel energetic in their job.
People in my work group feel inspired in their job.
People in my work group feel ecstatic in their job.
Cognitive dimension
My work group is ready to act at any given time.
People in my work group are mentally alert.
In my work group, there is a collective desire to make something happen.
People in my work group really care about the fate of this company.
People in my work group are always on the lookout for new opportunities.
Behavioral dimension
People in my work group go out of their way to ensure the company succeeds.
People in my work group often work extremely long hours without complaining.
There has been a great deal of activity in my work group.
People in my work group are working at a very fast pace.

Note: We instructed the employees to do the following: "Read the following set of statements and indicate the extent to which each describes the *current state of your direct work group*. A work group is defined as the team, group, or department one functions in." Responses to the affect (five) items were on a five-point frequency scale (1 = never; 5 = frequently, if not always). Responses to the cognition (five) items and behavioral (four) items were on a five-point agreement continuum (1 = strongly disagree; 5 = strongly agree).

[a] Items are an adapted version of the pleasant–aroused affect scale of Van Katwyk et al. (2000).

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