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475

Piia Seppälä

Work Engagement

Psychometrical, Psychosocial, and Psychophysiological Approach

JYVÄSKYLÄN YLIOPISTO

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UNIVERSITY OF JYVÄSKYLÄ

JYVÄSKYLÄ 2013

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ABSTRACT

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This research investigated work engagement from psychometrical, psychosocial and psychophysiological viewpoints. The specific aims were to investigate the construct validity and factorial invariance of the Utrecht Work Engagement Scales (UWES-17 and UWES-9) among Finnish employees, and the stability of work engagement over three- and seven-year time-periods. Furthermore, this research investigated the strength and direction of the relationship between job resources (i.e., role clarity, supervisory support, positive organizational climate and innovative climate) and work engagement. Finally, the research examined the possible linkages between work engagement and healthy cardiac autonomic activity, indicated by decreased heart rate and increased heart rate variability. This research utilized eight different Finnish datasets gathered from six research projects, of which one was a seven-year (2003–2010) longitudinal project with three-waves. The datasets included employees from various occupational groups (e.g., managers at different levels, health care personnel, educational employees, dentists, and cleaning workers). Study I utilized five of the datasets (n = 9,404), including the first follow-up from the longitudinal data (three-year follow-up n = 2,555). Study II was based on the seven-year longitudinal data with two- and three-waves (n = 1,964). Study III was part of the interdisciplinary research project and comprised 30 Finnish female cleaning workers. The main results revealed that both the UWES-17 and the UWES-9 consisted of three theoretically based and highly interrelated (r = .83–.97) dimensions: vigor, dedication, and absorption. However, only the short version of the scale, the UWES-9, measured these three dimensions invariantly among different occupational groups and at different time-points. The three dimensions showed high rank-order stabilities over the three-year period (β = .82–.86), and over two-thirds of the total variance of work engagement was accounted for by stable variance over the seven-year period. The relationship between job resources and work engagement was practically reciprocal and equally strong in both directions. Finally, work engagement was related to healthy cardiac autonomic activity, in particular to increased parasympathetic control. These main findings indicate that work engagement can be conceptualized as three different, though highly related dimensions, and that the UWES-9 is a psychometrically adequate measure to assess work engagement among Finnish employees. Work engagement is highly stable over time, but it can be fostered through psychosocial job resources. However, work engagement also fosters job resources, and thus job resources and work engagement form a positive reinforcement cycle. Finally, work engagement might be related to cardiac health via optimal functioning of cardiac autonomic activity. To conclude, work engagement is an important resource both for employees and for organizations. Therefore, organizations should promote work engagement among their employees by offering sufficient job resources; in turn, employees could also actively create their own job resources.

Keywords: work engagement, construct validity, stability, job resources, cardiac autonomic activity

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LIST OF ORIGINAL PUBLICATIONS

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II Seppälä, P., Hakanen, J., Mauno, S., Perhoniemi, R., Tolvanen, A., & Schaufeli, W. (2013). Stability and change model of job resources and work engagement: A seven-year three-wave follow-up study. *Manuscript submitted for publication.*

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TABLES

CONTENTS

1 INTRODUCTION

Work engagement, a positive, fulfilling, work-related state of mind, has recently gained increasing research interest in the field of occupational health psychology (for overviews, see, e.g., Albrecht, 2010b; Bakker & Leiter, 2010b). This interest in work engagement is linked with the emergence of so-called positive psychology at the beginning of the millennium (Seligman, 2002; Seligman & Csikszentmihalyi, 2000). Positive psychology studies and promotes human strengths, optimal functioning, health and well-being, which are seen as more than just the absence of unwell-being or ill-health; instead, they need to be acknowledged in their own right.

Despite the growing interest in positive occupational health psychology, the number of constructs and measures that indicate positive well-being at work are rather limited. This is probably one of the reasons why the Utrecht Work Engagement Scale (UWES), the scale that assesses work engagement (Schaufeli, Salanova, González-Romá, & Bakker, 2002), has been translated into several languages and used in scientific research among different organizational and occupational groups in many different countries. However, at the same time the psychometric properties of the UWES in different cultural contexts and in different time points have not been fully verified.

Furthermore, on the one hand, work engagement is theoretically assumed and has also been empirically demonstrated, to indicate a pervasive and persistent work-related state of mind (Schaufeli & Bakker, 2010; Schaufeli, Salanova, et al., 2002). On the other hand, psychosocial job resources are expected initiate work engagement (e.g., Bakker & Demerouti, 2007; Demerouti, Bakker, Nachreiner, & Schaufeli, 2001), while recent longitudinal studies have also revealed that the relationship between work engagement and job resources might be reciprocal (e.g., Salanova, Schaufeli, Xanthopoulou, & Bakker, 2010). However, research on the relationship between work engagement and job resources has not always fully taken the stability of work engagement into account. It is thus possible that the amount of stability in work engagement has been underestimated, and hence no clear evidence exists on the extent to which job resources may influence work engagement, or on the direction of that relationship.

Finally, work engagement has been related to many positive consequences both for the organization and for the individual; work engagement has even sometimes been related to better psychosomatic and physical health (for overviews, see, Bakker, 2009; Bakker, Albrecht, & Leiter, 2011b). However, knowledge on the psychophysiological mechanisms that would explain how work engagement relates to physical health outcomes is much scarcer. To date, no studies have been able to find any evidence of the psychophysiological mechanisms that would mediate the relationship between work engagement and better self-rated health (Langelaan, Bakker, Schaufeli, Van Rhenen, & Van Doornen, 2006; Van Doornen et al., 2009).

In this research, I aimed to filling these gaps in the literature by investigating work engagement from psychometrical, psychosocial, and psychophysiological viewpoints. The main interests were in the psychometric properties and the stability of work engagement (psychometrical approach), the strength and direction of the relationship between job resources and work engagement (psychosocial approach), and the possible linkages between work engagement and healthy cardiac autonomic activity (psychophysiological approach).

1.1 Conceptualizations of engagement at work

Despite the broad interest in engagement at work, to date there is no clear consensus on what (work) engagement means and how to best define and measure it (e.g., Albrecht, 2010a; Schaufeli & Bakker, 2010). Furthermore, there seems to be a difference in how researchers and practitioners define engagement. However, common to the many definitions of engagement is the notion that it is a positive work-related psychological and motivational state of mind that includes a genuine willingness to invest effort in one's work and toward organizational success (Albrecht, 2010a; Christian, Garza, & Slaughter, 2011; Schaufeli & Bakker, 2010; Simpson, 2009). Furthermore, there is agreement that engagement is a multi-dimensional construct, comprising an energy dimension and an identification (involvement) dimension. The theoretical reasoning for these two dimensions derive from the research on burnout (i.e., the negative opposite of work engagement; see, e.g., Maslach & Leiter, 1997; Maslach, Schaufeli, & Leiter, 2001; Schaufeli, Salanova, et al., 2002), which originally inspired the study of engagement. The dimensions of energy and identification are the opposites of the burnout dimensions of exhaustion and cynicism (Maslach, Jackson, & Leiter, 1996). However, there are two main but different definitions of engagement as the positive opposite of burnout: job engagement (Maslach & Leiter, 1997) and work engagement (Schaufeli, Salanova, et al., 2002). The main difference between these two definitions is whether engagement is seen as a direct opposite of burnout (Maslach & Leiter, 1997) or as a conceptual opposite, that is, independent positive construct, albeit negatively related to burnout (Schaufeli, Salanova, et al., 2002). In the present research, work engagement is defined and operationalized according to the definition by Schaufeli and his colleagues (Schaufeli, Salanova, et al., 2002).

I shall discuss these two main definitions of work engagement after first providing a brief overview of the early conceptualization of work-related engagement (Kahn, 1990). Furthermore, because work engagement has gained noticeable interest among practitioners, I also present the definition "employee engagement" (Harter, Schmidt, & Hayes, 2002), which is commonly utilized in business research (Schaufeli & Bakker, 2010). The main difference between these four different definitions of engagement at work concern what engagement is anchored to: whether this is to the work role (Kahn, 1990, 2010); to the satisfaction at work, to the work role, and to the organization and job resources (Harter et al., 2002); or to activity and positive feelings and experiences at work itself (Maslach & Leiter, 1997; Schaufeli, Salanova, et al., 2002).

1.1.1 Personal engagement

Kahn's (1990) conceptual foundation for *personal engagement* is commonly seen as the starting point for work engagement research. Personal engagement refers both to simultaneous self-expression and self-employment in work actions, and to active, full role work performances. In particular, Kahn (1990, p. 694) defines personal engagement as "the harnessing of organizational members' selves to their work roles". Therefore, engagement describes the self-expression and self-employment through which employees bring their personal selves, their real selves, into their work role performances (Kahn, 1990, 2010). Furthermore, according to Kahn (1990, p. 694) "in engagement, people employ and express themselves physically, cognitively, and emotionally during role performances". Engaged employees thus invest their personal energies in their work and use various degrees of their selves in their work roles, instead of being only physically present at work (Kahn, 1990, 2010).

Kahn (1990) also assumes that particular psychological conditions need to be met in order to be personally engaged at work: meaningfulness (e.g., the feeling that investment of the self is worthwhile and valuable), safety (e.g., the feeling that it is safe to show and employ one's self without negative consequences), and availability (e.g., the feeling that one is capable of investing personal energies into work). Although Kahn (1990) presented a complete theoretical model of personal engagement, he did not offer an operationalization of the concept, which might be one reason why personal engagement has received only limited research interest. Nevertheless, Kahn's conceptual foundation has inspired many researchers, who have since presented different engagement operationalizations based on Kahn's work (see, e.g., May, Gilson, & Harter, 2004; Rothbard, 2001; Saks, 2006; Schaufeli, Salanova, et al., 2002).

1.1.2 Job engagement

It was the pioneers of burnout research, Christina Maslach and Michael Leiter (1997), who first extended burnout research to include its positive opposite: *job* *engagement* (see also Maslach et al., 2001). According to Maslach and Leiter (1997), job engagement can be considered a direct opposite to chronic stress reaction, that is, burnout. Therefore, job engagement is characterized by the direct opposites of the three burnout dimensions: energy (emotional exhaustion), involvement (cynicism), and efficacy (reduced professional efficacy). *Energy* refers both to emotional and physical energy at work. *Involvement* reflects employees' interest in work and the meaningfulness of work. *Efficacy* consists of feelings of competence, successful achievement, and accomplishment in one’s work. Engaged employees thus have a sense of energetic and effective connection with their work; they see themselves as able to deal with the demands of their work, and consider their work meaningful. Because engagement is considered a direct opposite of burnout, it is also operationalized and assessed by inverse scores on the burnout inventory, the Maslach Burnout Inventory - General Survey (MBI-GS; Maslach et al., 1996). Thus, low scores on exhaustion and cynicism, and high scores on professional efficacy are expected to indicate engagement.

Furthermore, according to Maslach and Leiter (1997), job engagement and burnout are considered to exist on the same underlying continuum, with engagement on the one end and burnout on the other. Therefore, job engagement begins when symptoms of burnout start to decrease and there is a corresponding shift from the three negative experiences to their positive counterparts. According to Maslach and Leiter (1997), employees are expected to be somewhere on this continuum at any time point. However, to consider engagement and burnout as the opposite poles of a single underlying continuum is to ignore a crucial assumption of positive psychology, that is, that positive (well-being at work) is more than just the absence of negative (ill-being at work) and it should be studied in its own right (Seligman, 2002; Seligman & Csikszentmihalyi, 2000). Furthermore, using the same instrument to measure both engagement and burnout makes it impossible to investigate the relationship between them (Schaufeli, Salanova, et al., 2002).

1.1.3 Work engagement

From a different viewpoint – from positive perspective – Wilmar Schaufeli and Arnold Bakker with their colleagues (Schaufeli, Salanova, et al., 2002) define *work engagement* as a conceptual positive opposite of burnout, but as an independent and distinct construct. According to Schaufeli, Salanova, et al. (2002, p. 74), work engagement is defined as “a positive, fulfilling, work-related state of mind that is characterized by vigor, dedication, and absorption”. V*igor* refers to high levels of energy and mental resilience while working, the willingness to invest effort in one’s work, and persistence in the face of difficulties. *Dedication* is characterized by a sense of significance, enthusiasm, inspiration, pride, and challenge in one's work. *Absorption* refers to being fully concentrated and deeply engrossed in one’s work, and it is characterized by the sense of time passing quickly and difficulty in detaching oneself from work. Work engaged employees are therefore enthusiastic and energetic, involved and committed to their work, and they are often so intense in their work that it feels as if time is flying.

Furthermore, according to Schaufeli and his colleagues (Schaufeli, Salanova, et al., 2002), work-related well-being has two underlying bipolar dimensions: activation, a continuum from exhaustion to vigor, and identification, a continuum from cynicism to dedication. Thus, vigor and exhaustion, and dedication and cynicism are considered as the endpoints of these dimensions (Schaufeli & Bakker, 2004). Absorption, however, is a unique feature that is not considered as a positive opposite of reduced professional efficacy. Rather than endpoints on some underlying continuum, absorption and reduced professional efficacy are considered as conceptually distinct aspects of work-related well-being. In addition, because Schaufeli and his colleagues (Schaufeli, Salanova, et al., 2002) consider work engagement as a conceptual positive opposite to burnout, but not as a corresponding and exclusive opposite, it is possible, at least to some extent, that work engagement and burnout can occur at the same time. For example, an employee can feel emotionally drained and bursting with energy during the same week. Likewise, not feeling burned-out does not imply that the employee is work engaged, and conversely, not feeling work engaged does not imply that the employee is burned-out.

Nevertheless, contrary to the original assumptions of the two underlying bipolar dimensions of work-related well-being (Schaufeli, Salanova, et al., 2002), recent research has revealed that cynicism and dedication represent two opposites of the same continuum, while exhaustion and vigor represent two separate constructs (Demerouti, Mostert, & Bakker, 2010; Mäkikangas, Feldt, Kinnunen, & Tolvanen, 2012; see also González-Romá, Schaufeli, Bakker, & Lloret, 2006). Thus, it seems that employees can hold either positive or negative feelings towards work, but it is possible, though unlikely, that an employee can be to some extent exhausted and vigorous at the same time.

Finally, seen as an independent construct, and because the dimensions of work engagement differ from those of burnout, work engagement is operationalized and measured in its own right. The Utrecht Work Engagement Scale (UWES) is based on the definition of work engagement (Schaufeli, Salanova, et al., 2002) and it assesses the three underlying dimensions of vigor, dedication and absorption. The successful operationalization of work engagement is most likely one of the reasons why work engagement as defined by Schaufeli and his colleagues (Schaufeli, Salanova, et al., 2002) is so widely used in scientific research in many countries in Europe (e.g., Schaufeli & Salanova, 2011) and also in some studies outside Europe (e.g., Shimazu et al., 2008; Storm & Rothmann, 2003).

1.1.4 Employee engagement

Besides scientific research, engagement is also very popular in the business and consultancy fields (e.g., Albrecht, 2010a; Macey & Schneider, 2008; Schaufeli & Bakker, 2010). However, the definitions and measures of engagement used among practitioners are usually based on practice, rather than on scientific evidence reported in peer-reviewed journals (e.g., Schaufeli & Bakker, 2010). The exception is the construct *employee engagement* developed in the Gallup Organization by Harter et al. (2002). Employee engagement is defined as "the individual's involvement and satisfaction with as well as enthusiasm for work" (Harter et al., 2002, p. 269). Furthermore, employee engagement is expected to occur when "individuals are emotionally connected to others and cognitively vigilant" (Harter et al., 2002, p. 269). Employee engagement is assessed with the Gallup Workplace Audit (GWA; Harter et al., 2002), which includes an overall satisfaction item as well as items that measure employee's perceptions of work characteristics (e.g., role clarity, feedback, development opportunities). The GWA thus reflects an employee's satisfaction with the work place, but also processes and conditions that are antecedents to satisfaction and engagement (Harter & Schmidt, 2008). However, the actual state of engagement itself is not assessed (Macey & Schneider, 2008). Therefore, compared to work engagement, employee engagement is a broader construct that somewhat overlaps with earlier developed attitudinal constructs such as *job satisfaction* (Locke, 1976) and with the later conceptualization of *job resources* (Demerouti, Bakker, Nachreiner, et al., 2001). The broad definition is probably one of the reasons why employee engagement has received noticeable interest, in particular in the business and consultancy community (e.g., Schaufeli & Salanova, 2011).

1.1.5 Constructs related to work engagement

The lack of consensus on the definition of work engagement in scientific research as well as the many different conceptualizations of work engagement utilized in the business and consultancy community has led to claims that work engagement is nothing more than "new blend of old wines" (e.g., Newman & Harrison, 2008; Schohat & Vigoda-Gadot, 2010). Therefore, to be of any practical value, it is important to show the added and unique value of work engagement as compared to the other earlier developed constructs that indicate positive affective or motivational state and positive attitudes towards one's work.

Liking and being satisfied with one's job, along with psychological connection and affective attachment to one's work were topics of wide research interest already several decades before the concept of work engagement was proposed. *Job satisfaction* describes the positive emotional state that results from employee evaluations of one's job or job situation and conditions (e.g., Hackman & Oldham, 1976; Herzberg, Mausner, & Snyderman, 1959; Locke, 1976). Therefore, both job satisfaction and work engagement are work-related positive emotional states; however, the difference is that job satisfaction reflects an employee's evaluative description of the job and its characteristics, whereas work engagement reflects the individual's experiences of and feelings resulting from performing the work (e.g., Christian et al., 2011; Schaufeli & Bakker, 2010). Furthermore, job satisfaction connotes contentment and satisfaction; the employee is satisfied with the conditions at work, while work engagement connotes passion and activation: a work engaged employee is vigorous and willing to invest effort at work (Macey & Schneider, 2008; Schaufeli & Bakker, 2010; see also Warr, 1990). Thus, work engagement is a more dynamic and energetic work-related state of mind.

Job involvement and *organizational commitment* (e.g., Brown, 1996; Kanungo, 1982; Lodahl & Kejner, 1965; Rabinowitz & Hall, 1977) both reflect the degree to which one identifies psychologically with and is attached to one's work (i.e., job involvement) or to a particular organization (i.e., organizational commitment). Job involvement and organizational commitment are thus conceptually rather closely related to the dedication dimension of work engagement, which describes a strong emotional connection to and involvement in work, for example, enthusiasm and the sense of significance (Schaufeli & Bakker, 2010; Schaufeli, Salanova, et al., 2002). The main difference between dedication and organizational commitment is that dedication refers to work and organizational commitment to the organization. Furthermore, the difference between dedication and job involvement is that feelings of dedication are expected to refer to a deeper and stronger involvement than the usual level of job involvement (Schaufeli, Salanova, et al., 2002). However, to the best of my knowledge, this assumption of a stronger and deeper level of involvement has not been empirically tested. In addition, work engagement is different from involvement/commitment in that it is a broader concept that also encompasses energy and absorption (Schaufeli, Salanova, et al., 2002).

However, research on the difference between work engagement, job satisfaction, job involvement and organizational commitment has yielded contradictory results. On the one hand, there is some empirical evidence that all of these constructs reflect a single higher-order job attitude construct (see Newman, Joseph, & Hulin, 2010). On the other hand, there is also considerable evidence of only moderate overlaps between job satisfaction and work engagement ($\rho = .53$[1]), between work engagement and job involvement ($\rho = .52$[2]), and between work engagement and organizational commitment ($\rho = .59$[3]). Furthermore, a previous study has shown that work engagement, job involvement and organizational commitment are three empirically different constructs that reflect different aspects of work attachment, sharing only between 12% and 21% of the variance (Hallberg & Schaufeli, 2006). Therefore, when considering the degree of overlaps or redundancy between work engagement, job satisfaction, job involvement, and organizational commitment, it is also worthwhile considering the possibility that some of the overlaps may be related to imprecision in these pre-existing measures (see, Solinger, van Olffen, & Roe, 2008; see also Albrecht, 2010a; Macey & Schneider, 2008).

Although context-free and not particularly work-related construct, the construct, *positive affects (*e.g., Watson, Clark, & Tellegen, 1988) describes dispositional feelings and emotions that reflect the level of pleasurable engagement with the environment. Positive affects are assessed with items like energetic, strong, enthusiastic, inspired, attentive, and alert (the PANAS scale; Watson et al., 1988). These feelings and emotions are in fact very similar to those in the

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[1, 2, 3] The results are from a meta-analysis; see Christian et al., 2011. The meta-analysis also included other measures of work engagement than the UWES.

work engagement scale, for example: energy, vigorous, strong, enthusiastic, inspired, and immersed (UWES; Schaufeli, Salanova, et al., 2002). However, the main difference is that work engagement is considered a domain-specific, work-related positive state, whereas positive affects refer to a context-free dispositional trait. These concepts can, however, be related such that some employees might have a dispositional tendency to feel positive affects in the work context as well (e.g., Macey & Schneider 2008; Schaufeli & Bakker, 2010). A recent meta-analysis showed that work engagement corresponds to some extent with positive affects (ρ = .43[4]); however, this moderate relationship indicates that work engagement is more than just the affective and energetic feelings experienced generally in life.

Surprisingly, it has also been speculated whether work engagement – positive well-being at work – is similar to the concept of *workaholism*, the compulsion to work excessively (Taris, Schaufeli, & Shimazu, 2010; see also Spence & Robbins, 1992). Workaholism is defined as the compulsion or uncontrollable need to work constantly, and it has been characterized by two dimensions: 1) working excessively hard, and 2) the existence of a strong, compulsive, inner drive (e.g., Oates, 1971). Working hard refers to spending an exceptional amount of time on work and working beyond what is reasonably expected. Compulsive drive refers to persistent and frequent, obsessive thoughts about work, even when not working. Therefore, the conceptual reasoning for comparing work engagement to workaholism is that being strongly involved, enthusiastic and engrossed about one's work, as in work engagement, might, to some extent, be related to working hard as in workaholism (Schaufeli, Taris, & Bakker, 2006; Taris et al., 2010). However, although empirical studies have shown that both work engaged and workaholic employees can work hard and be fully absorbed in their work, work engaged employees lack the tendency to work compulsively, that is, the addiction to work (Hakanen, Rodrígues-Sánchez, & Perhoniemi, 2012; Schaufeli, Taris, et al., 2006; Schaufeli, Taris, & Van Rhenen, 2008). Thus, it seems that the reason for working hard differs from that behind workaholism: those who are work engaged work hard because they like it, but not because of a compulsory inner drive, as in the case of workaholic employees (e.g., Andreassen, Ursin, & Eriksen, 2007; Van Beek, Hu, Schaufeli, Taris, & Schreurs, 2012; Van Beek, Taris, & Schaufeli, 2011).

Finally, empirical studies have verified the theoretical assumption by Schaufeli and his colleagues (Schaufeli, Salanova, et al., 2002) that work engagement is negatively related to burnout (ρ = -.48, Crawford, LePine, & Rich, 2010; see also Halbesleben, 2010), but it is an independent and distinct concept from burnout (e.g., Hakanen & Schaufeli, 2012; Schaufeli & Bakker 2004; Schaufeli, Bakker, & Salanova, 2006; Schaufeli, Salanova, et al., 2002; Shimazu et al., 2008). However, the factor structures of work engagement and burnout have not been precisely identified. Previous studies have shown that instead of being

4 The results are from a meta-analysis; see Christian et al., 2011. The meta-analysis also included other measures of work engagement than the UWES.

a part of burnout, the (reduced) professional efficacy dimension constitutes a fourth dimension of work engagement (e.g., Schaufeli & Bakker 2004; Schaufeli, Bakker, et al., 2006; Schaufeli, Salanova, et al., 2002; Shimazu et al., 2008). This unexpected result, however, might be an artifact caused by the wording of the scales, as professional efficacy is measured with positively worded items, and the reversed professional efficacy items are assumed to measure the same thing as inefficacy (Maslach et al., 1996). A recent study confirmed this assumption and showed that when professional efficacy was worded negatively, that is, as professional inefficacy, it loaded, as expected, on the burnout factor (Schaufeli & Salanova, 2007). However, when worded positively, that is, using the original professional efficacy scale, it loaded on work engagement factor.

In sum, because work engagement is a multidimensional construct that captures how employees experience their work activity on many different levels, some aspects (items) of work engagement might overlap somewhat with constructs developed earlier. However, work engagement is conceptualized with distinct characteristics that are combined in a way that yields a unique construct, and recent empirical studies have verified this view (e.g., Macey & Schneider, 2008; Schaufeli & Bakker, 2010).

1.2 Operationalization of work engagement

Beside the need for a clear and unified definition of work engagement, it is important that the measure consistently operationalizes the definition of work engagement. The Utrecht Work Engagement Scale (UWES) is a scientifically verified self-report questionnaire that is derived from the definition of the three dimensions of work engagement: vigor, dedication and absorption (Schaufeli & Bakker, 2003, 2010; Schaufeli, Salanova, et al., 2002). The UWES is a widely used measure. It has been translated into 21 languages and used among various different occupational groups (e.g., Schaufeli, 2012; Schaufeli & Bakker, 2010). The scientific validation and the ability to assess employees' work engagement despite their professional field or occupational group are the most likely reasons for the popularity of the UWES.

The first version of the questionnaire comprised 17 items (UWES-17), six items for vigor, five for dedication, and six items for absorption (Schaufeli, Salanova, et al., 2002). However, subsequent psychometric analyses revealed two weak items (item 6 in the scale of vigor and item 6 in the scale of absorption; see Schaufeli & Bakker, 2003), and thus a 15-item version of the UWES has been used in some later studies (e.g., Extremera, Sánchez-García, Durán, & Rey, 2012; Xanthopoulou, Bakker, Kantas, & Demerouti, in press). The most recent version of the UWES is the short, 9-item version (UWES-9; Schaufeli, Bakker, et al., 2006). In this abridged scale, vigor, dedication, and absorption are assessed by three items per dimension. The correlation between the original UWES-17 and the short UWES-9 is very high (over .90), and therefore it seems that the short version of the scale assesses work engagement in virtually the same way as the original version (e.g., Schaufeli & Bakker, 2003; Schaufeli, Bakker, et al., 2006). The UWES can be found at www.schaufeli.com.

1.2.1 Construct validity and factorial invariance of the UWES

Construct validity is a type of validity that investigates whether the operationalization of a construct (a scale) is consistent with the underlying theorized construct (e.g., Cook & Campbell, 1979; Cronbach & Meehl, 1955). In other words, construct validity studies investigate whether a set of items presented in the UWES are adequate definitions of work engagement. Furthermore, confirmatory factor analysis (CFA) is a statistical method that can be used to test construct validity (e.g., Jöreskog, 1971, 2007). Therefore, with the use of CFA it is possible to test whether the UWES consists of the three different, though related, theoretically based dimensions of vigor, dedication, and absorption.

Previous CFA studies on the UWES have in general supported the correlated three-factor structure of the UWES-17 and/or UWES-9 in many different countries (e.g., China: Yi-wen & Yi-qun, 2005; Finland: Hakanen, 2009; Greece: Xanthopoulou et el., in press; Italy: Balducci, Franco, & Schaufeli, 2010; Japan: Shimazu et al., 2008; Spain: Salanova, Agut, & Peiró, 2005; South Africa: Storm & Rothmann, 2003; Sweden: Hallberg & Schaufeli, 2006; The Netherlands: Schaufeli & Bakker, 2003). However, not all studies have been able to verify the correlated three-dimensional structure of the scale (e.g., Federici & Skaalvik, 2011; Schaufeli & Bakker, 2004; Shimazu et al., 2008). Furthermore, previous CFA studies have shown that the three factors of work engagement are highly interrelated (correlations range from about .60 to over .90). Therefore, an alternative one-factor structure, in which all three dimensions were allowed to load into one underlying work engagement factor has also been tested (e.g., Balducci et al., 2010; Hallberg & Schaufeli, 2006; Schaufeli & Bakker, 2003; Schaufeli, Bakker, et al., 2006; Shimazu et al., 2008; Storm & Rothmann, 2003). In general, while the theoretically based correlated three-factor structure of the UWES has shown a better fit with the investigated data than the one-factor structure, the fit of one-factor structure of the UWES has also been acceptable (e.g., Balducci et al., 2010; Hallberg & Schaufeli 2006; Schaufeli, Bakker, et al., 2006; Shimazu et al., 2008; Storm & Rothmann, 2003). Therefore, there is evidence both for the three correlated but different dimensions of work engagement and for the one general dimension of work engagement.

Besides verifying the theoretically based structure of the scale, it is important to confirm that the construct is conceptualized in the same way and the strengths of the relations between items and their underlying constructs (dimensions) remain the same (i.e., factor loadings remain invariant) in different contexts (e.g., Meredith, 1964, 1993; Meredith & Teresi, 2006; Vandenberg & Lance, 2000). This is the basic requirement for measurement invariance (i.e., weak factorial invariance); otherwise the items are not measuring the factors in the same way. Indeed it is not certain whether the same factors underlie the items. Furthermore, only if the factor loadings are equivalent across groups can meaningful gross-group comparisons be made. If not, the differences may be "true" differences in the measured construct or they may be differences related to dissimilar psychometric properties of the scale, caused by the particular cultures and occupational groups studied, or different time points. The factor structure of the UWES might not be invariant, for instance, if work engagement was so abstract a construct that employees' perceptions of it depended on the cultural context.

Thus far, there exist some studies on the factorial invariance (i.e., weak measurement invariance) of the UWES in different contexts (e.g., Balducci et al., 2010; Schaufeli & Bakker, 2003; Schaufeli, Bakker, et al., 2006; Schaufeli, Martínez, Pinto, Salanova, & Bakker, 2002). These studies have shown that the correlated three-factor structure of the UWES-17 and/or UWES-9 remained invariant across different countries (e.g., across Italian and Dutch samples, Balducci et al., 2010) and across different occupational groups (e.g., across a heterogeneous sample of blue and white collar Dutch and Belgium employees, Schaufeli & Bakker, 2003). However, not all studies have been able to verify the invariance of the correlated three-factor structure of the UWES scales, and the sizes of the factor loadings have varied across countries (across Spanish, Portuguese and Dutch samples, Schaufeli, Martínez, et al., 2002; and across 10 different countries, Schaufeli, Bakker, et al., 2006). Furthermore, so far, there is only limited evidence on the invariance of the correlated three-factor structure of the UWES-17 over time (e.g., Hakanen, Peeters, & Perhoniemi, 2011; Hakanen, Perhoniemi, & Toppinen-Tanner, 2008; Hakanen & Schaufeli, 2012), and the time-invariance of the correlated three-dimensional structure of the UWES-9 has not yet been tested. Therefore, there is not much evidence on whether the UWES measures work engagement invariantly at different time points.

In sum, the psychometrical properties of the UWES have not yet been fully confirmed, and hence clearly merit further research. In particular, although the correlated three-factor structure of the UWES-17 and -9 has mainly been supported, the one-factor structure of the UWES has also gained support. Furthermore, the results on the invariance of the factor structure of the UWES in cross-cultural studies and in different occupational groups are contradictory, and the factorial time-invariance of the UWES has received only limited research interest. Despite this, the stability of work engagement has been widely studied.

1.3 Stability of work engagement

In addition to the expectations of the three different dimensions, vigor, dedication and absorption, the definition of work engagement also includes an assumption that these dimensions indicate relatively stable and long-lasting state of mind (Schaufeli & Bakker, 2010; Schaufeli, Salanova, et al., 2002). According to the definition, "rather than a momentary and specific state, engagement refers to a more persistent and pervasive affective-cognitive state that is not focused on any particular object, event, individual, or behavior" (Schaufeli, Salanova, et al., 2002, p. 74). Therefore, the scores of the UWES are expected to be more or less the same over time.

Recent longitudinal studies have verified this assumption and showed that the scores of the UWES-17 and the UWES-9 remain rather stable over time. The rank-order stabilities (i.e., the degree to which the relative ordering of individuals within a group on the basis of the UWES scores is maintained over time, e.g., Larsen & Buss, 2008) have varied from .59 to .81, indicating that from 35% to 66% of the variance of work engagement can be explained by the level of work engagement on the previous occasion (e.g., De Lange, De Witte, & Notelaers, 2008; Hakanen et al., 2011; Hakanen, Perhoniemi, et al., 2008; Hakanen & Schaufeli, 2012; Hakanen, Schaufeli, & Ahola, 2008; Mauno, Kinnunen, & Ruokolainen, 2007; Schaufeli, Bakker, & Van Rhenen, 2009; Simbula, Guglielmi, & Schaufeli, 2011; Weigl et al., 2010; Xanthopoulou, Bakker, Demerouti, & Schaufeli, 2009a). These stabilities are based on longitudinal studies among various occupations, with time-lags from one to seven years, and to correlations between sum scores or to standardized stability coefficients between the latent factors of work engagement estimated by structural equation modeling (SEM). The longitudinal studies on the stability of work engagement are presented in detail in Table 1.

However, it needs to be mentioned that the stability of work engagement somewhat depends on the statistical method with which it is measured and the timeframe within which it is measured. Because the standardized stability coefficients between the latent factors of work engagement are free of measurement errors, stabilities are by definition higher than the stabilities between the sum scores that include this error-variance. Furthermore, the results of follow-up studies with shorter time-lags, from a few days to a few weeks, have shown fluctuation in the level of work engagement within these short periods of time (e.g., Bakker & Bal, 2010; Sonnentag, 2003; Xanthopoulou, Bakker, Demerouti, & Schaufeli, 2009b; Xanthopoulou, Bakker, Heuven, Demerouti, & Schaufeli, 2008; see also Sonnentag, Dormann, & Demerouti, 2010). According to these studies, the day-specific level of work engagement fluctuates around a person's general level of work engagement. Thus, there can be days and weeks during which employees feel more work engaged than on others; however, despite these temporary fluctuations, the general level of work engagement seems to be fairly stable over longer periods of time (see Table 1).

Two important concerns arise when reviewing the studies presented in Table 1. First, surprisingly, the stability coefficients of work engagement do not decrease over time (the time-lags in these studies varied from one to seven years), although stability is in general expected to decrease over time (see, e.g., Jöreskog, 1970). This indicates that there also seems to be considerable time-invariant stability in work engagement (i.e., stable variance; see also trait work engagement, Sonnentag, 2003; Sonnentag, Dormann, et al., 2010). The amount of stable variance may explain why despite the brief and temporary fluctuations, work engagement seems to return to its habitual level during a longer period of time (Headey & Wearing, 1989; Ormel & Schaufeli, 1991; see also Schaufeli, Maassen, Bakker, & Sixma, 2011). However, to the best of my knowledge, while the stability of work engagement across succeeding time periods has been investigated in previous longitudinal studies, the time-invariant stability, which might affect over all time periods, has been neglected. Therefore, it is possible that the stability of work engagement might have been underestimated and hence future studies should apply modeling techniques that can reveal all the stability inherent in work engagement. Second, because work engagement is a rather highly stable phenomenon, it can be questioned how much room (i.e., variance) is left for external factors to influence work engagement. Two theoretical frameworks commonly used in work engagement studies, the Job-Demands-Resources (JD-R) model (Bakker & Demerouti, 2007; Demerouti & Bakker, 2011; Demerouti, Bakker, Nachreiner, et al., 2001), and the Conservation of Resources theory (COR theory; Hobfoll, 1998, 2001, 2002) indicate how work engagement can be influenced.

TABLE 1 Summary table of longitudinal work engagement studies

Authors and publication year	*Participants and time-lag*	*Measure of work engagement*	*Statistical analyses*	*Rank-order stability for work engagement*
De Lange, De Witte, & Notelaers (2008).	Belgian employees from different sectors (*n* = 871, 54% females). Two-wave design with 16-month time-lag.	Vigor and dedication subscales of the UWES-9.	Correlation coefficient between sum scores of total work engagement.	*r* = .71.
Hakanen, Peeters, & Perhoniemi (2011).	Finnish dentists (*n* = 1,632; 72% females). Two-wave design with three-year time-lag.	All subscales of the UWES-17.	Latent factor of total work engagement in SEM models.	β for different SEM models and for different genders varied from .71 to .77.
Hakanen, Perhoniemi, & Toppinen-Tanner (2008).	Finnish dentists (*n* = 2,555; 74% females). Two-wave design with three-year time-lag.	All subscales of the UWES-17.	Latent factor of total work engagement in SEM models.	β for two different SEM models were .67 and .72.
Hakanen & Schaufeli (2012).	Finnish dentists (*n* = 1,964; 76% females). Three-wave design with seven-year time-lag.	All subscales of the UWES-17.	Latent factor of total work engagement in SEM models.	β between T1 and T2 = .78, and β between T2 and T3 = .77.
Hakanen, Schaufeli, & Ahola (2008).	Finnish dentists (*n* = 2,555; 74% females). Two-wave design with three-year time-lag.	Vigor and dedication subscales of the UWES-17.	Latent factor of total work engagement in SEM models.	β for two different SEM models were .71 and .78.

(continues)

TABLE 1 (continues)

Mauno, Kinnunen, & Ruokolainen (2007).	Finnish health care personnel (*n* = 409, 88% females). Two-wave design with two-year time-lag.	All subscales of the UWES-17.	Dimension specific correlation coefficients.	Vigor, *r* = .73; dedication, *r* = .67; absorption *r* = .69.
Schaufeli, Bakker, & Van Rhenen (2009).	Telecom managers (*n* = 201, 89% males). Two-wave design with one-year time-lag.	Vigor and dedication subscales of the UWE-17.	Latent factor of total work engagement in SEM models.	β = .68.
Simbula, Guglielmi, & Schaufeli (2011).	Italian school teachers (*n* = 104; 90% females). Three-wave study with approximately four-month time-lags.	Vigor and dedication subscales of the UWES-9.	Correlation coefficients between sum scores of total work engagement.	T1 and T2, *r* = .81; T2 and T3, *r* = .78; T1 and T3, *r* = .80.
Weigl, Hornung, Parker, Petru, Glaser, & Angerer (2010).	German medical doctors (*n* = 416; 51% males). Three-wave study design with 14- and 19-month time-lags.	All subscales of the UWES-9.	Latent factor of total work engagement in SEM models.	β between T1 and T2 = .59, and β between T2 and T3 = .64.
Xanthopoulou, Bakker, Demerouti, & Schaufeli (2009a).	Dutch employees working in electrical engineering and electronics company (*n* = 163; 80% males). Two-wave design with average 18-month time-lags.	All subscales of the UWES-9.	Correlation coefficient between sum scores of total work engagement.	*r* = .70.

1.4 What influences work engagement? Theoretical frameworks

1.4.1 The Job-Demands-Resources model

The theoretical framework that is most often used when investigating the antecedents of work engagement, is the Job-Demands-Resources (JD-R) model developed by Demerouti et al. (Demerouti, Bakker, Nachreiner, et al., 2001; see also Bakker & Demerouti, 2007; Demerouti & Bakker, 2011). The JD-R model is a comprehensive job characteristics model that aims to explain both ill-health and motivation at work. Therefore, on the one hand, the JD-R model has its roots in the balance models of job stress, such as the demands-control model, which assumes that job stress is caused by the combination of high job demands and low job control (Karasek, 1979), or in the effort-reward imbalance model, which assumes that job stress is the result of an imbalance between effort (e.g., workload) and reward (e.g., salary, career opportunities; Siegrist, 1996). On the other hand, the JD-R model has similarities with earlier motivational theories, such as the job characteristic theory, which assumes that job-related task-level resources (i.e., skill variety, task identity, task significance, autonomy, task feedback) affect motivation (Hackman & Oldham, 1976), or with the two-factor model of job satisfaction and motivation (Herzberg et al., 1959). The two-factor model presumes that there are two kinds of resources: extrinsic (e.g., salary, supervision) and intrinsic (e.g., achievement, professional growth). Intrinsic resources lead to motivation and satisfaction, whereas extrinsic resources, that is, the "hygiene" factors prevent motivational problems, but when lacking lead to dissatisfaction (Herzberg et al., 1959).

The JD-R model includes three basic assumptions (Bakker & Demerouti, 2007; Demerouti, Bakker, Nachreiner, et al., 2001). First, regardless of the type of a job or occupational group, psychosocial work conditions can be divided into two characteristics: job demands and job resources. *Job demands* refer to those physical, psychological, social, or organizational conditions or aspects of a job that require sustained psychological (i.e., cognitive and emotional) and/or physical effort or skills, and are therefore associated with certain psychological and physiological costs. Examples of job demands are role conflicts, time pressure, irregular working hours, and work-family conflict. The job demands are not necessarily negative, but they may turn into negative job stressors when the attempt to meet them and sustain one’s optimal performance entails major effort, thereby causing negative responses, such as fatigue and eventually burnout.

Job resources refer to those physical, psychological, social, or organizational conditions or aspects of a job that 1) may reduce job demands, 2) are needed in achieving work goals, and 3) stimulate personal growth, development and learning. Thus, job resources not only deal with job demands but they are also important in their own right, since they may have an extrinsic or intrinsic motivational role at work: an extrinsic motivational role because job resources are needed in achieving work goals, and an intrinsic motivational role because job resources may foster employees' growth, learning and development, and thus satisfy the basic psychological needs of autonomy, belonging, and competence (see, e.g., Van den Broeck, Vansteenkiste, De Witte, & Lens, 2008; see also Deci & Ryan, 2000). Examples of job resources that have frequently been studied are autonomy/job control, supervisory and collegial support, innovativeness and positive team or organizational climate (for a review, see Mauno, Kinnunen, Mäkikangas, & Feldt, 2010).

However, the distinction between job demands and job resources does not seem to be as parsimonious as the original definition of the JD-R model assumes. Recent studies have divided job demands into challenge stressors (e.g., time pressure, responsibility) and hindrance stressors (e.g., role conflict, role overload), and found that job hindrances associated, as assumed, negatively with work engagement, whereas job challenges were positively related to work engagement (e.g., Crawford et al., 2010; Van den Broeck, De Cuyper, De Witte, & Vansteenkiste, 2010; see also LePine, Podsakoff, & LePine, 2005). Furthermore, recent studies have suggested that not only job resources but also personal resources (e.g., self-efficacy and self-esteem) are related to work engagement and that job resources and personal resources may be reciprocally related (e.g., Llorens, Schaufeli, Bakker, & Salanova, 2007; Xanthopoulou, Bakker, Demerouti, & Schaufeli, 2007; Xanthopoulou et al., 2008, 2009a).

The second basic assumption of the JD-R model is that these two types of working conditions may evoke two psychologically different, though related, underlying processes: 1) a *health impairment* process, in which high and chronic job demands exhaust employees' mental and physical resources when they are trying to meet them, and may lead to depletion of energy and burnout, and eventually to health problems; and 2) a *positive motivational* process, in which job resources have motivational potential and may lead to work engagement and, in consequence, also to such outcomes as organizational commitment and excellent performance (e.g., extra-role performance, personal initiative, innovativeness; see, e.g., Bakker & Demerouti, 2007; Demerouti & Bakker, 2011).

The third and most recent assumption of the JD-R model is that interactions exist between job demands and job resources that are important for the development of health impairment and motivation (Bakker & Demerouti, 2007; Demerouti & Bakker, 2011; Hakanen & Roodt, 2010). On the one hand, job resources are expected to "buffer" the negative impacts of job demands on burnout, because with increased job resources employees can cope with the negative influences of their job demands (e.g., Bakker, Demerouti, & Euwema, 2005). On the other hand, job resources are expected to have motivational potential and "boost" work engagement, particularly when job demands are high (e.g., Bakker, Hakanen, Demerouti, & Xanthopoulou, 2007; Hakanen, Bakker, & Demerouti, 2005; see also Hobfoll, 2002).

In this research, the positive pole, that is, the motivational process of the JD-R model is applied as a theoretical framework, because the motivational process, in particular, is assumed to foster work engagement. However, a review of the previous studies on the motivational process of the JD-R model yielded three concerns that merit future research. First, the motivational associations between job resources and work engagement have not been as strong as expected on basis of the propositions of the JD-R model (Hakanen & Roodt, 2010). This is an indication that, aside from job resources, other factors, for example, the baseline level of work engagement, also influence work engagement. Accordingly, there exists rather wide variation in the strength of the relationship between work engagement and job resources depending on whether the level of previous measurements of work engagement was controlled for (β between latent factors varies from about .10 to about .70; Hakanen et al., 2011; Schaufeli et al., 2009; Simbula et al., 2011; Weigl et al., 2010; Xanthopoulou et al., 2009). When the level of previous measurements of work engagement was controlled for, there was obviously less room for the relationship with job resources (e.g., Hakanen et al., 2011; Schaufeli et al., 2009; Weigl et al., 2010).

Furthermore, when the stability of work engagement has been controlled for, this has been done by including the level of work engagement on the previous measurement occasion in the statistical models (Hakanen et al., 2011; Schaufeli et al., 2009; Weigl et al., 2010). However, following this procedure means that the stability of work engagement reflects the stability of the observed values between two measurement points, which includes all the variance; that is, the variance reflects both stability and change in work engagement. Therefore, as already pointed out, the stability of work engagement might have been underestimated. In order to provide an accurate estimate of the relationship between job resources and work engagement, the stable and changing variance in work engagement need to be separated, and the influence of the stable variance needs to be controlled for. Therefore, there is a need for wider theoretical perspectives and more rigorous methodological approaches when applying the JD-R model to investigate the antecedents of work engagement.

Second, knowledge on the antecedents of work engagement is more extensive than knowledge on the consequences of work engagement (for overviews, see Halbesleben, 2010; Mauno et al., 2010). To date many cross-sectional studies have shown a positive association between different job resources (e.g., job control/autonomy, support at work, feedback, developmental opportunities) and work engagement (ρ = .27–.53[5]). There is also considerable longitudinal evidence to show that different job resources predict work engagement (e.g., De Lange et al., 2008; Hakanen et al., 2011; Hakanen, Perhoniemi, et al., 2008; Hakanen, Schaufeli, et al., 2008; Mauno et al., 2007; Schaufeli et al., 2009; Simbula et al., 2011; Weigl et al., 2010; Xanthopoulou et al., 2009a). In addition, beside work-related antecedents, recent studies have also revealed that non-work-related antecedents, for example, home-related resources (Hakanen et al., 2011) and recovery (Feldt et al., 2013; Kinnunen, Feldt, Siltaloppi, & Sonnentag, 2011; Sonnentag, 2003; Sonnentag, Mojza, Demerouti, & Bakker, 2012) are related to work engagement. However, thus far, most of the studies on the consequences of work engagement have utilized organizational commitment and/or performance as the outcomes of work engagement, although there could be other important consequences as well (e.g., Hakanen & Roodt, 2010). Although the original JD-R model makes no assumptions on the link between work engagement and health relations, a few studies have explored and found associations between work engagement and mental and physical health (e.g., Airila, Hakanen,

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5 The results are from two different meta-analyses; see Christian et al., 2011; Halbesleben, 2010. The meta-analyses also included other measures of work engagement than the UWES.

Punakallio, Lusa, & Luukkonen, 2012; Demerouti, Bakker, De Jonge, Janssen, & Schaufeli, 2001; Hakanen, Bakker, & Schaufeli, 2006; Hakanen & Schaufeli, 2012; Parzefall & Hakanen, 2010; Schaufeli & Bakker, 2004; Schaufeli et al., 2009; Shimazu et al., 2008). Therefore, beside the motivational outcomes (motivational process), work engagement might also be related to health outcomes (health enhancement process).

Third and finally, recent longitudinal studies have suggested that the motivational process might not be solely a one-way process, as the original JD-R model proposes. Instead, it seems that, rather than a unidirectional influence from job resources to work engagement, job resources and work engagement reciprocally impact each other (e.g., De Lange et al., 2008; Hakanen et al., 2011; Hakanen, Perhoniemi, et al., 2008; Schaufeli et al., 2009; Simbula et al., 2011; Weigl et al., 2010; Xanthopoulou et al., 2009a). Furthermore, there is some evidence that this mutual relationship is equally strong in both directions (Hakanen, Perhoniemi, et al., 2008; Xanthopoulou et al., 2009a). Therefore, in addition to the unidirectional relationship, the JD-R model might also include feedback loops; work engagement might also predict job resources, which, in turn, and equally strongly, might predict subsequent work engagement.

1.4.2 Conservation of Resources theory

Theoretical reasoning for the reciprocal relationships between work engagement and job resources can be found in the Conservation of Resources theory (COR; Hobfoll, 1998, 2001), which is also a widely used theoretical framework in work engagement studies. The COR theory is a resource-based stress theory and its main principle is the maintenance and accumulation of valued resources. According to the COR theory, individuals try to obtain, protect, maintain and foster resources that are either valuable in their own right or important for protecting valued resources or attaining future goals (Hobfoll, 1998, 2001). Resources are divided into four categories and defined as valued objects (e.g., equipment, socioeconomic status), personal characteristics (e.g., occupational skills, self-efficacy), conditions (e.g., social support, well-being, health), and energies (e.g., time, knowledge).

Additionally, the COR theory assumes that the relationship between different resources is dynamic and mutual (Hobfoll, 2001). Therefore, resources (and also resource losses) are cumulative and can aggregate in "caravans". This means that resources tend not to exist in isolation but rather tend to link to other resources in the future, which may foster initial and other resources and finally lead to an aggregation of reciprocal "resource or gain cycles and gain spirals" (Hobfoll, 2001, 2002; see also Salanova et al., 2010). Furthermore, the COR theory posits that individuals must invest resources in order to protect against resource loss, recover from such losses, and gain new resources. Therefore, those with greater resources are more likely to gain additional resources in the future and are less vulnerable to resource loss (Hobfoll, 1998, 2001). Thus, in line with the COR theory, the relationship between job resources and work engagement is not solely unidirectional, as assumed in the JD-R model, but dynamic and reciprocal. Employees with several job resources are more likely to feel work engagement, which in turn can lead back to gaining additional job resources (e.g., Hakanen et al., 2011; Hakanen, Perhoniemi, et al., 2008; Schaufeli et al., 2009; Weigl et al., 2010; Xanthopoulou et al., 2009a).

Finally, according to the assumptions of positive caravans and gain cycles and spirals present in the COR theory, positive well-being at work, namely, work engagement, can accumulate into well-being in other life domains, for instance into physical and mental health. As pointed out in subsection 1.4.1, some studies have shown a positive relationship between work engagement and health: work engagement has positive associations with higher subjective ratings of physical and mental health (for overviews, see Bakker, 2009; Bakker et al., 2011b).

1.5 Work engagement and health relations

The studies addressing the relationship between work engagement and subjectively rated physical health have found an association between work engagement and fewer psychosomatic health complaints or health problems, such as headache, stomach ache and back pain (e.g., Demerouti, Bakker, De Jonge, et al., 2001; Schaufeli & Bakker, 2004; Shimazu et al., 2008). Furthermore, a few studies have found relationships with positive health indicators, such as self-rated health (Hakanen et al., 2006) and work ability (Airila et al., 2012; Hakanen et al., 2006). In addition, two previous longitudinal studies showed that work engagement predicted reduced sickness absences over a one-year period (Schaufeli et al., 2009) and reduced depressive symptoms over a seven-year period (Hakanen & Schaufeli, 2012).

The theoretical rationale for the beneficial relationship between work engagement and physical health can be found in the optimal functioning of the two main psychophysiological (stress) systems: the autonomic nervous system (ANS) and the hypothalamic-pituitary-adrenal (HPA) axis (e.g., Brownley, Hurwitz, & Schneiderman, 2000; Guyton & Hall, 2000; Lovallo & Thomas, 2000). These two systems have crucial roles in mediating the associations between any psychological (work-related) states and physiological outcomes. In addition, considerable evidence exists that prolonged work-related stress and burnout (i.e., the conceptual negative opposite of work engagement) are linked to physical ill-health, especially to cardiac diseases and cardiovascular-related events, via dysregulations in the functions of ANS and HPA (for reviews, see, Belkic, Landsbergis, Schnall, & Baker, 2004; Melamed, Shirom, Toker, Berliner, & Shapira, 2006). It thus seems plausible that the optimal functioning of these same psychophysiological systems would mediate the relationship between work engagement and physical health. However, previous studies have not been able to find the expected beneficial associations between work engagement and the functioning of ANS and/or HPA (Langelaan, Bakker, Schaufeli, et al., 2006; Van Doornen et al., 2009). Therefore, evidence for the psychophysiological mechanism underlying the relationship between work engagement and health remains unclear, and consequently merits further research.

In the present research, the relationship between work engagement and the ANS, and especially healthy cardiac autonomic activity, is the focus of interest. The are two main reasons for investigating this topic: first, previous studies on the relationship between burnout and the (dys)functioning of HPA axis (e.g., salivary cortisol awakening responses and/or cortisol levels) have shown highly contradictory results (e.g., De Vente, Ollf, Van Amsterdam, Kamphuis, & Emmelkamp, 2003; Grossi et al., 2005; Grossi, Perski, Evengård, Blomkvist, & Orth-Gomér, 2003; Mommersteeg, Heijnen, Verbraak, & Van Doornen, 2006; Pruessner, Hellhammer, & Kirschbaum, 1999; Zanstra, Schellekens, Schaap, & Kooistra, 2006). Second, non-invasive marker indicating ANS, especially parasympathetic, control of the heart in normal healthy individuals during real-life settings is both widely used and generally accepted (i.e., ambulaotry electrocardiogram (ECG) monitorings and heart rate variability (HRV) analysis, see, e.g., Berntson et al., 1997; Task Force, 1996); and although the results are somewhat contradictory, associations have been reported between positive affects (i.e., general positive feelings and emotions) and parasympathetic control of the heart (e.g., Pressman & Cohen, 2005).

1.5.1 Work engagement and healthy cardiac autonomic activity

Although cardiac automaticity is intrinsic to various pacemaker tissues, heart rate (HR) and rhythm are largely under control of the ANS (Brownley et al., 2000; Guyton & Hall, 2006; see also Ekman, Levenson, & Friesen, 1983). The ANS consists of two different components: the sympathetic and the parasympathetic nervous systems. In brief, sympathetic stimulation increases the overall activity of the heart whereas parasympathetic (i.e., vagal) stimulation mainly causes the opposite effects. However, regulation of the HR is the result of dynamic interaction between the sympathetic and parasympathetic components, and thus at any time there exists a certain sympatho-vagal balance (e.g., Berntson, Cacioppo, & Quigley, 1993; Thayer & Brosschot, 2005).

In normal healthy individuals, a demanding or challenging stimulus, for example a challenge at work produces only a brief increase in sympathetic activity and a decrease in parasympathetic activity; but, in constantly stressed or challenged individuals, the autonomic imbalance might persist, with sympathetic activity continuously dominating parasympathetic activity (e.g., Porges, 1995; Thayer & Brosschot, 2005; Thayer & Lane, 2007). Therefore, in healthy individuals the HR is not stable; even at rest the HR varies continuously around its mean value. In fact, the greater the range in the increase and decrease in the HR, the healthier the individual is considered to be (e.g., Porges & Byrne, 1992; Thayer & Brosschot, 2005). In addition, there is considerable evidence that autonomic imbalance, and especially decreased parasympathetic activity, results in cardiovascular ill health and that the combined effect of the sympathetic and parasympathetic nervous system is important for dynamic flexibility and cardiac health (e.g., Porges, 1995; Thayer & Lane, 2007).

Thus far, the relationship between work-related *positive* mental states and *healthy* cardiac autonomic activity has been largely neglected. As already mentioned, occupational health psychology studies have mainly focused on the negative aspects, that is, on work-related stress and burnout, and on increased risk for cardiovascular diseases (Belkic et al., 2004; Melamed et al., 2006). Therefore, the empirical evidence for the possible relationship between work engagement and healthy cardiac autonomic activity has to be drawn from the psychophysiological research on the negative opposite of work engagement, that is, burnout (e.g., De Vente et al., 2003; Van Doornen et al., 2009; Zanstra et al., 2006) and from research on another positive, although non work-related, construct, namely, positive affect (e.g., Bacon et al., 2004; Bhattacharyya, Whitehead, Rakhit, & Steptoe, 2008; Frazier, Strauss, & Steinhauer, 2004; Neumann & Waldstein, 2001; Steptoe & Wardle, 2005).

However, despite the considerable evidence linking burnout to cardiac diseases (e.g., Belkic et al., 2004; Melamed et al., 2006), there is no clear understanding of the cardiovascular psychophysiological mechanisms underlying this relationship. Previous studies have indicated only a minor disturbance in cardiac autonomic activity, that is, increased sympathetic and/or reduced parasympathetic control (e.g., De Vente et al., 2003; Zanstra et al., 2006). Furthermore, although several studies have found an association between positive affects and parasympathetic control, the results are somewhat contradictory. In some studies, positive affects have been associated with both increased and decreased HR (e.g., Neumann & Waldstein, 2001; Steptoe & Wardle, 2005), while in others, positive affects have shown no association with HR (e.g., Shapiro, Jamner, & Goldstein, 1997). Furthermore, the results on positive affects and HRV are inconsistent: in some studies positive affects have been related to increased (e.g., Bacon et al., 2004; Bhattacharyya et al., 2008) and decreased (e.g., Frazier et al., 2004) HRV, and in others positive affects have not shown any association with HRV (e.g., Hanson, Godaert, Maas, & Meijman, 2001). Thus, the previous results do not show a consistent pattern with regards to increased parasympathetic control (for a review, Pressman & Cohen, 2005; see also Steptoe, Dockray, & Wardle, 2009). However, in light of these indirect findings on positive affects and burnout, and the theoretical reasoning concerning the optimal function of the ANS, one possible mechanism linking work engagement and physical health could be the optimal functioning of ANS, and, in particular, increased parasympathetic activity.

1.6 Research questions and hypotheses

The main aims of this research were to investigate: 1) the construct validity of the Utrecht Work Engagement Scale, and the stability of work engagement 2) the strength and direction of the relationship between work engagement and job resources, and 3) the association between work engagement and healthy cardiac autonomic activity. These research aims are addressed in three separate sub-studies.

> *1) Do the Finnish versions of the Utrecht Work Engagement Scale -17 and -9 show construct validity among five different occupational groups and over a three-year time period? Is work engagement a stable state of mind over the three-year period? (Study I)*

Particularly the aim was to test whether both versions of the scale consist of the three correlated theoretically based dimensions of vigor, dedication, and absorption. To ensure the validity of the correlated three-factor structure, and since the three dimensions of work engagement have correlated highly in previous studies, an alternative one-factor structure of the UWES-17 and UWES-9 was also tested. Furthermore, the rank-order stability of work engagement over the three-year period was investigated. Theoretically, and according to previous longitudinal studies, work engagement was expected to be a pervasive and persistent state of mind.
(H1) The UWES-17 and the UWES-9 consist of the three correlated theoretically based factors of vigor, dedication, and absorption, instead of one work engagement factor.
(H2a) The correlated three-factor structures of the scales remain invariant across different occupational groups.
(H2b) The correlated three-factor structures of the scales remain invariant over the three-year time period.
(H3) The stabilities of work engagement factors are rather high over the three-year time period.

> *2) To what extent and in what direction does job resources influence work engagement? (Study II)*

To investigate the strength and direction of the relationship between work engagement and job resources (i.e., role clarity, supervisory support, positive organizational climate and innovative climate), the expected stability of work engagement needs to be excluded. Thus, the aim was first to investigate the extent to which work engagement can be explained by a component reflecting stability (i.e., stable variance) and a component reflecting change (i.e., change variance) over a seven-year time period (see also subsection 2.3.1). On the basis of the theoretical assumptions and previous longitudinal studies, most of the variance of work engagement was expected to be accounted for by the stable component. Furthermore, after excluding the stable component, according to the motivating qualities of job resources presented in the JD-R model, the gain cycles proposed in the COR theory, and the results of recent longitudinal studies, the relationship between work engagement and job resources was expected to be reciprocal and equally strong.
(H4) Work engagement is a stable state of mind, and most of its variance is accounted for by the stable component.

(H5) The relationship between work engagement and job resources is positive, reciprocal and equally strong.

3) Is work engagement related to healthy cardiac autonomic activity? (Study III)

The possible relationship between work engagement and healthy cardiac autonomic activity was examined by utilizing indicators of reduced sympathetic and increased parasympathetic control of the heart, that is, lower HR and increased HRV. Based on the indirect findings of previous studies on positive affects, and the theoretical reasoning of the optimal function of the ANS, it was expected that work engagement would be related to lower HR and higher HRV during the work time over and above the other factors (i.e., baseline level of HR and HRV, age, body mass index (BMI), physical fitness, and medication) that are expected to influence HR and HRV.
(H6a) Work engagement is related to and accounts for the variance of lower HR.
(H6b) Work engagement is related to and accounts for the variance of higher HRV.

2 METHOD

2.1 Participants and procedure

This research was based on eight different datasets gathered in six different Finnish research projects. Detailed information on the demographic characteristics of the participants and research procedures are provided in the original sub-studies, and thus only a short summary is given here. A summary of the main study aims, participants, variables and data analysis is given in Table 2.

Study I utilized five different datasets gathered in five diverse research projects in Finland in 2001–2006, focusing only on those participants who filled in the UWES questionnaire (n = 9,404). *Dataset 1* consisted of participants randomly selected from a single public health care organization in Finland in 2003 (see Mauno et al., 2007, for more information). The majority (n = 736, response rate 46%) were women (87%) and worked as nurses (n = 468, 64%). The mean age of the participants was 44 years (SD = 9.8). The mean level for work engagement measured with the UWES-17 was 4.4 (SD = 1.0), and measured with the UWES-9 it was 4.5 (SD = 1.1). *Dataset 2* consisted of participants who were members of the Finnish Union of Professional Engineers or Union of Salaried Employees in 2006, age 35 years or less and worked in a managerial position (see Hyvönen, Feldt, Salmela-Aro, Kinnunen, & Mäkikangas, 2009, for more information). The majority (n = 747, response rate 49%) were men (86%) and the mean sample age was 31 years (SD = 3.2). The mean level for work engagement measured with the UWES-17 was 4.4 (SD = 0.9), and measured with the UWES-9 it was 4.4 (SD = 1.0). *Dataset 3* consisted of a random sample of 1,301 managers (response rate 40%) gathered from the members of five Finnish trade unions (Union of Professional Engineers, Association of Graduates in Economics and Business, Association of Graduate Engineers, Association for Human Resource Management, or Experts and Managerial Professionals of Municipalities Association) in 2005 (see Kinnunen, Feldt, & Mäkikangas, 2008, for more information). The majority of the participants were men (70%) and the mean sample age was 48 years (SD = 8.5). The mean level for work engagement measured with the UWES-17 was 4.3 (SD = 0.9), and measured with the UWES-9 it was 4.6 (*SD* = 1.0). *Dataset 4* consisted of 3,365 participants (response rate 52%) from the Educational Department of Helsinki in 2001 (see Hakanen et al., 2006, for more information). The majority were female (79%) and most of the participants worked as teachers (*n* = 2,038; 60%). The age group 46–55 years contained the largest proportion (31%) of the participants. The mean level for work engagement measured with the UWES-17 was 4.4 (*SD* = 1.0), and measured with the UWES-9 it was 4.4 (*SD* = 1.2). *Dataset 5* utilized the first follow-up period (2003–2006) of a longitudinal research project comprising Finnish dentists who were members of the Finnish Dental Association at the time the data was first gathered in 2003 (see Hakanen et al., 2005; Hakanen, Perhoniemi, et al., 2008, for more information). In 2003, 3,255 dentists (response rate 71%), and in 2006, 2,555 dentists of those identified three years later (*n* = 3,035) participated in the study (response rate 84%). Most of the respondents (over 70%) were women and the mean sample age of the dentists in 2003 was 46 years (*SD* = 9.4). Dataset 5 is based on the responses of the dentists who participated either in the first or in both phases of the follow-up, depending on the research question. The mean level for work engagement at 2003 measured with the UWES-17 was 4.4 (*SD* = 1.0), and measured with the UWES-9 it was 4.6 (*SD* = 1.1). The mean level for work engagement at 2006 measured with the UWES-17 was 4.4 (*SD* = 0.9), and measured with the UWES-9 it was 4.6 (*SD* = 1.1). Attrition analyses of the samples are presented in the relevant articles in conjunction with the introduction to the research projects. However, attrition analyses were not possible for all of the Study I variables in all of the studied samples.

Study II was part of a seven-year (2003–2010), three-wave longitudinal research project conducted among Finnish dentists (for more information, see Hakanen & Schaufeli, 2012). The Study II data were based on the answers of the dentists who participated in all three phases of the study (*n* = 1,964; response rate 86%). Most of the participants (76%) were women and 64% of the sample was employed in the public sector. The mean level for work engagement in 2003 was 4.6 (*SD* = 1.1), in 2006 it was 4.6 (*SD* = 1.0), and in 2010 it was 4.6 (*SD* = 1.1). The attrition analysis of the study variables is presented in the original article (Seppälä et al., 2013). Of the study variables, the dentists who participated at all three time points showed slightly greater dedication than those who participated only at T1 (4.9 vs. 5.0, *p* = .01). As the participants did not differ on the basis of any other study variables, it seems unlikely that this difference significantly biased the results.

Study III was part of an interdisciplinary (psychology and biology of physical activity) research project conducted among 57 Finnish female cleaning workers (response rate 48%) from a municipal-owned cleaning company in Central Finland in 2006. However, of the original sample, 23 participants were excluded for medical reasons, three because of failures in the assessment, and one participant because of work role differences (she worked as a supervisor), resulting in a final sample of 30 participants. The mean age of the respondents was 46 years (*SD* = 11.1) and their work experience ranged between 1 and 41 years (*M* = 16.0, *SD* = 11.8). The ECG of the participants was recorded continuously for three nights and two succeeding working days (length of recordings: 54–56 hours) and participants were allowed to maintain their normal daily routines. During the ambulatory monitoring period, the participants completed a detailed diary on their daily activities. A postal questionnaire, which included the UWES, was sent to the participants during the week immediately following the monitoring. The mean level for work engagement was 3.9 (*SD* = 1.2). It is important to note that, for this sample, attrition analysis was not possible for either demographics or the study variables, as no information was available on those employees who did not participate in the study.

TABLE 2 Summary of the aims, participants, variables and data analyses used in Studies I–III

Study	*Participants*	*Variables*	*Data analysis*
Study I Construct validity and rank-order stability of the UWES.	Five different Finnish samples. Total sample size *n* = 9,404 (65% women). One of the samples (dentists) was a three-year (2003–2006) longitudinal sample with two-waves (*n* = 2,555; 74% women).	*Work engagement* - UWES-17 (α = .75–.90) - UWES-9 (α = .75–.87)	CFA and SEM [Weighted Least Squares (WLS), listwise deletion]; Satorra-Bentler scaled χ^2-difference test.
Study II Stability and change in work engagement, and the strength and direction of the relationship between work engagement and job resources.	Seven-year (2003–2010) and three-wave longitudinal sample of Finnish dentists (*n* = 1,964; 76% women).	*Work engagement* - UWES-9 (α = .74–.85) *Job resources* - role clarity (α = .73–.76) - supervisory support (α = .80–.81) - positive organizational climate (α = .85–.86) - innovative climate (α = .71–.72)	CFA and SEM [robust maximum likelihood with standard errors (MLR), missing data method]; Satorra-Bentler scaled χ^2-difference test.
Study III Relationship between work engagement and healthy cardiac autonomic activity.	Finnish female cleaning workers (*n* = 30). Cross-sectional study with 54–56 hours ambulatory recordings.	*Work engagement* - UWES-9 (α = .89) *Cardiac autonomic activity* - HR - HFP *Control variables* - Baseline HR and HFP - Age - BMI - Physical fitness - Medication/natural remedy	Hierarchical linear regression analyses; Spearman correlations.

CFA = confirmatory factor analysis, SEM = structural equation modeling, HR = heart rate, HFP = high frequency power of heart rate variability, BMI = body mass index.

2.2 Measures

Detailed information on the measures is given in the original articles and the Utrecht Work Engagement Scale is also presented in the Introduction section. Thus, only a short summary of the measures is provided in here (see also Table 2).

2.2.1 Work engagement

Work engagement was measured with the Finnish translation of the Utrecht Work Engagement Scale -17 and -9 (Hakanen, 2002; Schaufeli, Salanova, et al., 2002). The UWES comprises three underlying sub-scales – vigor, dedication and absorption – which are assessed, when using the UWES-17, with six, five and six statements (in that order), and, when using the UWES-9, each with three statements. Vigor is measured with items such as "At my work, I feel bursting with energy", dedication with items like "I am enthusiastic about my job", and absorption with items, such as "I feel happy when I am working intensely". The responses are given on a seven-point rating scale ranging from 0 (never) to 6 (every day). In Study I, both the 17-item and 9-item versions of the scale were used, and in Study II and Study III, the 9-item version was used. Work engagement was represented by items in Study I, by a total work engagement factor (mean sum scores for each sub-scales) in Study II, and by a composite sum-variable comprising all sub-scales in Study III.

2.2.2 Job resources

In this research, four different job resources were selected according to the motivational assumptions of the JD-R model (Bakker & Demerouti, 2007; Demerouti & Bakker, 2011; Demerouti, Bakker, Nachreiner, et al., 2001). As described above (see section 1.4.1), the JD-R model assumes that regardless of type of job, job resources refer to those physical, psychological, social, or organizational aspects of a job that are functional in achieving work goals, may reduce job demands, and stimulate personal growth, development and learning. Thus, in order to capture these different aspects of a job, job resources assessing task, interpersonal and organizational aspects of a job were selected. Furthermore, support at work, and positive and innovative team or organizational climate, are commonly used antecedents of work engagement (e.g., Mauno et al., 2010). Although less often investigated as an antecedent of work engagement, previous studies have shown that role clarity is associated with other positive (work-related) constructs (e.g., flow; see Demerouti, 2006; Quinn, 2005; Steele & Fullagar, 2009). In addition, because in this research job resources were assessed in only one professional group (i.e., dentists) job resources that were assumed to be important across different occupational groups were chosen.

Role clarity was measured with the Finnish version of Nordic Questionnaire for Psychological and Social Factors at Work (QPS Nordic; Dallner et al., 2000). The scale consists of three questions, such as "Do you know what your responsibilities are?". Answers are given on a five-point scale ranging from 1 (very seldom or never) to 5 (very often or always).

All the other three scales measuring job resources were derived from the Healthy Organization Barometer (HOB), a well-validated questionnaire that is widely used in Finnish organizations (Lindström, Hottinen, & Bredenberg, 2000).

Supervisory support was measured with the following three questions: "Does your supervisor provide help and support when needed?", "Does your supervisor provide feedback on how you performed at work?", "Does your supervisor describe what is expected of your work?". The items are rated on a five-point scale ranging from 1 (hardly ever) to 5 (very often).

Positive organizational climate was assessed by using three items framed by the question: "What is the climate in your work unit like?". The items were "Pleasant and relaxed", "Encouraging and supportive of new ideas", and "Nervous and strained". The answers to each are ranked on a five-point scale ranging from 1 (strongly disagree) to 5 (strongly agree), except that the one negatively framed item was recoded.

Innovative climate was measured with three items framed by the question: "How often do the following aspects occur in your work?". The items were "We continuously make improvements concerning our jobs", "Tasks and goals are discussed together", and "We ask our clients for feedback and ideas for improvement". The answers are rated on a five-point scale ranging from 1 (hardly ever) to 5 (very often).

The mean sum score of the items was computed separately for each four job resources.

2.2.3 Healthy cardiac autonomic activity

Healthy cardiac autonomic activity was assessed with decreased HR and increased HRV (i.e., high frequency power of heart rate variability, HFP). The analysis of HR and HRV enables evaluation of the sympatho-vagal balance (Berntson et al., 1997; Task Force, 1996), and thus the assessment of the interaction between psychological states and cardiac autonomic activity (Berntson et al., 1997; Porges & Byrne, 1992; Thayer & Brosschot, 2005). The normal resting HR of an adult is 60–80 beats per minute (bpm); however, challenging circumstances (e.g., work-related stress) or exercise can increase HR (i.e., decrease in parasympathetic and increase in sympathetic activity) while, in contrast, a resting HR below 60 bpm is common during sleep (i.e., increase in parasympathetic and decrease in sympathetic activity; Brownley et al., 2000; Guyton & Hall, 2006). HRV tends to be combined within several discrete frequency bands (i.e., heart rate variation distributes as a function of frequency) and the relative contribution of these discrete frequency bands to the original heart signals can be determined (Task Force, 1996). The most clear of these bands is at the respiratory frequency. Respiratory sinus arrhythmia is a rhythmical fluctuation in heart periods at the respiratory frequency that is characterised by shortening and lengthening of heart periods in a phase relationship with inspiration and expiration, respectively. Furthermore, to date, there is a clear consensus that respiratory frequency band (i.e., high frequency band of heart rate variability) is mostly influenced by parasympathetic activity (Berntson et al., 1997; Task Force, 1996).

HR and HFP were measured by using ECG, which was recorded continuously for three nights and two succeeding working days (the detailed procedure is described in the original article; see Seppälä et al., 2012). HR was calculated as the number of heart beats per minute (bpm) and the mean values of HR for work period and night period were used in Study III. HR was used to illustrate both heart sympathetic and parasympathetic activity (Task Force, 1996). HFP was computed within the frequency bands of 0.15–0.40 Hz and the mean values of HFP for work and night periods were used. HFP was used to illustrate heart parasympathetic (i.e., vagal) activity (Task Force, 1996).

Because many factors are expected to influence HR and HRV (e.g., Carter, Banister, & Blaber 2003; De Meersman & Stein, 2007; Dietrich et al., 2006; Myrtek, Fichtler, Strittmatter, & Brügner, 1999; Thayer & Lane, 2007; Watanabe et al., 2002), Study III included the following control variables: *baseline HR* and *HFP*, *age*, *BMI, physical fitness*, and the use of *medication* and/or *natural remedy*. Mean values of HR and HFP for the first four hours of the first two nights were used as indicators of the individual baseline level. Only the first four hours of the night periods, starting 30 minutes after going to bed, were used in the analyses to improve the accuracy and comparability of the night measurements, due to very different bedtimes and duration of sleep (5.4–8.7 hours) (see, e.g., Hynynen, Vesterinen, Rusko, & Nummela, 2010). BMI was calculated as the weight in kilograms divided by the square of height in meters (kg/m^2). Physical fitness (i.e., maximum oxygen uptake, ml/kg/min) was estimated by the Firstbeat Health software application (version 3.0.0.9, Firstbeat Technologies Ltd, Finland; detailed information is provided in the original article, see Seppälä et al., 2012; see also Smolander et al., 2008). Self-reported medication (i.e., antihistamines for allergic rhinitis, oral contraceptives, hormonal therapy for menopausal symptoms, lipid-lowering medication, and/or hormonal therapy for hypothyroidism) and/or natural remedy was treated as a dichotomous variable (yes/no) and natural log transformed values of HFP (lnHFP) were used in the analyses.

2.3 Data analyses

Study I was conducted by using CFA, multigroup confirmatory factor analysis (MGCFA) and SEM techniques, which were performed with the LISREL 8.72 program (Jöreskog & Sörbom, 1996). Study II was conducted by using CFA and SEM techniques, which were performed with the Mplus statistical package (version 6.0; Muthén & Muthén, 1998–2010). CFA, MGCFA and SEM were chosen, as they are the most rigorous statistical methods to analyse the following research questions. First, CFA made it possible to investigate the construct validity of the UWES and test whether the UWES is consistent with the underlying theory of work engagement (e.g., Jöreskog, 1971, 2007; Millsap & Meredith, 2007), in particular, to explore whether there are three correlated latent factors (vigor, dedication, absorption) underlying the manifested variables instead of one latent work engagement factor (Study I). Second, MGCFA enabled the estimation of simultaneous models in multiple groups, permitting invariance constraints on any model parameter (e.g., Jöreskog, 1971; Millsap & Meredith, 2007). In particular, it was possible to investigate whether the factor structure and factor loadings of the UWES remained invariant across different occupational groups and over time (Study I). Third, with SEM the correlated measurement errors over time could be taken into account, thereby producing an error-free estimation of the rank-order stabilities of the work engagement dimensions (Study I; e.g., Kline, 2011). In addition, SEM made it possible to explore the extent of the stable variance in work engagement (Study II), and to estimate different types of relationship simultaneously in multi-variable (work engagement and job resources) and multi-wave (three-wave) models (Study II; e.g., Zapf, Dormann, & Frese, 1996).

Study III was conducted by using hierarchical linear regression analysis and performed with the SPSS 15.0 program. The main aim of Study III was to investigate whether work engagement accounts for the variance of decreased HR and increased HFP, over and above the other factors that are related to cardiac autonomic activity. Hierarchical linear regression analysis was chosen because in this study aggregated values of HR and HFP were used for the selected segments of interest (i.e., work and night periods). Aggregated values of HR and HFP instead of daily-based values were chosen in order to reduce the many unpredictable confounding influences on HR and HRV (see, e.g., Manuck, 1994).

2.3.1 Stability and change model

In this research, a rather complex statistical modeling technique, the stability and change model (Ormel & Schaufeli, 1991; see also Cole, Martin, & Steiger, 2005) was also utilized to explore the stability of work engagement and the relationship between work engagement and job resources. As this rigorous modeling technique has only rarely been applied to the examination of well-being at work (e.g., Schaufeli et al., 2011), the main assumptions of the model are presented next. The stability and change model is based on the dynamic equilibrium model of subjective well-being (Headey & Wearing, 1989). Following the stability and change model, the extent of the variance in work engagement at a particular time point can be explained by a component reflecting stability and a remaining component reflecting change (Ormel & Schaufeli, 1991). The stable component is based on stable personal characteristics (e.g., personality traits) and enduring environmental conditions (e.g., stable economic and social environment). The model further assumes that environmental changes (e.g., job resources) may cause a deviation from the stable level of work engagement. However, internal adaptive processes (e.g., ways of coping) try to ensure that the stable level of work engagement is sustained, so that the influences of the environmental changes are usually only temporary (i.e., the stable component is expected to counteract any cross-lagged effects and to maintain individuals' functioning at the characteristic and stable level; see Ormel & Schaufeli, 1991). The stronger these individual, adaptive processes are, the less room there is for influence by environmental forces (Headey & Wearing, 1989).

Thus, utilizing the stability and change model, it was possible more accurately to investigate the stability of work engagement, as the model reveals the stability not only between consecutive time points but also across all the time points. Furthermore, the model yields a very accurate estimate of the relationship between work engagement and job resources, as all the stability inherent in work engagement is controlled for and the relationship with job resources is estimated through the change components.

3 OVERVIEW OF THE ORIGINAL STUDIES

3.1 Study I

Do the Finnish versions of the Utrecht Work Engagement Scale -17 and -9 show construct validity among five different occupational groups and over a three-year time period? Is work engagement a stable state of mind over the three-year period?

Study I investigated the psychometrical properties of work engagement scale and the stability of work engagement. More specifically, the construct validity of the UWES-17 and UWES-9 was investigated among five independent samples, of which one was a longitudinal (*n* = 2,555) sample, totalling 9,404 Finnish employees. First, it was tested whether the UWES-17 and UWES-9 consist of three correlated theoretically based factors of vigor, dedication, and absorption, instead of one work engagement factor (i.e., all dimensions load on the same factor). Next, the factorial invariance of the scales was investigated by testing whether the hypothesized correlated three-factor structure (i.e., factor loadings) remains invariant across different occupational groups and over a three-year time period. Finally, Study I investigated the rank-order stabilities of the scales over a period of three-years.

The hypothesis (H1) that both versions of the scales consist of three different, but highly related (*r* = .83–.97), theoretically based dimensions of vigor, dedication, and absorption was confirmed. Furthermore, the correlated three-factor structure showed a better fit with all five occupational groups and at both measurement points than the alternative one-factor structure. However, the high correlations between the three factors also indicated substantial overlaps between the factors. Furthermore, partially in line with the expectations of factorial group-invariance (H2a), the correlated three-factor structure remained rather invariant in different samples, but only when measured with the UWES-9. In addition, partly in line with the expectations of factorial time-invariance (H2b), the correlated three-factor structure was relatively invariant over the three-year time period when assessed with the UWES-9. The results therefore indicated good construct validity for the UWES-9, and the use of the 9-item version of the scale can be recommended in future research on work engagement in Finland. Finally, as hypothesized (H3), the rank-order stabilities (measured with the UWES-9) for the three factors of work engagement were rather high, ranging from .82 to .86. Thus, as expected, work engagement is a persistent and long-lasting work-related state of mind.

3.2 Study II

To what extent and in what direction does job resources influence work engagement?

Study II investigated work engagement from a psychosocial point of view. The main aim was to investigate the strength and direction of the relationship between work engagement and psychosocial job resources (i.e., role clarity, supervisory support, positive organizational climate and innovative climate) after excluding the stability inherent in work engagement. Study II was conducted among Finnish dentists (n = 1,964) over a seven-year period (2003–2010) with three measurement points. Both of the study aims, the stability of work engagement and the strength and direction of the relationship between work engagement and job resources, were explored by using the stability and change model (Ormel & Schaufeli, 1991). Therefore, it was possible to obtain a very accurate estimate of the strength and direction of the relationship, as the stable components of work engagement and job resources were controlled for and the relationship between the change components was estimated.

As expected (H4), work engagement was a stable state of mind even over a period as long as seven-years, and most of its variance was explained by the stable component. In particular, between 69% and 77% of the variance of dentists' work engagement was accounted for by the stable component, and thus from 23% to 31% by the change component. Therefore, the statistical method used here yielded a very accurate estimate, showing even higher stability for work engagement than reported in previous studies. However, after the stability inherent in work engagement had been taken into account, about one-quarter to one-third of the variance of work engagement remained that was open to influence. As hypothesized (H5), the strength and direction of the relationship between job resources and work engagement was positive, practically reciprocal and equally strong: work engagement influenced job resources almost as strongly as job resources influenced work engagement, explaining roughly 10% of the variance. Consequently, it was possible to positively influence work engagement by job resources, but it was also possible to positively, and as strongly, influence job resources by work engagement. The results thus indicate that a reciprocal motivational reinforcement cycle exists between work engagement and job resources.

3.3 Study III

Is work engagement related to healthy cardiac autonomic activity?

Study III investigated work engagement from a psychophysiological viewpoint. The main purpose of Study III was to investigate the possible association between work engagement and healthy cardiac autonomic activity, indicated by reduced sympathetic and increased parasympathetic control of the heart. Specifically, Study III explored whether work engagement is related to lower HR and higher HFP during work period, and whether work engagement makes a unique contribution on HR and HFP over and above the other factors (i.e., baseline level of HR and HFP, age, BMI, physical fitness, and medication) that are expected to influence HR and HFP. Study III was carried out among Finnish female cleaning workers (n = 30) using a daily life setting and ambulatory monitoring period of over two workdays and preceding nights (54–56 hours).

In line with the hypothesis (H6a), work engagement was negatively related to HR during the work period (r = -.37, p < .05). However, in contrast to the hypothesis (H6a), work engagement did not account for the variance of HR after controlling for the confounding variables (β = -.28, p = .07). Furthermore, work engagement was, as hypothesized (H6b), positively related to HFP during the work period (r = .44, p < .05) and explained an additional 19% of the variance in HFP (β = .48, p < .01), after controlling for the baseline level of HFP, age, BMI, physical fitness, and medication. Therefore, work engagement was related to healthy cardiac autonomic activity during the work period, especially to reduced vagal withdrawal. This indicates that work engagement might be related to cardiac health via healthy and balanced functioning of the ANS.

4 DISCUSSION

4.1 Main findings of the research

4.1.1 Work engagement consists of three strongly related and highly stable dimensions

This research confirmed the theoretical expectations (Schaufeli, Salanova, et al., 2002) that work engagement is a multidimensional construct, which consists of three strongly related (r = .83–.97) dimensions of vigor, dedication, and absorption. Both versions of the UWES scales (UWES-17 and UWES-9) measured this three-dimensional structure among five separate samples with various occupational groups and at two different time points. The correlated three-factor structure of the scales also showed statistically better fit with all these datasets than the alternative one-factor structure, where all the three dimensions were captured in one underlying work engagement factor. Thus, according to the present research, and in agreement with previous studies (e.g., Balducci et al., 2010; Hallberg & Schaufeli, 2006; Schaufeli & Bakker, 2003; Schaufeli, Bakker, et al., 2006), work engagement consists of three separate, but related dimensions, all of which describe slightly different kinds of positive experiences resulting from one's work.

However, although both versions of the scales assessed the three dimensional structure of work engagement across different occupational groups and over time, some differences were observed in the contribution of specific items in explaining work engagement dimensions from one occupational group to another and across two points in time (i.e., the size of the factor loadings differed). Therefore, against expectations, the UWES scales did not measure the dimensions of work engagement similarly across different contexts. Nevertheless, the factorial group- and time-invariance of the two versions of the UWES were different. The work engagement dimensions were conceptualized and manifested more similarly among the different occupational groups and at the two different time points when measured with the UWES-9 than with the

UWES-17. Different degrees of invariance, depending on which version of the UWES is used, has also been found in a previous study, where the psychometric properties of the UWES-9 remained more invariant than those of the UWES-17 among different occupational groups (Schaufeli & Bakker, 2003).

Furthermore, although the UWES-9 had good construct validity and it seems to be structurally a sound measure of work engagement, it should be remembered that construct validity is only a one form of validity. The items assessing, for example, the meaning and purpose of work, and persistence in the face of difficulties – items that are considered among the key characterizations of work engagement – are omitted from the short version of the scale. Consequently, it can be questioned whether the UWES-9 captures the same content (i.e., content validity) as the original UWES-17. The correlations between the dimensions measured with the original and short version of the scale have, however, been very high (in the present research around .90 and in previous studies even higher; see, e.g., Schaufeli & Bakker, 2003; Schaufeli, Bakker, et al., 2006). Therefore, both versions of the scale seem to measure work engagement rather similarly, suggesting that the UWES did not need these excluded items in the first place.

Because only the UWES-9 assessed work engagement invariantly over time, the UWES-9 was used to examine the rank-order stabilities of the work engagement dimensions. In line with the theoretical assumption (Schaufeli, Salanova, et al., 2002) and previous longitudinal studies (e.g., De Lange et al., 2008; Hakanen et al., 2011; Hakanen & Schaufeli, 2012; Mauno et al., 2007; Schaufeli et al., 2009; Simbula et al., 2011; Weigl et al., 2010; Xanthopoulou et al., 2009a), the present research revealed that experiences of work engagement remained highly stable over the three-year period. The stability coefficients for the three dimensions of work engagement ranged from .82 to .86. Thus, work engagement experienced at the first measurement time explained about 70% of the variance at the second measurement time three years later. However, despite the high stability, room remained for the influence of other factors on work engagement.

4.1.2 Work engagement and job resources form a mutual and equal reinforcement cycle

The present research also showed that the stability of work engagement was rather high, even over a period as long as seven-years. However, although the main predictor of work engagement over the seven-year period was the stability inherent in work engagement, that is, between 69% and 77% of the total variance was accounted for by the stable variance, room was nevertheless left for other factors to influence work engagement. As expected according to the motivational assumptions of the JD-R model (Bakker & Demerouti, 2007; Demerouti, Bakker, Nachreiner, et al., 2001), job resources, namely, role clarity, supervisory support, positive organizational climate and innovative climate, were positively related to experiences of work engagement. However, the present research also showed that the relationship between job resources and work engagement was not merely unidirectional. In line with the expectations based on the premises of the gain cycles and gain spirals illustrated in the COR theory (Hobfoll, 1998, 2001) and previous empirical studies (e.g., Hakanen et al., 2011; Hakanen, Perhoniemi, et al., 2008; Schaufeli et al., 2009; Simbula et al., 2011; Weigl et al., 2010; Xanthopoulou et al., 2009a), not only was work engagement influenced by job resources, but work engagement was also positively related to perceptions of job resources. Furthermore, as expected according to recent findings (Hakanen, Perhoniemi, et al., 2008; Xanthopoulou et al., 2009a), the relationship between work engagement and job resources was equally strong in both directions. Work engagement influenced job resources as strongly as job resources influenced work engagement, each explaining approximately 10% of the other's variance.

Therefore, in accordance with the recent modification of the JD-R model (Bakker, 2011; Bakker & Demerouti, 2007), this research suggest that the original JD-R model should include feedback loops between work engagement and job resources. However, this research was unable to reveal the order of the relationship between job resources and work engagement. Thus, both job resources and work engagement can be considered the most important initiators of this process, and reinforcing either one is beneficial to this cycle. In practice, however, it seems convenient to initiate the reinforcing cycle by offering job resources to an employee as soon as she/he joins an organization, than merely expect employees to create their own job resources (e.g., Saks & Gruman, 2010). Furthermore, the starting and ending point of a process is not perhaps that crucial an issue for research and practice. It would be more important to find out how these positive resource cycles and spirals occur and the circumstances, in which they occur most optimally. Although the COR theory draws attention to the processes by which different resources operate, that is, through caravans, cycles, or spirals, the generality of these processes limit their utility (Hobfoll, 2001, 2002). It is of course impossible to summarize all the different processes that are possible, as the paths most likely vary for different individuals and in different circumstances. However, some general processes or circumstances to which the principles of the COR theory might more specifically apply may nevertheless exist (see also Bakker, 2010; Salanova et al., 2010).

One theory that might provide some perspective on the positive resource cycles and spirals is the broaden-and-build theory of positive emotions (Fredrickson, 2001). According to the broaden-and-build theory, positive emotions, such as work engagement, are assumed to broaden people's momentary thought-action repertoires, meaning that positive emotions extend the array of thoughts and action tendencies that spontaneously come to mind. Following the broaden-and-build theory, it seems possible that work engaged employees actively enhance or "craft" their own working conditions (e.g., job resources) and consequently experience enhancement in the meaning of their work (Bakker, 2010; Tims, Bakker, & Derks, 2012; see also Wrzesnieski & Dutton, 2001). Thus, work engaged employees might optimize their working conditions, for example, by asking for feedback to develop their social support and by looking for new opportunities to make their work more challenging (e.g., Bakker & Bal, 2010; Hakanen, Perhoniemi, et al., 2008; Hyvönen et al., 2009; Xanthopoulou et al., 2009a).

However, the present research did not met the criteria for a true gain spiral; that is, alongside a longitudinal study with at least three waves and a reciprocal relationship, an increase in the level of the constructs over time would also be needed (e.g., Lindsley, Brass, & Thomas, 1995). Therefore, this research did not show that an increase in work engagement increases job resources and, vice versa, that an increase in job resources increases work engagement, as expected on the basis of the broaden-and-build theory and the gain spirals of the COR theory. Instead of demonstrating a true gain spiral, work engagement and job resources seem to co-occur and generate mutual and equal reinforcement, a so-called positive gain cycle. To the best of my knowledge, no previous study has met the theoretical requirements for a gain spiral. Usually, a reciprocal relationship between job resources and work engagement has been observed (e.g., Hakanen et al., 2011; Hakanen, Perhoniemi, et al., 2008; Schaufeli et al., 2009; Simbula et al., 2011; Weigl et al., 2010; Xanthopoulou et al., 2009a), and in some cases the requirement for three waves has also been met (Simbula et al., 2011; Weigl et al., 2010). Nevertheless, no evidence of also an increment in the mean levels of job resources or work engagement over time has thus far been reported (see Salanova, Llorens, & Schaufeli, 2011; see also Vuori, Toppinen-Tanner, & Mutanen, 2012).

The high extent of the stable variance in work engagement revealed in this research might make it rather difficult to demonstrate a true gain spiral. The stable variance of work engagement sustains work engagement on its habitual level, at least if working conditions remain largely unchanged (Headey & Wearing, 1989; Ormel & Schaufeli, 1991). Therefore, according to the present research, job resources need to be either very considerable one-time effects (e.g., promotion; see De Lange et al., 2008) or continuous and long-standing everyday practices in the workplace, such as daily support, in order to induce a significant increase from the general level of work engagement. However, even considerable positive one-time influences do not usually have strong and long-lasting effects (for a review, see Baumeister, Bratslavsky, Finkenauer, & Vohs, 2001).

4.1.3 Work engagement can accumulate into health enhancement process

To the best of my knowledge, this research was the first to reveal an association between work engagement and indicators of healthy cardiac autonomic activity. Work engagement was, as expected, related to decreased HR and increased HFP during work period, and accounted for 19% of the variance in HFP after excluding the control variables (i.e., individual baseline level, age, BMI, physical fitness, and medication). However, against expectations, work engagement did not account for the variance of lower HR after excluding the confounding variables. Nevertheless, as this relationship almost reached statistical significance ($\beta = -.28$, $p = .07$), it can be speculated that a tendency towards this effect exists, and hence this result can be seen as encouraging for future studies.

In line with the indirect findings on the relationship between positive affects and greater parasympathetic control (e.g., Bacon et al., 2004; Bhattacharyya et al., 2008), work engagement was related, in particular, to increased parasympathetic control. Furthermore, parasympathetic control is generally agreed to have an important role in cardiac health, and decreased parasympathetic activation of the heart has been associated with elevated risk for cardiovascular diseases and even mortality (for a review, see Thayer & Lane, 2007). Thus, greater parasympathetic control could be one of the mechanisms underlying the relationship between work engagement and better self-rated physical health (e.g., Demerouti, Bakker, De Jonge, et al., 2001; Hakanen & Schaufeli, 2012; Schaufeli & Bakker, 2004; Shimazu et al., 2008).

This finding is noteworthy for two main reasons. First, it contributes importantly to the existing literature on the psychophysiology of occupational health. Thus far, the literature has largely been dominated by research on the relationships between occupational ill-being and cardiac problems (e.g., Belkic et al., 2004; Melamed et al., 2006). In addition, it provides further evidence on the modified JD-R model (e.g., Airila et al., 2012; Demerouti, Bakker, De Jonge, et al., 2001; Hakanen et al., 2006; Hakanen & Schaufeli, 2012; Schaufeli & Bakker, 2004; Shimazu et al., 2008): alongside the health impairment process from job demands via burnout to health problems, the model can also be proposed to include a positive association between work engagement and the health enhancement process (i.e., job resources – work engagement – health). Furthermore, in light of the present research, it seems possible that the improved physical health of work engaged employees might also work as a mediator in the JD-R model between work engagement and the motivational/performance outcomes (i.e., work engagement – better health – better performance; see also Bakker, 2011; Leiter & Maslach, 2010). Because work engaged employees experience better health, they have the potential to bring more capacity to the task at hand and perform better in their work.

Second, the association between work engagement and healthy and balanced cardiac autonomic activity questions recent speculation that work engagement, as an energetic and vigorous state, might be related to too high arousal levels (i.e., neuroendocrine and cardiovascular, e.g., Cacioppo, Tassinary, & Berntson, 2007) and in consequence has "a dark side" (e.g., Bakker et al., 2011b). It has been proposed that those who are highly work engaged might have levels of arousal so high as to distract from cognitive performance (Beal, Weiss, Barros, & MacDermid, 2005), and/or lead to costs to well-being, as individuals cannot expend their energy at the highest levels all the time (Macey & Schneider, 2008). However, the present research did not find support for the proposition that arousal levels are too high. Instead, the opposite was found: work engagement was related to lower arousal levels of cardiac autonomic control, especially, to higher HRV during work period.

However, this research cannot rule out the possibility that work engagement may have negative effects on health mediated via some other indirect mechanisms (e.g., unhealthy behavior choices) than the (parasympathetic) cardiac autonomic control. It is possible, for example, that work engaged employees may work overtime, because they are enthusiastic about their jobs (e.g., Beckers et al., 2004; Hakanen et al., 2012; Schaufeli et al., 2008; Schaufeli, Taris, et al., 2006). As a consequence they may not detach psychologically and recover from work sufficiently (e.g., Hakanen et al., 2012), which might cause psychosomatic symptoms (e.g., Sonnentag, Binnewies, & Mojza, 2010; Sonnentag & Fritz, 2007). Nevertheless, recent studies have found a positive relationship between work engagement and feelings of recovery and psychological detachment from work (Kinnunen et al., 2011; Kühnel, Sonnentag, & Westman, 2009; Sonnentag, 2003; Sonnentag et al., 2012). In addition, although thus far more support exists for positive enrichment between work engagement and family (e.g., Culbertson, Mills, & Fullagar, 2012; Hakanen et al., 2011; Mauno, 2010; Siu et al., 2010), it is possible that because work engaged employees show extra-role work behaviors, they expend more resources on work than is expected from them (Halbesleben, Harwey, & Bolino, 2009). As a result they have fewer resources to deploy at home, which can cause interference with the family domain, possibly leading to negative health consequences (e.g., Greenhaus, Allen, & Spector, 2006).

It is also plausible that work engagement can increase job demands over time; those who are highly work engaged may, for instance, craft too many additional tasks (George, 2011; Halbesleben, 2011). Increased job demands can further lead to poor health and well-being via burnout (Bakker & Demerouti, 2007; Demerouti, Bakker, Nachreiner, et al., 2001). Nevertheless, no “risk limits or cut-of scores" have been set for unhealthy amounts of job demands (see Demerouti & Bakker, 2011), which also depend on the availability of job resources (e.g., Bakker et al., 2005; Hakanen et al., 2005) and recovery (e.g., Kinnunen et al., 2011; Sonnentag, Binnewies, et al., 2010). Nevertheless, work engagement should also be viewed from this perspective, and too high job demands should be prevented (De Lange et al., 2009). Furthermore, it has been suggested that energy and identification can, over time, turn out into exhaustion and cynicism, if enthusiastic employees invest large amounts of effort at work without receiving appropriate outcomes (Pines, Aronson, & Kafry, 1981; Schaufeli & Salanova, 2011). However, so far, there is no empirical evidence to suggest that work engaged individuals would end up being burned out, even in the long-term (Hakanen & Schaufeli, 2012).

Finally, it is important to note that there are contradictory views on what the most important outcomes of work engagement are that future studies should explore. In fact, the importance of investigating the relationship between work engagement and psychophysiological indicators has been questioned. On the one hand, because physical health is determined by much more than the workplace, it has been suggested that future studies should rather focus on exploring behavioral outcomes, such as job performance (e.g., Maslach, 2011; see also Maslach, 2001). On the other hand, because knowledge on psychophysiological processes remains very limited, it has been proposed that illuminating the psychophysiological mechanisms that could explain the relationship between work engagement and self-rated physical health is one of the key questions for future research on work engagement (Bakker et al., 2011b). Furthermore, it has been suggested that this challenge should go even further. Future studies should try to include the other parts of the JD-R model (i.e., job demands and resources) in the health enhancement process, and reveal the conditions under which this process best occurs (Bakker & Leiter, 2010a; Demerouti & Bakker, 2011). The value of, and the most important outcomes, "the crucial bottom line", for work engagement will, of course, differ according to whether it is viewed from the perspective of employees from that of employers' (Bakker et al., 2011b; George, 2011; Maslach, 2011). However, it should be noticed that both of these positive outcomes of work engagement, health-relations and improved performance, benefit the employee as well as the organization.

4.2 Strength and limitations of the research and recommendations for future studies

This research has both its strengths and limitations that need to be considered when interpreting the findings. The major strengths were the multi-sample and longitudinal datasets, rigorous statistical methods, and the use of both self-rated and objective measures. These are clear merits, as studies on work engagement have most often relied solely on self-reports and a cross-sectional design (see Bakker, 2011).

The first strength of this research was the utilization of many different datasets including a longitudinal dataset with three waves and a seven-year time-lag, which is thus far the longest follow-up on work engagement. Altogether eight different samples containing a variety of different occupational groups were utilized, thereby making it possible to validate the Finnish version of the UWES across a broad range of occupations. This research focused on managers at different levels, health care personnel, educational employees, dentists, and also included cleaning workers, an occupational group that has usually been ignored in work engagement research. The second strength was the use of rigorous statistical methods. CFA, MGCFA and SEM methods were utilized in two of the three sub-studies. In the first sub-study the psychometric properties of the UWES were explored by using the CFA and the MGCFA procedure. The construct validity and factorial invariance of a questionnaire are fundamental issues that are gradually becoming more widely recognized among researchers (e.g., Millsap & Meredith, 2007). Therefore, the decision to utilize the UWES-9 in the further two sub-studies was based on the outcome of the statistical evaluation. In addition, after demonstrating the factorial time-invariance of the UWES-9, it was possible to rule out the possible confounding effects of dissimilar psychometric properties of the scale over time, and make a valid estimate of the rank-order stability of work engagement. Third, instead of self-rated questionnaires this research also utilized objective indicators of physical health, which increased the validity of the results and freed them from common-method bias (e.g., Podsakoff, Mackenzie, Lee, & Podsakoff, 2003). In addition, it was innovative to utilize measures indicating cardiac autonomic activity, that is, outcome variables beyond the outcomes of the motivational process of the JD-R model that most of the current work engagement research builds on.

Nevertheless, there are also limitations in this research that should be considered when interpreting the results. First, there are some limitations related to the selected datasets and study design. Although several datasets were utilized in this research, some of the research questions were investigated only among one particular occupational group. The stability of work engagement was revealed in two of the three sub-studies; but in both cases the participants were Finnish dentists (i.e., upper white-collar) only. Because the stability of work engagement has been found to be high among Finnish dentists (see Table 1, p. 23), it needs to be questioned whether the results are generalizable beyond this one occupational group. Likewise, the sample of Finnish female cleaning workers was homogeneous by occupation and gender. However, the purpose of these sub-studies was to explore the theoretical assumptions of work engagement and illuminate positive psychophysiolocigal processes and not to make group comparisons, which would have needed more representative samples. The present results, based on only one occupational group, should, however, be replicated in more representative samples of workers in the future. Finally, the present datasets concerned Finnish employees only. Considering that most studies of work engagement have examined European workers with relatively small cultural differences, cross-cultural studies on work engagement are clearly needed (e.g., Shimazu, Miyanaka, & Schaufeli, 2010).

Furthermore, the construct validity of the UWES was investigated utilizing five divergent samples; however, the response rates of some of these samples were somewhat low (40–84%), and therefore it is possible that the samples obtained in the original studies were to some extent selective and not representative with respect to those occupational groups. In addition, as no information was available on the 63 cleaning workers (52%) who did not participate in the study, it is impossible to confirm the representativeness of the responses in relation to the original sample. Previous studies have found, for example, that non-respondents showed greater intentions to quit and lower levels of organizational commitment (e.g., Rogelberg, Luong, Sederburg, & Cristol, 2000), both of which have been negatively related to work engagement (e.g., Hakanen et al., 2006; Schaufeli & Bakker, 2004). Thus, it is possible that the respondents in this research may to some extent show greater work engagement than the original population. Nevertheless, the (low) response rates in this research are consistent with the average response rates in studies that utilize data collected from individuals (Baruch & Holtom, 2008). Furthermore, equally likely reasons for non-participation could have been, for instance, over-surveying in a growing number of areas and/or the effort required of participants (e.g., Rogelberg & Stanton, 2007), neither of which have been related to work engagement.

In addition, the criteria for causality, which would have needed an experimental design with a random assignment of individuals to the conditions of interest, could not be met in this research (e.g., Antonakis, Bendahan, Jacquart, & Lalive, 2010). Therefore, the causal direction of the relationships between work engagement and job resources, and between work engagement and healthy cardiac autonomy could not be inferred from the present data. It is also possible that both of these links were caused by some unmeasured third variables. Thus, at this stage, because this research was the first to reveal an association between work engagement and healthy cardiac autonomic activity, the results must be considered with caution. As Maslach (2011), for example, pointed out, physical health is determined by many other than work-related factors. Apart from work engagement, no other well-being constructs, for example, positive affects, were studied. Because positive affects have been related to parasympathetic activity (e.g., Bacon et al., 2004; Bhattacharyya et al., 2008), this relationship could modify the relationship between work engagement and healthy cardiac autonomic activity, and hence the latter association could disappear after adjusting for positive affects. However, an unpublished preliminary analysis showed that negative affectivity (i.e., the tendency to experience negative emotions across time and situations; Denollet, 1998; see also Watson et al., 1998) was not significantly related to HR or HRV during work-time.

Furthermore, although several of the variables that are known to influence HR and HRV (i.e., baseline level of the outcomes, age, BMI, physical fitness, and medication) were controlled for in this research, it was not possible to exclude them all. For example, favorable health habits, prudent lifestyle, and general health were not controlled for (e.g., Li & Sung, 1999). Nevertheless, 11 of the 30 employees who participated in the study were smokers and two participants had a BMI over 30, both of which factors are associated with decreased parasympathetic activity (e.g., Dietrich et al., 2006; Thayer & Lane, 2007). In addition, according to the unpublished preliminary analyses, self-rated general health did not show a significant association with either HR or HFP. Given that the criteria for true causality can hardly ever in practice be met, if work engagement is investigated in natural settings, good ecological validity can be considered an additional strength: the employees were studied in a daily life setting allowing them to maintain their normal lifestyle.

Second, there are also some methodological limitations in this research. It should be noted that although the UWES-9 measured work engagement rather similarly across the different occupational groups and over time, a few of the factor loadings of the UWES-9 were noninvariant (detailed information is provided in the original article; see Seppälä et al., 2009). However, the statistical power of SEM is based not only on the characteristics of the model but also on the sample size. Therefore, studies with large sample sizes, as in this research, might produce results that have statistical (i.e., significant chi-square value), but not practical significance (see, e.g., Bollen, 1989; Chen, 2007; Cheung & Rensvold, 2002). In addition, because the requirement that all factor loadings should be equal across different contexts is difficult to satisfy, it has been proposed that noninvariant factor loadings can be permitted to constitute a small portion of the model (e.g., Steenkamp & Baumgartner, 1998; see also Vandenberg & Lance, 2000) and that researchers should also examine the absolute differences in the factor loadings (Vandenberg & Lance, 2000). The absolute differences in the size of the factor loadings of the UWES-9 in this research were indeed only minor, and for all practical purposes meaningless (see Seppälä et al., 2009).

In addition, this research explored rank-order stabilities, which reflect the degree to which the relative ordering of individuals within a group on the basis of their UWES-9 scores is maintained over time (e.g., Roberts & DelVecchio, 2000). Therefore, the high rank-order stability found for work engagement does not rule out the possibility that the mean-levels of the UWES-9 scores increased or decreased over time while the ordering of the individuals remained the same. In addition, the rank-order stability investigates the stability of work engagement from a variable-focused approach, which assumes similar stability for all the individuals included in the study (e.g., Roberts & DelVecchio, 2000). Thus, the high rank-order stability found in this research does not rule out the possibility of individual differences in stability. The stability of work engagement could have been different, for example, for employees in different work situations among the same data. In fact, a previous study found that the stabilities for work engagement varied a great deal among different groups of employees (β = .22 for job changers, β = .68 for stayers; De Lange et al., 2008). In addition, on the basis of unpublished preliminary analyses, different latent subgroups of dentists were identified on the basis of the level of work engagement they showed across time; in four subgroups, work engagement seemed to remain stable (“stable high and stable low”) and in two subgroups, work engagement seemed to increase and decrease (“moderate increasing and moderate decreasing”). Future studies could, therefore, attempt a more specific understanding of the stability of work engagement by investigating various forms of stability, for example, by using above-mentioned person-centered approach, which enables identification of groups of individuals among the same data who share particular characteristics, “latent classes” (see, e.g., Hertzog & Nesselroade, 1987; Laursen & Hoff, 2006; Magnusson, 1998; see also Mäkikangas et al., 2012).

Third, this research has limitation with regard to the selected variables. The relationship between work engagement and job resources was investigated solely on the basis of self-report questionnaires. It is thus possible that the estimate of this relationship might have been inflated by the bias common to the method, as the same method was used to measure different variables. Furthermore, the high amount of stable variance found for work engagement raises questions about the roots of this stability, which the present research was unable to determine. The role of personality factors in work engagement has been raised rather often (e.g., Albrecht, 2010b), and it has also been empirically examined in some studies (e.g., Inceoglu & Warr, 2011; Kim, Shin, & Swanger, 2009; Langelaan, Bakker, Van Doornen, & Schaufeli, 2006). These studies have found relationships between specific personality traits (i.e., extraversion, conscientiousness, and neuroticism/emotional stability) and work engagement. Furthermore, some studies have indicated that employees high in extraversion report more job resources (Bakker et al., 2010) and employees high in neuroticism perceive their work environment as more threatening and more demanding (e.g., Bakker et al., 2010; Schneider, 2004). It is thus possible that some employees are dispositionally more likely to be engaged at work and perceive more job resources in their work environment. According to previous studies, it seems that workers who are emotionally stable and/or socially proactive might perceive more job resources and be more engaged in their work. However, the relationship between personality traits (i.e., extraversion, conscientiousness, and neuroticism/emotional stability) and work engagement have not been very strong (r = .17–.56; Inceoglu & Warr, 2011; Kim et al., 2009; Langelaan et al., 2006), and the relationship with job-related factors has been stronger. Thus, for practical purposes, rather than underestimating the influence of job resources because of personality factors, future studies could investigate how individuals with different personalities can become work engaged (De Mello & Wildermuth, 2010; Durán, Extremera, & Rey, 2010; see also Inceoglu & Warr, 2011). For example, are social job resources more important for work engagement among individuals high in extraversion than among those who are less extraverted? After all, as this research indicated, work engagement can be improved by developing and managing job resources.

Moreover, on the basis of the thorough investigation of common method problems by Podsakoff et al. (2003) and Spector (2006), it can be questioned whether the disadvantages of common method bias are to some extent overstated. These above-mentioned studies found that using solely self-reports does not guarantee finding significant results, and that potentially biasing variables (e.g., social desirability) do not generally inflate correlations among the study variables. Furthermore, mono-method correlations are not necessarily higher than multi-method correlations, and the use of a longitudinal design reduces the risks of common method bias. Nevertheless, on the one hand, as the evidence on the (reciprocal) relationship between job resources and work engagement is thus far based mostly on employees' self-rated perceptions of their job resources, the need remains to include other information on job resources, such as, bonuses, courses or other-rated measures, in future studies. On the other hand, the job resources that have intrinsic motivational role for a particular employee may be rather difficult, or even impossible, to measure objectively.

Fourth and finally, the conceptualization and choice of job resources should be critically evaluated. According to the definition of the JD-R model (Demerouti, Bakker, Nachreiner, et al., 2001), job resources in this research were regarded as a latent higher-order factor, and thus which of the four job resources were the most strongly related to work engagement was not evaluated. Although the factor structure of job resources was good (for details, see Seppälä et al., 2013), all four job resources were not necessarily equally important predictors of work engagement. Future studies could gain a better understanding of the antecedents of work engagement, if different conceptualizations of job resources were utilized. For example, when utilizing a latent factor, the dimensions are specific manifestations of a more general construct, and when utilizing an aggregate construct, the dimensions combine to produce the construct. These two approaches consequently result in different estimates in SEM (Edwards, 2001; Law & Wong, 1999).

Furthermore, the rather weak strength of the relationship between work engagement and job resources found in this research (β around .30 for both directions), on the one hand, underlines the importance to investigate which particular job resource is the most important for work engagement in different occupations. One possibility is to focus on occupation-specific job resources (e.g., Hakanen & Roodt, 2010; Mauno et al., 2010), as has already been done in some studies (e.g., Hakanen et al., 2011; Hakanen, Perhoniemi, et al., 2008; Hakanen, Schaufeli, et al., 2008). Although from the generalizability point of view it is important to study job resources that are typical to most occupations, as in the present research, the same job resources might in various degrees be relevant for work engagement among different occupational groups (see Hakanen & Roodt, 2010). However, as work engagement seems to be influenced by a large number of job resources, it is perhaps unrealistic to hope that a few variables would have particular importance. On the other hand, the strength of the reverse relationship encourages investigation of what job resources an engaged employee can significantly affect. The more general and distal the job resource is, such as a positive organizational climate, the more the relationship may be affected by the other (external) influences. All in all, it seems worthwhile to take context sensitivity into account when planning future empirical studies on work engagement.

4.3 Implications for theory and practice

This research makes an important contribution to both the theory and practice of positive occupational health psychology. In general, this research showed that work engagement is a work-related, highly stable, three-dimensional phenomenon, which is associated with job resources and healthy cardiac autonomic control.

First of all, the results supported the definition of work engagement as a three-dimensional construct with vigor, dedication and absorption subscales among Finnish employees. Therefore, from a rigorous psychometrical perspective, work engagement should be operationalized as three-dimensional. However, because of the substantial overlaps between these dimensions, it may be difficult to capture the theoretical differences between them in practice. Furthermore, the results of this and previous studies indicate that the theoretical expectations regarding the antecedents and consequences of work engagement also apply when work engagement is used as a one-dimensional construct. After all, all three strongly related dimensions refer to the same underlying construct – work engagement. Therefore, as also previously proposed (e.g., Balducci et al., 2010; Schaufeli, Bakker, et al., 2006), I recommend that work engagement can be used both as a one- and as a three-dimensional construct depending on the purpose of the research and the modeling techniques used. On the one hand, the cut-off values for overall work engagement seems convenient for practical purposes, for example, when targeting organizational interventions (although unequivocal norm levels for work engagement do not as yet exist). On the other hand, in scientific research, the three dimensions as well as the total score of work engagement can be used. However, to avoid problems with multicollinearity, the three dimensions should not be simultaneously entered in regression analyses, and to make the SEM models reasonable in size, the mean scores of the dimensions can also be used to construct a latent work engagement factor. However, since to the best of my knowledge no studies thus far have demonstrated that the three dimensions separately produce different results than the three dimensions together, it remains for future research to solve whether work engagement is more than the sum of its dimensions.

Furthermore, this research demonstrated that the short version of the UWES, the UWES-9, is a psychometrically adequate measure to assess work engagement among Finnish employees. Thus, the use of the UWES-9 can be recommended in future research on work engagement in Finland. The shorter version of the scale is also preferable for practical reasons – to reduce the likelihood of attrition the scale should contain as few items as possible while remaining reliable and valid.

In addition, the present research provides further information on how and to what extent work engagement and psychosocial working conditions are related. According to the present findings, the vast majority of an employee's current state of work engagement (over two-thirds of the variance) can be explained by stable personality and stable environmental factors; however, this still leaves room (almost one-third of the variance), for job resources to influence work engagement. The relationship between job resources and work engagement remained significant even after controlling for the stability inherent in work engagement, which further supports and validates the motivational relationships of the JD-R model (e.g., Bakker & Demerouti, 2007). However, the present research also showed that the positive association between work engagement and job resources is not only unidirectional but mutual: the current state of work engagement also influences current perceptions of job resources, and this enrichment cycle can be initiated both ways (Hobfoll, 1998, 2001; see also Bakker, 2011; Demerouti & Bakker, 2011). Work engagement might as well lead to resources than merely result from them. Therefore, as work engagement seems to be a function of work (e.g., job resources) and individual aspects (e.g., personality and proactive work behavior), future studies in the field of occupational health psychology could benefit from more extensive models that integrate work characteristics and conditions with individual perspectives. In addition, interventions and job redesign practices could perhaps in future, as well as the work (i.e., job resources) also involve the self (i.e., individual resources) to effectively influence work engagement (see Vuori et al., 2012). However, with respect to the high amount of stable variance inherent in work engagement, job resources need to be constant and long-standing in order to cause an actual increase in the level of work engagement. Therefore, organizational interventions or redesign practices should be long-lasting and preferably part of everyday organizational practices to effectively influence work engagement.

A major contribution of the present research, both theoretically and in practice, is that it is the first to reveal a positive relationship between work engagement and healthy cardiac autonomic activity. One possible mechanism underlying the relationship demonstrated between work engagement and self-rated physical health is thus the healthy and adaptable functioning of the ANS, in particular, increased parasympathetic activity. Therefore, it is time for changes in attitudes. Alongside studies of traditional "risk" mechanisms on the relationship between work ill-being and cardiac diseases (e.g., Cacioppo et al., 2007), there is a clear need for broader and more firmly grounded theoretical frameworks in seeking to explain the cardiovascular mechanism related to work well-being. Furthermore, it is time to "do" engagement (Bakker, Albrecht, & Leiter, 2011a). Apart from the fact that work engagement has many positive motivational outcomes (e.g., organizational commitment, extra-role performance, personal initiative) and is, of course, important in itself – as a positive affective-motivational state of mind – this research showed that work engagement might also be relevant to better cardiac health. The financial incentive of this finding for organizations is already being increasingly recognized in the field of health and productivity management (e.g., Goetzel, Guindon, Turshen, & Ozminskowski, 2001). Therefore, in the light of the positive health-relations found in this research, I suggest that work engagement is an important resource for organizations and it should be one of the main foci of occupational health care and management practices in the future. However, as a final concluding remark and to raise a crucial concern for future, I would like to pose the question, whose concern is work engagement? The health-enhancing benefits of work engagement can have positive consequences beyond the particular employee (e.g., longer and healthier work career) and even beyond the particular organization (e.g., better productivity), and consequently benefit not only employees and organizations, but broadly also working life. Thus, should work engagement be merely the responsibility of individuals and employers, or should it be the responsibility of policymakers in the wider field of working life?

YHTEENVETO (SUMMARY)

Työn imu: Psykometrinen, psykososiaalinen ja psykofysiologinen näkökulma

Tämän tutkimuksen tavoitteena oli tutkia työhyvinvointia kuvaavaa työn imu -käsitettä kolmesta erilaisesta näkökulmasta: psykometrisesta, psykososiaalisesta ja psykofysiologisesta. Tutkimukseni keskeisinä päätavoitteina oli 1) tarkastella työn imua mittaavan kyselymenetelmän psykometrisia ominaisuuksia, 2) tutkia työn imun ajallista pysyvyyttä, 3) selvittää työn imun ja työn psykososiaalisten voimavarojen välistä yhteyttä sekä 4) tarkastella, onko työn imu yhteydessä sydämen tervettä autonomista säätelyä ilmentäviin sydämen syke- ja sykevaihtelukuvaajiin. Tutkimukseni koostui kolmesta erillisestä osatutkimuksesta, jotka perustuivat kuuden suomalaisen tutkimusprojektin yhteydessä kerättyihin poikkileikkaus- ja pitkittäisaineistoihin (vuosina 2001–2010). Aineistot edustivat useita eri ammattialoja ja ammattiryhmiä, kuten esimerkiksi johtajia, terveydenhuollon ammattilaisia, hammaslääkäreitä, opettajia ja siivoojia.

Ensimmäisen osatutkimuksen tavoitteena oli tutkia työn imua arvioivan Utrecht Work Engagement Scale (UWES) -kyselylomakkeen alkuperäisen (UWES-17) ja lyhennetyn (UWES-9) version rakennevaliditeettia eri ammattiryhmissä (johtajat, opettajat, terveydenhuollon ammattilaiset, hammaslääkärit; n = 9404) ja eri mittausajankohtina (kaksi mittausajankohtaa, n = 2555). Tavoitteena oli siis selvittää, mittaako UWES-mittari teorian mukaista työn imu -käsitettä suomalaisessa aineistossa. Lisäksi selvitettiin työn imun ajallista pysyvyyttä kolmen vuoden aikavälillä (2003–2006). Tutkimus toteutettiin hyödyntäen konfirmatorista faktorianalyysia ja rakenneyhtälömallinusta. Tutkimuksen tulokset osoittivat, että työn imu -mittarin molemmat versiot mittaavat teorian mukaisesti työn imun kolmea erillistä ulottuvuutta: tarmokkuutta, omistautumista ja uppoutumista. Ulottuvuudet kuitenkin korreloivat voimakkaasti. Sen sijaan vain UWES-9-mittarin rakenne pysyi samana ammattiryhmästä ja mittausajankohdasta riippumatta. Alkuperäisen UWES-17-mittarin rakenne ei pysynyt samana eri ammattiryhmissä ja eri mittausajankohtina, vaan se näytti mittaavan työn imua hieman eri tavoin aineistosta riippuen. Lisäksi tulokset osoittivat, että työn imu on suhteellisen pysyvä ilmiö; työn imun kokemukset ennakoivat myöhempiä työn imun kokemuksia. Tarkalleen ottaen, työn imun ulottuvuudesta riippuen työn imun kokemukset ensimmäisenä mittausajankohtana selittivät 67–74 % työn imun kokonaisvaihtelusta toisena mittausajankohtana kolme vuotta myöhemmin.

Toisessa osatutkimuksessa selvitettiin työn psykososiaalisten voimavarojen (työroolien selvyys, esimiehen tuki, työpaikan myönteinen ja innovatiivinen ilmapiiri) ja työn imun välistä vuorovaikutussuhdetta. Tavoitteena oli selvittää, ovatko työn voimavarat myönteisesti yhteydessä työn imuun ja onko työn imu niin ikään myönteisesti yhteydessä työn voimavaroihin. Lisäksi tutkittiin, kuinka voimakasta työn voimavarojen ja työn imun välinen vuorovaikutus on sen jälkeen, kun molempien käsitteiden pysyvyys seitsemän vuoden aikavälillä (2003–2010) on otettu huomioon. Tutkimuksessa hyödynnettiin kolmen mittauskerran hammaslääkäreistä koostuvaa pitkittäistutkimusaineistoa (n = 1964). Tilastollisena analyysimenetelmänä käytettiin rakenneyhtälömallinnusta. Tutkimuksen tulokset osoittivat, että työn imun koke-

mukset olivat varsin pysyviä jopa seitsemän vuoden ajanjaksolla. Työn imun kokonaisvaihtelusta suurin osa (noin kaksi kolmasosaa) oli ajankohdasta toiseen pysyvää, mutta työn imusta (sen vaihtelusta) noin kolmannes oli kuitenkin sellaista, johon voitiin vaikuttaa työn voimavaratekijöillä. Tulokset osoittivat myös, että kun työn imun ja työn voimavarojen pysyvyys oli kontrolloitu, niiden välillä oli myönteinen, molemminpuolinen ja yhtä voimakas vuorovaikutussuhde.

Kolmannessa osatutkimuksessa selvitettiin, onko työn imulla yhteys matalampaan keskisykkeeseen ja suurempaan korkeataajuiseen sykevaihteluun työaikana, kun erilaiset taustatekijät (keskisykkeen ja sykevaihtelun perustaso, ikä, painoindeksi, fyysinen kunto ja lääkitys) on kontrolloitu. Tutkimusaineisto perustui monitieteiseen tutkimusprojektiin, jossa tarkasteltiin naissiivoojien (n = 30) psykologista ja fysiologista (sydämen syke ja sykevaihtelu) työhyvinvointia. Tutkimukseen osallistuneiden siivoojien sydämen toimintaa mitattiin yhtäjaksoisesti yli kaksi vuorokautta sekä työpäivien aikana että vapaalla. Analyysimenetelmänä käytettiin hierarkkista regressioanalyysia. Tulokset osoittivat, että työn imu ei ollut yhteydessä matalampaan keskisykkeeseen työaikana taustatekijöiden kontrolloimisen jälkeen. Sen sijaan, kun taustekijät oli vakioitu, työn imulla oli yhteys suurempaan korkeataajuiseen sykevaihteluun (lisääntynyt parasympaattisen hermoston säätely) työaikana, mikä kuvaa autonomisen hermoston tervettä ja joustavaa säätelyä.

Tutkimukseni tulokset tarjoavat sekä teoreettista että käytännöntyössä hyödynnettävää lisätietoa työn imusta. Tutkimukseni perusteella työn imu on moniulotteinen ilmiö, jota kuvaa tarmokkuus, omistautuminen ja uppoutuminen. Suomalaisten työntekijöiden työn imua voidaan arvioida luotettavasti UWES-9-kyselylomakkeen avulla ammattialasta tai ammattiryhmästä riippumatta. Työn imu on varsin pysyvä työhön liittyvä tunne- ja motivaatiotila jopa seitsemän vuoden aikavälillä. Työn imuun voidaan silti myös vaikuttaa, ja työn imuun ovat myönteisesti yhteydessä erilaiset työn psykososiaaliset voimavarat. Vuorovaikutussuhde ei ole kuitenkaan vain yhdensuuntainen, vaan työntekijän kokema työn imu on myös myönteisesti yhteydessä työn voimavaratekijöihin; työn imua kokevat työntekijät saattavat osittain myös luoda omat työn voimavaransa. Lisäksi työn imulla näyttäisi olevan yhteys autonomisen hermoston tasapainoiseen ja joustavaan säätelyyn työaikana, mikä taas on ominaista sydämen terveelle toiminnalle.

Tutkimukseni pohjalta esitän, että työn imu on työpaikkojen arvokas voimavara. Edistämällä ja ylläpitämällä työn imua voidaan myötävaikuttaa työntekijän psyykkiseen ja fyysiseen työhyvinvointiin, mutta myös työpaikan psykososiaalisiin voimavaroihin. Toisaalta työn imun myönteiset hyödyt tuskin rajoittuvat vain yksittäisiin työntekijöihin ja tai yksittäisiin työpaikkoihin. Työn imulla voi olla laajoja yhteiskunnallisia vaikutuksia hyvän työterveyden myötä esimerkiksi pidempiin, laadukkaampiin ja tuottavampiin työuriin. Tärkeää onkin pohtia, kenelle kuuluu päävastuu työn imusta, työntekijälle itselleen, esimiehelle, työterveyshuollolle vai kenties jopa laajemmin suomalaisesta työ- ja elinkeinoelämästä vastaaville toimijoille?

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ORIGINAL PAPERS

I

THE CONSTRUCT VALIDITY OF THE UTRECHT WORK ENGAGEMENT SCALE: MULTISAMPLE AND LONGITUDINAL EVIDENCE

by

Piia Seppälä, Saija Mauno, Taru Feldt, Jari Hakanen, Ulla Kinnunen, Asko Tolvanen & Wilmar Schaufeli, 2009

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The Construct Validity of the Utrecht Work Engagement Scale: Multisample and Longitudinal Evidence

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Abstract This study investigated the factor structure and factorial group and time invariance of the 17-item and 9-item versions of the Utrecht Work Engagement Scale (UWES; Schaufeli et al. (2002b) Journal of Happiness Studies 3:71–92). Furthermore, the study explored the rank-order stability of work engagement. The data were drawn from five different studies ($N = 9{,}404$), including a three-year longitudinal study ($n = 2{,}555$), utilizing five divergent occupational samples. Confirmatory factor analysis supported the hypothesized correlated three-factor structure—vigor, dedication, absorption—of both UWES scales. However, while the structure of the UWES-17 did not remain the same across the samples and time, the structure of the UWES-9 remained relatively unchanged. Thus, the UWES-9 has good construct validity and use of the 9-item version can be recommended in future research. Moreover, as hypothesized, Structural Equation Modeling showed high rank-order stabilities for the work engagement factors (between 0.82 and 0.86). Accordingly, work engagement seems to be a highly stable indicator of occupational well-being.

Keywords Work engagement · Utrecht Work Engagement Scale · Construct validity · Factor structure · Factorial group and time invariance · Rank-order stability

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1 Introduction

With the emergence of positive psychology (e.g., Seligman 2002, 2003; Seligman and Csikszentmihalyi 2000; Turner et al. 2002) added to the fact that the number of positive constructs of occupational well-being are limited, the concept of *work engagement* has received increasing attention in the field of occupational health psychology (Schaufeli and Salanova 2007). Work engagement, including the three dimensions of vigor, dedication and absorption, is assumed to be a strictly positive and relatively stable indicator of occupational well-being (Schaufeli et al. 2002b). The three dimensions of work engagement are also included in the *Utrecht Work Engagement Scale* (UWES), a survey which has been developed to measure work engagement (Schaufeli et al. 2002b).

The UWES has been translated into many languages and used among different occupational groups (e.g., blue-collar workers, dentists, hospital staff, managers, police officers, teachers; see Schaufeli 2007a; Schaufeli and Bakker 2003) although its psychometric properties have remained somewhat less explored. For example, it is still unclear whether the theoretically based three-dimensional structure of the scale remains the same across different occupational groups (i.e., factorial group invariance) and/or across different measurement points (i.e., factorial time invariance). Furthermore, while the time-invariance of the structure of the scale is uncertain, the assumed stability of work engagement remains without strong empirical evidence.

Accordingly, the aim of this study was to investigate the psychometric properties of the UWES by utilizing five divergent data sets, one of which was longitudinal, gathered in Finland ($N = 9{,}404$). Specifically, the purpose of the study was to test the factor structure of the UWES and its group- and time-invariant properties by means of confirmatory factor analysis (CFA). The former was studied by evaluating the factor structure of the UWES across five samples containing different, although mainly white-collar, occupational groups (i.e., dentists, educational staff, health care staff, managers, and young managers), and the latter by utilizing the so-called multi-sample method and among the dentists ($n = 2{,}555$), three-year longitudinal data with two measurement points. Furthermore, the longitudinal data made it possible to investigate the stability of work engagement during this three-year time-period. Also the stability of work engagement was assessed by using CFA within the Structural Equation Modeling (SEM) framework, a procedure which results in an error-free stability coefficient for work engagement.

1.1 Work Engagement

Work engagement is considered as the positive opposite of burnout (Schaufeli et al. 2002b; see also Maslach et al. 1996; Maslach and Leiter 1997; Maslach et al. 1996, 2001). Specifically, Schaufeli et al. (2002b, p. 74) define work engagement "as a positive, fulfilling, work-related state of mind that is characterized by vigor, dedication, and absorption." *Vigor*, refers to high levels of energy and mental resilience while working, the willingness to invest effort in one's work, and persistence in the face of difficulties. *Dedication* is characterized by a sense of significance, enthusiasm, inspiration, pride, and challenge. *Absorption* refers to being fully concentrated and deeply engrossed in one's work, and is characterized by time passing quickly and difficulties in detaching oneself from work. According to a recent review, work engagement is positively associated, for instance, with mental and psychosomatic health, intrinsic motivation, efficacy beliefs, positive attitudes towards work and the organization, and high performance (Schaufeli and Salanova 2007).

Furthermore, Schaufeli et al. (2002b, p. 74) define work engagement as a relatively stable state of mind: "rather than a momentary and specific state, engagement refers to a more persistent and pervasive affective-cognitive state that is not focused on any particular object, event, individual, or behavior." Thus work engagement is considered to be more stable than work-related emotions (e.g., contented, enthusiastic, cheerful; see Warr 1990), but less stable than personality traits, such as the Big Five (for the distinction between emotions, moods, and temperament; see Gray and Watson 2001). As a matter of fact, work engagement has been considered a work-related mood (Schaufeli and Salanova 2007).

1.1.1 Utrecht Work Engagement Scale

The UWES, a self-report questionnaire, consists of 17 items (UWES-17), which measure the three underlying dimensions of work engagement: vigor (six items), dedication (five items), and absorption (six items) (Schaufeli 2007b; Schaufeli et al. 2002b; see Appendix). At first the UWES consisted of 24 items, but after psychometric testing seven unsound items were omitted and 17 items were retained. Subsequent psychometric analyses revealed another two weak items (item 6 in the scale of vigor and item 6 in the scale of absorption; see Schaufeli and Bakker 2003), and hence a 15-item version of the UWES has been used in some studies (e.g., Xanthopoulou et al., in press). Recently, a shorter 9-item version of the UWES (UWES-9) has also been developed (Schaufeli et al. 2006; see Appendix). In this abridged scale, vigor, dedication and absorption are assessed by three items per dimension.

1.1.2 Previous Studies of the UWES

Recent confirmatory factor analytic (CFA) studies have supported the theoretically based correlated three-factor—vigor, dedication, absorption—structure of the UWES-17 and UWES-9 (e.g., Hakanen 2002; Hallberg and Schaufeli 2006; Schaufeli and Bakker 2003; Schaufeli et al. 2002b, 2006). All these studies have also shown that the three factors of work engagement are highly interrelated (correlations between 0.60 and 0.99). Because of the high correlations between the three factors, an alternative one-factor structure of the UWES-17 and the UWES-9 has also been tested. In this one-factor structure all the items were constrained to load on one underlying factor (Hallberg and Schaufeli 2006; Schaufeli and Bakker 2003; Schaufeli et al. 2002b, 2006). However, in all these studies, the theoretically based correlated three-factor structure has shown significantly better fit with the data than an alternative one-factor structure and thus has received most support.

In addition to verifying the theoretically based structure of the scale, it is very important to determine whether the structure of the scale remains the same (i.e., at least the factor loadings remain equal; see, e.g., Jöreskog 2005; see also Statistical analyses below) across different contexts and over time. If not, we cannot be sure that we are measuring the same construct and what the construct we are measuring actually is. Therefore, to obtain comparable results the construct (the structure of the scale) needs to be the same despite, for example, occupation, culture, or time point.

Thus far, studies of the factorial invariance of the correlated three-factor structure of the UWES-17 and the UWES-9 across groups (i.e., factorial group invariance) have remained rather limited. In fact, the factorial group invariance of the UWES-17 has not been fully confirmed, as in previous group-invariance studies the scale has been revised. In a study conducted among students from Spain, the Netherlands, and Portugal, the correlated three-factor structure of a 14-item UWES-S (i.e., a slightly shortened student version of the

UWES-17; vigor item 6 and absorption items 4 and 6 were removed because of non-significant or poor (<0.40) factor loadings) was found to be only partially group-invariant (see Schaufeli et al. 2002a). The unconstrained correlated three-factor structure showed significantly better fit with data than the constrained correlated three-factor structures (i.e., factor loadings and error covariances were constrained to be equal) in all pairs of countries. The detailed analysis also showed that from one to three of the factor loadings differed between the countries; only the factor loadings of the absorption subscale remained the same across all the country comparisons, while the factor loadings of the vigor subscale remained the same in two of the three countries.

In addition, a study conducted among Greek and Dutch employees failed to support the factorial group invariance of the correlated three-factor structure of the UWES-15 (i.e., vigor item 6 and absorption item 6 were removed). In particular, the unconstrained correlated three-factor structure showed significantly better fit with data than the constrained correlated three-factor structures (i.e., factor loadings, factor variances, and error variances were constrained to be equal) (Xanthopoulou et al., in press). To date, only Schaufeli et al. (2006) have tested the group-invariance of the UWES-9. They found that the correlated three-factor structure of the UWES-9 did not remain the same across 10 countries (Australia, Belgium, Canada, Finland, France, Germany, The Netherlands, Norway, South Africa, Spain). Specifically, the unconstrained correlated three-factor structure fitted the data significantly better than the constrained correlated three-factor structures (i.e., the factor loadings and factor covariances were constrained to be equal across 10 countries). Taken together, the results on factorial group-invariance are somewhat conflicting and the equality of the correlated three-factor structure of the UWES-17 and the UWES-9 in different contexts has not been shown.

Longitudinal studies of work engagement are rare, and to the best of our knowledge the factorial invariance of the correlated three-factor structure of the UWES-17 and the UWES-9 across time (i.e., factorial time invariance) has not previously been studied (see Schaufeli 2007a). Therefore, it continues to be unclear whether the hypothesized correlated three-factor structure of the UWES-17 and the UWES-9 remains unchanged over time. Moreover, the hypothesized stability of work engagement remains unclear, since the stability of the construct can only be evaluated if the structure of the scale remains unchanged.

In the present study, CFA within the SEM framework makes it possible to test the invariance of the correlated three-factor structure of the UWES-17 and the UWES-9 across time by connecting CFA models tested at different measurement points in the same model (e.g., Jöreskog 2005). Furthermore, demonstration of the structural time-invariance of the UWES-17 and the UWES-9 allows for the production of error-free rank-order stability coefficients of work engagement. Rank-order stability reflects the degree to which the relative ordering of individuals within a group is maintained over time. Therefore, rank-order stability is conceptually and statistically distinct from traditional exploratory techniques, such as investigating absolute mean level changes occurring in a concept over time.

Thus far, the rank-order stability of work engagement has been assessed by using correlation coefficients between the corresponding constructs (Llorens et al. 2007; Mauno et al. 2007; Schaufeli et al. 2006). In previous longitudinal studies, the experience of work engagement has tended to remain fairly stable. In a two-year follow-up study in Finland, the test-retest correlations of the UWES-17 for vigor, dedication and absorption were 0.73, 0.67, 0.69, respectively (Mauno et al. 2007). Also, in a one-year follow-up study conducted in Australia and Norway, the corresponding test-retest correlations of the UWES-9 were 0.61, 0.56, and 0.60 for Australia, and 0.71, 0.66, and 0.68 for Norway (Schaufeli et al. 2006). In a study among Spanish university students, the test-retest correlations were

0.68 for vigor and 0.61 for dedication over a three-week period, when a slightly adapted student version of the vigor and dedication subscales of the UWES-17 were used in a laboratory setting (Llorens et al. 2007).

1.2 Aims of the Study

To sum up, the psychometric testing of the UWES is still in progress and warrants further research. So far, only a few studies have been conducted on factorial group invariance (Schaufeli et al. 2002a, 2006; Xanthopoulou et al., in press). These have shown somewhat conflicting results and in no case has factorial group invariance been demonstrated. Moreover, according to the definition, work engagement is considered a stable rather than a momentary state of mind (Schaufeli et al. 2002b); however, the true stability of work engagement remains unclear, as evidence for the factorial time invariance of the scale is lacking. In addition, the short version of the scale has only recently been developed, and therefore the psychometric properties of the UWES-9 have not yet been fully tested. The present study addresses each of these concerns.

Specifically, the present study investigated the construct validity of the Finnish translations of the UWES-17 and the UWES-9. The first aim was to test whether the Finnish translations of the scales would include the three interrelated theoretically based dimensions of vigor, dedication, and absorption. To ensure the validity of the hypothesized structure, and since the three dimensions of work engagement have correlated highly in previous studies, an alternative one-factor structure of the UWES-17 and UWES-9 was also tested. The second aim was to investigate whether the correlated three-factor structure would remain the same across different occupational samples (i.e., factorial group invariance). The third aim of this study was to investigate whether the correlated three-factor structure would remain the same across different measurement points (i.e., factorial time invariance) by conducting a three-year follow-up study among dentists. The final aim was to examine the rank-order stabilities of the three work engagement factors across the three-year follow-up period.

The study hypotheses, on the basis of the theory and previous studies of work engagement, can be summarized as follows:

H1: The correlated three-factor structure of the UWES-17 and the UWES-9 fits better to the data than the one-factor structure in each occupational sample and at both measurement points.

H2: The correlated three-factor structure of the UWES-17 and the UWES-9 remains the same across the five occupational samples.

H3: The correlated three-factor structure of the UWES-17 and the UWES-9 remains the same across the two measurement points.

H4: The rank-order stabilities of the work engagement factors are relatively high over the three-year follow-up time.

2 Method

2.1 Participants

The study was based on five independent samples containing a total of 9,404 Finnish participants. Table 1 shows the distribution of background factors (gender, age,

Table 1 Background characteristics and mean levels of the dimensions of work engagement for the study samples

Variable	Sample 1 Health care ($n = 736$)	Sample 2 Young managers ($n = 747$)	Sample 3 Managers ($n = 1{,}301$)	Sample 4 Education ($n = 3{,}365$)	Sample 5 Dentists ($n = 3{,}255$, follow-up $n = 2{,}555$)		Total $N = 9{,}404$
Gender					2003	2006	
Female	639 (87%)	108 (15%)	394 (30%)	2,534 (79%)	2,328 (72%)	1,883 (74%)	6,003 (65%)
Male	97 (13%)	637 (85%)	902 (70%)	676 (21%)	927 (28%)	672 (26%)	3,239 (35%)
Age	$M = 44.00$ $SD = 9.81$ Range = 19–63	$M = 30.96$ $SD = 3.22$ Range = 23–35	$M = 47.88$ $SD = 8.52$ Range = 23–65	16–25 (5%) 26–35 (24%) 36–45 (25%) 46–55 (31%) Over 55 (15%)	$M = 45.79$ $SD = 9.43$ Range = 23–82	$M = 48.49$ $SD = 8.82$ Range = 27–76	Range = 16–82
Organizational/job tenure	Organizational tenure	Organizational tenure	Organizational tenure	Job tenure	Job tenure		Range = 0–52
	$M = 13.81$ $SD = 9.38$ Range = 0–40	$M = 4.37$ $SD = 3.62$ Range = 0–18	$M = 11.86$ $SD = 9.35$ Range 0–40	$M = 12.37$ $SD = 9.86$ Range 0–41	$M = 19.54$ $SD = 9.95$ Range = 0–50	$M = 22.30$ $SD = 9.41$ Range = 3–52	
Permanent job	579 (80%)	696 (93%)	1,261 (98%)	2,183 (67%)	2,998 (94%)	2,404 (96%)	7,717 (84%)
Fixed-term job	148 (20%)	50 (7%)	29 (2%)	1,087 (33%)	200 (6%)	87 (4%)	1,514 (16%)
Hours worked weekly	$M = 38.43$ $SD = 6.07$ Range = 8–85	$M = 38.52$ $SD = 2.90$ Range = 7–50	$M = 47.28$ $SD = 8.33$ Range = 16–90	$M = 36.77$ $SD = 9.52$ Range = 2–75	$M = 32.88$ $SD = 8.16$ Range = 0–79	$M = 32.45$ $SD = 7.81$ Range = 2–55	Range = 0–90
UWES-17							
Vigor	$M = 4.51$, $SD = 1.05$	$M = 4.57$, $SD = 0.93$	$M = 4.52$, $SD = 0.97$	$M = 4.58$, $SD = 1.01$	$M = 4.52$, $SD = 1.04$	$M = 4.59$, $SD = 0.95$	Range = 4.51–4.59
Dedication	$M = 4.82$, $SD = 1.12$	$M = 4.63$, $SD = 1.13$	$M = 4.80$, $SD = 1.08$	$M = 4.67$, $SD = 1.19$	$M = 4.97$, $SD = 1.09$	$M = 4.97$, $SD = 0.99$	Range = 4.63–4.97
Absorption	$M = 3.82$, $SD = 1.38$	$M = 4.07$, $SD = 1.21$	$M = 4.34$, $SD = 1.15$	$M = 3.92$, $SD = 1.34$	$M = 3.81$, $SD = 1.40$	$M = 3.81$, $SD = 1.35$	Range = 3.81–4.34
UWES-9							

Table 1 continued

Variable	Sample 1 Health care ($n = 736$)	Sample 2 Young managers ($n = 747$)	Sample 3 Managers ($n = 1,301$)	Sample 4 Education ($n = 3,365$)	Sample 5 Dentists ($n = 3,255$, follow-up $n = 2,555$)		Total $N = 9,404$
Vigor	$M = 4.64$, $SD = 1.17$	$M = 4.55$, $SD = 1.08$	$M = 4.53$, $SD = 1.11$	$M = 4.56$, $SD = 1.18$	$M = 4.63$, $SD = 1.24$	$M = 4.71$, $SD = 1.14$	Range = 4.53–4.71
Dedication	$M = 4.66$, $SD = 1.27$	$M = 4.54$, $SD = 1.19$	$M = 4.71$, $SD = 1.15$	$M = 4.56$, $SD = 1.29$	$M = 4.89$, $SD = 1.22$	$M = 4.85$, $SD = 1.15$	Range = 4.54–4.89
Absorption	$M = 4.10$, $SD = 1.40$	$M = 4.13$, $SD = 1.29$	$M = 4.41$, $SD = 1.18$	$M = 4.13$, $SD = 1.44$	$M = 4.22$, $SD = 1.44$	$M = 4.23$, $SD = 1.37$	Range = 4.10–4.41

organizational/job tenure, type of job contract, hours worked weekly) among the participants and the mean levels for the dimensions of work engagement in each sample.

Sample 1 consisted of questionnaire data collected in a single public health care organization in Finland in 2003 (Central Finland Health Care District, henceforth health care; see Mauno et al. 2005, 2007). Of the selected random sample, 736 participants returned the questionnaire (response rate 46%). The majority of the participants were women (87%) and worked as nurses ($n = 468$; 64%). The other occupational groups represented in the sample were physicians ($n = 38$; 5%), clerical workers ($n = 85$; 12%) (i.e., support services), administrative ($n = 77$; 11%), researchers/research assistants ($n = 37$; 5%), and technical/warehouse/delivery workers ($n = 23$; 3%).

Sample 2 consisted of questionnaire data gathered in 2006 from registered members of two Finnish trade unions (Union of Professional Engineers in Finland and Union of Salaried Employees). A postal questionnaire was sent to all members of the trade unions who were age 35 years or less and in a managerial position (henceforth young managers). The sample consisted of 747 managers (response rate 49%). The great majority of the participants were men (86%) and they worked in different parts of Finland in both the private and public sectors. Of them 43% represented lower management, 49% middle management and 8% top management.

Sample 3 consisted of questionnaire data gathered in 2005 from the members of five large Finnish trade unions (Union of Professional Engineers in Finland, Finnish Association of Graduates in Economics and Business, Finnish Association of Graduate Engineers, Finnish Association for Human Resource Management, and Experts and Managerial Professionals of Municipalities Association; see Kinnunen et al. 2008). The random sample consisted of 1,301 participants (response rate 40%) after omitting those employees who were not in a managerial position (henceforth managers). The majority of the participants were men (70%), and 42% represented lower management, 26% middle management and 32% top management.

Sample 4 consisted of questionnaire data gathered in 2001 from the Educational Department of Helsinki, Finland (henceforth education; see Bakker et al. 2007; Hakanen 2002; Hakanen et al. 2006). The sample consisted of 3,365 participants (response rate 52%) from across the whole organization and from all the professional groups within it. The majority of participants were female (79%) and most of them worked as teachers ($n = 2{,}038$; 60%) at elementary ($n = 843$), lower secondary ($n = 497$), upper secondary ($n = 278$), or vocational schools ($n = 217$). The other occupational groups represented in the sample were support staff (e.g., psychologist, school assistant) ($n = 936$; 28%) and administrative workers ($n = 391$; 12%).

Sample 5 consisted of questionnaire data collected in a three-year follow-up study (2003–2006) with two measurement points among Finnish dentists (henceforth dentists; see Hakanen et al. 2005). The postal questionnaire was sent to every dentist who was a member of the Finnish Dental Association at the time the data were gathered in 2003. In 2003, 3,255 dentists answered the questionnaire (response rate 71%), and in 2006, 2,555 of those identified three years later ($n = 3{,}035$) returned the questionnaire (response rate 84%). Most of the respondents (over 70%) were women and 60% of the respondents were employed in the public sector.

2.2 Instrument

Work Engagement was assessed by using Finnish translations of the UWESs 17 and 9 (Hakanen 2002). The accuracy of the Finnish translations was checked by the back-translation method. The UWES-17 consists of 17 items on the three underlying dimensions of vigor, dedication, and absorption (Schaufeli 2007b; see Appendix). "Vigor" is measured with six items (items 1, 4, 8, 12, 15, 17), "dedication" with five items (items 2, 5, 7, 10, 13), and "absorption" with six items (items 3, 6, 9, 11, 14, 16). Items are rated on a seven-point scale ranging from 0 (*never*) to 6 (*every day*). The internal consistencies (Cronbach's alpha) of the UWES-17 ranged between 0.75 and 0.83 for vigor, between 0.86 and 0.90 for dedication, and between 0.82 and 0.88 for absorption. The shortened version of the UWES, the UWES-9, contains three items for vigor (items 1, 4, 8), three for dedication (items 5, 7, 10) and three for absorption (items 9, 11, 14) (Schaufeli et al. 2006; see Appendix). The items are rated on the same scale as the UWES-17. The internal consistencies (Cronbach's alpha) of the UWES-9 varied from 0.81 to 0.85 for vigor, from 0.83 to 0.87 for dedication, and from 0.75 to 0.83 for absorption.

2.3 Statistical Analyses

To investigate the psychometric properties of the UWES scales, CFA within the SEM framework, performed with the LISREL 8.72 program (Jöreskog and Sörbom 1996a), was used. As the variables were ordinal, the Weighted Least Squares (WLS) estimation procedure based on polychoric correlations and asymptotic covariance matrices, calculated by the PRELIS 2.72 program (Jöreskog and Sörbom 1996b), was applied. Likewise, as the variables were ordinal, threshold values of the observed variables were set to be equal for each sample and in Sample 5 for both measurement points, using the PRELIS 2.72 program (Jöreskog and Sörbom 1996b). This was done to ensure that the response scale was the same across the investigated samples and across the different measurement points (see, e.g., Jöreskog 2005). The distributions of the responses were skewed—the majority of the answers were in categories 4 ("O*nce a week*") or 5 ("*A few times a week*"). The polychoric correlation is, however, considered to be rather robust to violations of underlying bivariate normality (see, e.g., Jöreskog 2005). Because there is no consensus on the fit indices for evaluating structural equation models (e.g., Bollen and Long 1993; Boomsma 2000; Hoyle and Panter 1995), model fit and model comparisons were based on several fit indices (see Fit indices below). This study focused on the participants who answered all the items of the UWES-17 and the UWES-9 (i.e., listwise deletion).

The analytic procedure consisted of three steps. In the first step of the analyses, the hypothesized correlated three-factor model (henceforth M1; see Fig. 1a) of the UWES-17 and the UWES-9 was tested for each sample separately, and also for both measurement points in Sample 5, to determine whether the observed variables (items) of work engagement loaded on the hypothesized latent factors (vigor, dedication, absorption) on each occasion. To ensure that the correlated three-factor model was valid, an alternative one-factor model (henceforth M2; see Fig. 1b) of the UWES-17 and the UWES-9 was also tested. In the one-factor model, all the items were restricted to load on one latent factor.

In the second step of the analyses, the factorial group invariance of the best-fitting factor model was simultaneously investigated across the five samples by using the multi-sample method (i.e., data on the same variables collected from several samples were estimated in a joint analysis). The factorial group invariance of the UWES-17 and the UWES-9 was tested by comparing the fit of the baseline model (i.e., thresholds of observed variables were constrained to be equal and other parameter estimates were freely estimated) to that of the constrained model (i.e., thresholds of observed variables and factor loadings were constrained to be equal across the five samples). Since the statistical power of a structural

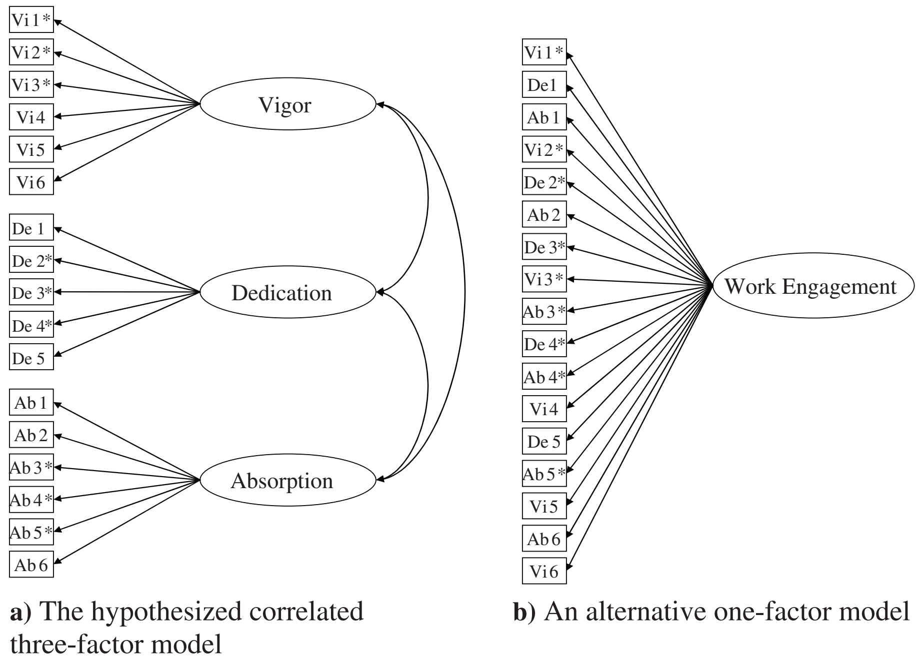

Fig. 1 The CFA models of the UWES-17 and the UWES-9 tested in the study (* = UWES-9)

equation model is a function of the characteristics of the model and size of the sample, the large sample size of this study might produce results that are of statistical, but not practical, significance (e.g., Hoyle and Panter 1995; see also Fit indices below). Therefore, because of the very large sample size ($N = 9{,}404$), only the weak measurement invariance was tested. To determine weak measurement invariance, the equality of the factor loadings (i.e., same unit of measurement; see Jöreskog 2005) across samples must be demonstrated; this is not required of the other parameters (see Meredith 1964, 1993). In other words, the equality of the factor loadings is the minimum assumption for factorial group invariance to hold, because if the factor loadings do not remain the same across different groups, we cannot be sure that we are measuring the same construct and what the construct we are measuring actually is.

In the third step of the analyses, the factorial time invariance of the best-fitting factor model of the UWES-17 and the UWES-9 was investigated over a three-year follow-up with two measurement points (Sample 5). First, the baseline stability model was estimated by using structural equations between the latent factors of work engagement to connect the factor models estimated at the two time points. Next, the constrained stability model was estimated by setting the corresponding factor loadings equal across the two measurement points. Factorial time invariance was then tested by comparing the fit of the baseline stability model (i.e., thresholds of observed variables were set equal and other parameters freely estimated) to the constrained stability model (i.e., thresholds of observed variables and factor loadings were set equal across the two measurement points). As previously, the equality of the factor loadings at different measurement points must be demonstrated; however, equality of the other parameters is not required to determine weak measurement invariance (see Meredith 1964, 1993). Finally, the rank-order stabilities of the work engagement factors were investigated by estimating the stability coefficients of the UWES-17 and the UWES-9 in Sample 5 (i.e., β-coefficients between the three latent factors of work engagement at Time 1 and Time 2).

2.3.1 Fit Indices

The fit of the different models was evaluated by using several types of fit indices. The absolute fit of the model was assessed with the chi-square index and the fit of the competing models was compared with the chi-square difference test (Satorra–Bentler's scaling corrections were used; Satorra and Bentler 2001). A general rule is that a non-significant chi-square value indicates good model fit. In addition, in the chi-square difference test a non-significant reduction in the chi-square, relative to the change in the number of degrees of freedom, indicates that the constrained model is acceptable. If the reduction in the chi-square is significant, the baseline model is more satisfactory. However, a well-known disadvantage of the chi-square statistic is its high sensitivity to sample size (e.g., Bentler and Bonett 1980). With large sample sizes most models tend to be rejected, although deviations of the empirical data from theoretical expectations (i.e., chi-square test) or a significant reduction in the chi-square value for the constrained model (i.e., chi-square difference test) are for practical purposes irrelevant and due to the overwhelming statistical power of the sample size (e.g., Bentler and Bonett 1980). Therefore, the fit and the invariance of the models were also evaluated by other fit indices. The RMSEA (Root Mean Square Error of Approximation) is also an absolute fit index and it indicates the error of approximation; values of 0.05 or less indicate close fit of the model, values below 0.08 indicate reasonable model fit, and values over 0.1 indicate poor model fit (e.g., Browne and Cudeck 1993; Yu 2002). The incremental fit of the models was evaluated by using the CFI (Comparative Fit Index) and the NNFI (Non Normed Fit Index). The CFI and NNFI measure the improvement in the fit by comparing the hypothesized model with an independence model that specifies no covariances among the variables; the CFI and NNFI values should be 0.95, or preferably, above, to indicate good model fit (e.g., Hu and Bentler 1999; Yu 2002).

3 Results

3.1 The Factor Structure of the UWES-17 and the UWES-9

The goodness-of-fit statistics for the hypothesized correlated three-factor model (M1) and an alternative one-factor model (M2) of the UWES-17 and the UWES-9 are summarized in Tables 2 and 3. As Tables 2 and 3 show, M1 fitted—except according to the chi-square test—the data well, but the fit of M2 was also acceptable. M1, however, showed a better fit with the data than M2. The chi-square difference test also revealed that the fit of M1 was significantly better than that of M2 in all five samples and at both measurement points (H1). Thus, work engagement as a three-dimensional construct gained support and M1 was chosen for the subsequent analyses of factorial group and time invariance. As expected, the three latent factors were highly correlated. The correlations between the latent factors of the UWES-17 ranged from 0.90 to 0.96, and the correlations between the latent factors of the UWES-9 ranged from 0.83 to 0.97.

However, it should be noted that although the overall fit of M1 of the UWES-17 was good, absorption item 6 ("*It is difficult to detach myself from my job*") showed a somewhat

Table 2 Goodness-of-fit statistics for the alternative CFA models of the UWES-17

Sample	Models	$\chi^2(df)$	RMSEA	CFI	NNFI	$\Delta\chi^2(\Delta df)$
Sample 1						
(n = 674)	M1	409.06 (116)	0.061	0.97	0.96	
(n = 674)	M2	471.41 (119)	0.066	0.96	0.95	62.35 (3), $p < 0.001$
Sample2						
(n = 730)	M1	479.59 (116)	0.066	0.97	0.97	
(n = 730)	M2	567.15 (119)	0.072	0.97	0.96	87.56 (3), $p < 0.001$
Sample 3						
(n = 1,275)	M1	771.23 (116)	0.067	0.97	0.96	
(n = 1,275)	M2	858.89 (119)	0.070	0.96	0.96	87.66 (3), $p < 0.001$
Sample 4						
(n = 2,971)	M1	1392.14 (116)	0.061	0.94	0.93	
(n = 2,971)	M2	1616.29 (119)	0.065	0.93	0.92	224.15 (3), $p < 0.001$
Sample 5						
(n = 2,723)	M1	1524.97 (116)	0.067	0.94	0.93	
(n = 2,723)	M2	1685.64 (119)	0.070	0.94	0.93	160.67 (3), $p < 0.001$
Follow-up (n = 2,314)	M1	1311.81 (116)	0.067	0.94	0.92	
Follow-up (n = 2,314)	M2	1483.74 (119)	0.070	0.93	0.92	171.93 (3), $p < 0.001$

M1 = hypothesized correlated three-factor model

M2 = alternative one-factor model

lower factor loading in one sample and vigor item 6 ("*At my work I always persevere, even when things do not go well*") showed slightly lower factor loadings in two samples when compared to the other factor loadings. For absorption item 6, the factor loading was 0.51 in Sample 5, and for vigor item 6, the factor loading was 0.37 in Sample 5 and 0.56 in Sample 4. The other factor loadings were in general high, ranging from 0.61 to 0.99.

With respect to the UWES-9 it should be pointed out that the RMSEA values of M1 did not meet the cut-off criteria in all samples. On the basis of the information given by the modification indices, absorption item 4 ("*I am immersed in my work*") and absorption item 5 ("*I get carried away when I'm working*") revealed a rather strong correlation between their error variances in all five samples (error covariances varied between 0.18 and 0.29). As the UWES-9 has only recently been developed and thus has been less studied, a modified correlated three-factor model ($M1_{mod.}$), in which the error variances of absorption items 4 and 5 were allowed to correlate, was also computed. This led to an improvement in the fit of the model (see $M1_{mod.}$ in Table 3). However, as the viewpoint of the study was confirmatory and as the hypothesized model needed only this minor modification, the comparisons between the alternatively restricted models were done with the original M1.

3.2 The Factorial Group Invariance of the UWES-17 and the UWES-9

Table 4 reports the results for the factorial group invariance tests of M1 of the UWES-17 and the UWES-9. As Table 4 shows, the baseline model of the UWES-17 showed good fit—except according to the chi-square test—with the data. However, on the basis of the chi-square difference test, the factor loadings invariance assumption was not supported, as the constrained model displayed a significant loss of fit when compared to the baseline

Table 3 Goodness-of-fit statistics for the alternative CFA models of the UWES-9

Sample	Models	χ^2(df)	RMSEA	CFI	NNFI	$\Delta\chi^2$(Δdf)
Sample1						
(n = 699)	M1	124.52 (24)	0.077	0.98	0.96	
(n = 699)	$M1_{mod.}$	74.48 (23)	0.057	0.99	0.98	
(n = 699)	M2	150.25 (27)	0.081	0.97	0.96	25.73 (3), $p < 0.001$
Sample 2						
(n = 732)	M1	144.19 (24)	0.083	0.98	0.97	
(n = 732)	$M1_{mod.}$	117.63 (23)	0.075	0.98	0.97	
(n = 732)	M2	176.92 (27)	0.087	0.97	0.96	32.73 (3), $p < 0.001$
Sample 3						
(n = 1,288)	M1	268.87 (24)	0.089	0.97	0.96	
(n = 1,288)	$M1_{mod.}$	217.38 (23)	0.081	0.98	0.97	
(n = 1,288)	M2	355.68 (27)	0.097	0.96	0.95	86.81 (3), $p < 0.001$
Sample 4						
(n = 3,140)	M1	348.09 (24)	0.066	0.98	0.97	
(n = 3,140)	$M1_{mod.}$	204.23 (23)	0.050	0.99	0.98	
(n = 3,140)	M2	530.48 (27)	0.077	0.96	0.95	182.39 (3), $p < 0.001$
Sample 5						
(n = 2,935)	M1	458.18 (24)	0.079	0.97	0.96	
(n = 2,935)	$M1_{mod.}$	217.95 (23)	0.054	0.99	0.98	
(n = 2,935)	M2	669.68 (27)	0.090	0.96	0.95	211.50 (3), $p < 0.001$
Follow-up (n = 2,399)	M1	391.85 (24)	0.080	0.97	0.95	
Follow-up (n = 2,399)	$M1_{mod.}$	146.11 (23)	0.047	0.99	0.98	
Follow-up (n = 2,399)	M2	574.99 (27)	0.092	0.95	0.93	183.14 (3), $p < 0.001$

M1 = hypothesized correlated three-factor model

$M1_{mod.}$ = modified correlated three-factor model, error variances of absorption items 4 and 5 were allowed to correlate

M2 = alternative one-factor model

Table 4 Group-invariance tests for the correlated three-factor model of the UWES-17 and the UWES-9

Multi-sample comparisons	χ^2	df	$\Delta\chi^2$(Δdf)	p	RMSEA	CFI	NNFI
1. Baseline model							
UWES-17	4541.55	580			0.064	0.96	0.95
UWES-9	1328.65	120			0.076	0.98	0.96
2. Constrained model							
UWES-17	5293.46	636	2 vs. 1		0.066	0.95	0.94
			751.91 (56)	< 0.001			
UWES-9	1432.69	144	2 vs. 1		0.071	0.97	0.97
			104.04 (24)	< 0.001			

Baseline model = thresholds of observed variables set to be equal across five samples

Constrained model = thresholds of observed variables and factor loadings set to be equal across five samples model. This indicates that the size of the factor loadings was not equal but differed across the samples, which led to the deterioration in the model fit when the factor loadings were constrained to be equal. Although the chi-square difference test is highly sensitive to sample size, the loss of fit regarding degrees of freedom was notable (χ^2/df ratio = 13.4). The χ^2/df ratio estimates how many times larger the chi-square estimate is than its expected value, and ratios indicating good fit range from 2 to 5 (see Bollen 1989). Thus, it is possible that even with a smaller sample size the chi-square difference test would not have supported the group invariance assumption.

The detailed analysis of the paired comparisons of the samples also revealed that the factor loadings invariance assumption was not supported in any of the pairs of samples (see Table 5). The constrained model displayed a significant loss of fit when compared to the baseline model in all pairs of samples, indicating that the size of the factor loadings was different in every pair of the samples. In addition, the detailed analysis of the factor loadings of the UWES-17 revealed marked variation in the factor loadings across the five samples, varying from 0.03 to 0.44 (on the basis of M1 with all parameters estimated freely, completely standardized solution). The largest loading variations were for the

Table 5 Paired comparisons of the samples for the correlated three-factor model of the UWES-17 and the UWES-9

Combination of samples	Baseline model $\chi^2(df)$	Constrained model $\chi^2(df)$	$\Delta\chi^2(\Delta df)$	p
UWES-17				
1, 2	872.18 (232)	914.06 (246)	41.88 (14)	< 0.001
1, 3	1151.10 (232)	1195.59 (246)	44.49 (14)	< 0.001
1, 4	1790.96 (232)	1866.52 (246)	75.56 (14)	< 0.001
1, 5	1924.65 (232)	2111.44 (246)	186.79 (14)	< 0.001
2, 3	1242.91 (232)	1287.90 (246)	44.99 (14)	< 0.001
2, 4	1878.67 (232)	2067.98 (246)	189.31 (14)	< 0.001
2, 5	2002.24 (232)	2392.88 (246)	390.64 (14)	< 0.001
3, 4	2148.09 (232)	2315.54 (246)	167.45 (14)	< 0.001
3, 5	2272.37 (232)	2695.22 (246)	422.85 (14)	< 0.001
4, 5	2922.13 (232)	3078.94 (246)	156.81 (14)	< 0.001
UWES-9				
1, 2	260.08 (48)	276.93 (54)	16.85 (6)	= 0.010
1, 3	388.03 (48)	397.28 (54)	9.25 (6)	= 0.160
1, 4	472.76 (48)	487.91 (54)	15.15 (6)	= 0.019
1, 5	584.06 (48)	592.13 (54)	8.07 (6)	= 0.233
2, 3	404.87 (48)	411.70 (54)	6.83 (6)	= 0.337
2, 4	489.70 (48)	528.01 (54)	38.31 (6)	< 0.001
2, 5	600.32 (48)	628.15 (54)	27.83 (6)	< 0.001
3, 4	606.91 (48)	635.58 (54)	28.67 (6)	< 0.001
3, 5	712.08 (48)	734.74 (54)	22.66 (6)	< 0.001
4, 5	807.19 (48)	861.25 (54)	54.06 (6)	< 0.001

Baseline model = thresholds of observed variables set to be equal across pair of samples

Constrained model = thresholds of observed variables and factor loadings set to be equal across pair of samples loadings of absorption item 6 and vigor item 6. Finally, on the basis of the modification indices seven factor loadings were estimated as unequal (loadings of vigor items 4, 5, 6; dedication item 2; absorption items 2, 3, 6). However, even after these loading modifications, the chi-square difference test still produced a significant loss of fit for the constrained model when compared to the baseline model [$\Delta\chi^2$ (28) = 170.13]. Thus, the UWES-17 measured work engagement differently, according to the occupational group, and the group-invariance hypothesis (H2) regarding the UWES-17 was not supported.

Table 4 also shows the results for the corresponding factorial group invariance tests of the UWES-9. The baseline model of the UWES-9 also showed good fit—except according to the chi-square test—with the data. However, on the basis of the chi-square difference test the factor loadings invariance assumption was not supported as the constrained model displayed a significant loss of fit when compared to the baseline model. As before, this indicates that the size of the factor loadings differed across the samples. However, the loss of fit regarding degrees of freedom was rather modest (χ^2/df ratio = 4.3; see Bollen 1989), and therefore it is possible that the significant reduction in the chi-square value is related to the large sample size.

The detailed analysis of the paired comparisons of the samples also revealed that the factor loadings had different degrees of invariance, depending on the sample size (see Table 5). The factor loadings invariance assumption was mainly supported among the pairs of small samples (i.e., $n < 1{,}000$) and on those occasions where pairs of small and large (i.e., $n \geq 1{,}000$) samples were combined, except for pairs 2 and 4, and 2 and 5. On the other hand, for the constrained model the loss of fit was significant among the pairs of large samples. In addition, the detailed analysis of the factor loadings of the UWES-9 showed only modest variation in the factor loadings across the five samples, varying from 0.02 to 0.11 (on the basis of M1 with all parameters estimated freely, completely standardized solution). Except for absorption item 4, the variation in the factor loadings was less than 0.10. Therefore, the factor loadings of absorption item 4 were estimated as unequal, but this modification hardly at all affected the value of the chi-square difference test [$\Delta\chi^2$ (20) = 88.86].

To sum up: on the basis of the chi-square difference test, the factor loadings invariance assumption of the UWES-9 was rejected; however, the detailed analyses revealed that the assumption of the invariance of the factor loadings was supported among the small samples and also showed only minor variation in the factor loadings across the samples. Therefore, the UWES-9 measured work engagement rather similarly among the different occupations and the group-invariance hypothesis (H2) regarding the UWES-9 was relatively well supported.

3.3 The Factorial Time Invariance and Rank-order Stability of the UWES-17 and the UWES-9

Table 6 reports the results for the factorial time invariance tests of M1 of the UWES-17 and the UWES-9. The fit of the baseline stability model of the UWES-17 was relatively good, although the modification indices indicated that seven autocovariances (i.e., correlation between error variances of an item measured at both time points) between dedication items 1, absorption items 1, vigor items 3, dedication items 4, vigor items 4, absorption items 6, and vigor items 6 needed to be estimated. Because of the large sample size, several autocovariances were statistically significant; hence autocovariances smaller than 0.10 were not estimated in the model, as they were considered to be of no practical importance.

Table 6 Time-invariance tests for the correlated three-factor model of the UWES-17 and the UWES-9

Alternative stability models	χ^2	*df*	$\Delta\chi^2(\Delta df)$	*p*	RMSEA	CFI	NNFI
1. Baseline stability model							
UWES-17	4207.72	518			0.060	0.95	0.94
UWES-17[a]	2901.24[a]	511			0.048[a]	0.97[a]	0.96[a]
UWES-9	1176.00	126			0.061	0.97	0.96
UWES-9[b]	816.29[b]	123			0.051[b]	0.98[b]	0.97[b]
2. Constrained stability model							
UWES-17[a]	3377.38[a]	525	2 vs. 1[a]		0.052[a]	0.96[a]	0.96[a]
			476.14 (14)	< 0.001			
UWES-17[c]	2915.97[c]	519	2 vs. 1[c]		0.048[c]	0.97[c]	0.96[c]
			14.73 (8)	$= 0.065$			
UWES-9[b]	992.68[b]	129	2 vs. 1[b]		0.055[b]	0.97[b]	0.97[b]
			176.39 (6)	< 0.001			
UWES-9[d]	830.32[d]	127	2 vs. 1[d]		0.050[d]	0.98[d]	0.97[d]
			14.03 (4)	$= 0.007$			

Baseline stability model = thresholds of observed variables set to be equal across two measurement points

Constrained stability model = thresholds of observed variables and factor loadings set to be equal across two measurement points

[a] Seven autocovariances of the UWES-17 estimated in the model

[b] Three autocovariances of the UWES-9 estimated in the model

[c] Seven autocovariances of the UWES-17 estimated in the model and the factor loadings of vigor items 2 and 4, dedication items 2 and 3, and absorption items 2 and 6 of the UWES-17 estimated as unequal across time

[d] Three autocovariances of the UWES-9 estimated in the model and the factor loadings of vigor item 2 and dedication item 2 of the UWES-9 estimated as unequal across time

After estimating these seven autocovariances, the fit of the baseline stability model clearly improved. Next, the equality of the factor loadings was tested. However, according to the chi-square difference test, the factor loadings equality assumption was not supported, as the constrained stability model yielded a significant loss of fit when compared to the baseline stability model (see Table 6). Thus, the size of the factor loadings did not remain unchanged over time, and the factor loadings could not be constrained to be equal but needed to be estimated freely. According to the modification indices, six factor loadings needed to be estimated freely. After the loadings of vigor items 2 and 4, dedication items 2 and 3, and absorption items 2 and 6 were estimated as unequal, the chi-square difference test did not produce a significant loss of fit. Since the six factor loadings were estimated as unequal, the UWES-17 did not measure work engagement in the same way at the two time points, and the thus time-invariance hypothesis (H3) regarding the UWES-17 was not supported.

As Table 6 also shows, the baseline stability model of the UWES-9 fitted the data well, but the modification indices indicated that three significant autocovariances between vigor items 3, dedication items 4, and absorption items 4 should be estimated (as previously, the cut-off point was 0.10). After estimating these autocovariances, the fit of the baseline stability model clearly improved. Next, the equality of the factor loadings was tested. However, the chi-square difference test did not support the factor loadings equality assumption, as the loss of fit for the constrained stability model was significant when

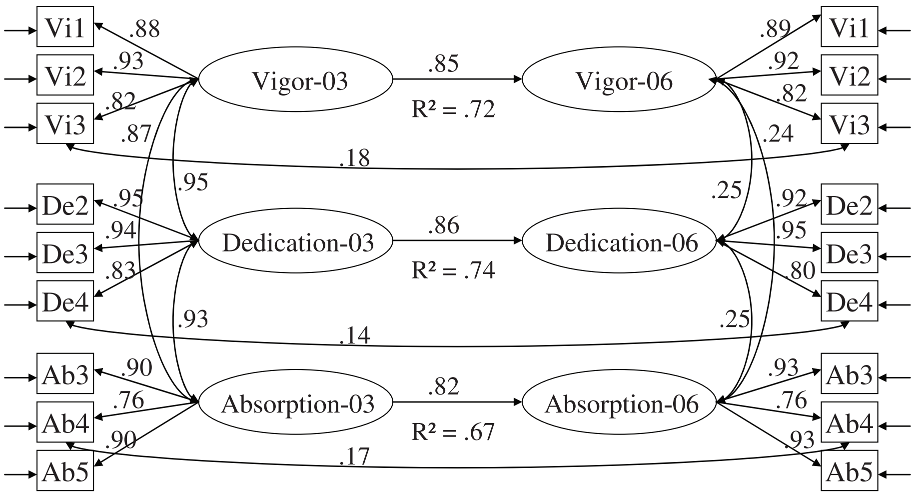

Fig. 2 Completely standardized solution for the final stability model of the correlated three-factor structure of the UWES-9. Three autocovariances between vigor items 3, dedication items 4, and absorption items 4 were estimated in the model. Factor loadings were constrained to be equal over time, with the exception that vigor item 2 and dedication item 2 were estimated as unequal over time

compared to the baseline stability model (see Table 6). Thus, the factor loadings did not remain equal over time, which impaired the fit of the constrained model. According to the modification indices, the factor loadings of vigor item 2 and dedication item 2 needed to be estimated as unequal. After these modifications, the factor loadings invariance assumption was supported, according to the chi-square difference test, at the 0.001 significance level. The final stability model of the UWES-9 is shown in Fig. 2. However, the detailed analysis (on the basis of the baseline stability model, completely standardized solution) revealed only minor, and for all practical purposes meaningless, variation in the factor loadings across time (between 0.01 and 0.04). Therefore, owing to the fact that the unequal factor loadings were unimportant and, that except for the chi-square difference test, the loss of fit was minor, the UWES-9 measured work engagement rather similarly over time. Thus the time-invariance hypothesis (H3) regarding the UWES-9 was relatively well supported.

Finally, the rank-order stabilities of work engagement factors were evaluated. However, as the structure of the UWES-17 did not remain invariant over time, the stability of work engagement was examined for the UWES-9. The standardized stability coefficients of the work engagement factors were high: vigor 0.85, dedication 0.86, and absorption 0.82 (see Fig. 2) and the stability hypothesis (H4) was fully supported. Thus, the reports of vigor, dedication and absorption remained highly stable over the three-year time-period and the proportion of the variance of the second measurement time explained by the first measurement time for each aspect of work engagement varied between 67% and 74%.

4 Discussion

Work engagement is one important construct of adults' happiness and well-being at work. The present study produced new knowledge about its measurement and stability. The study focused specifically on investigating the factor structure and factorial group and time invariance of the Finnish translations of the UWES-17 and the UWES-9 as well as the rank-order stability of work engagement by using data from five different studies, one of which was a longitudinal study with a three-year follow-up time.

4.1 Work Engagement Consists of Three Interrelated Factors

The first hypothesis that work engagement consists of three correlated factors—vigor, dedication and absorption—was fully supported. As in previous CFA studies on work engagement (Hakanen 2002; Hallberg and Schaufeli 2006; Schaufeli and Bakker 2003; Schaufeli et al. 2002b, 2006), the theoretically based correlated three-factor structure of the UWES-17 and the UWES-9 showed good fit both for each sample and at both measurement points, as well as better fit with all the data sets than the alternative one-factor structure (H1). Also, as hypothesized, the three factors correlated highly.

However, the correlated three-factor structure did not show a flawless approximation with the data. In line with the previous studies, the loadings of absorption item 6 ("*It is difficult to detach myself from my job*") and vigor item 6 ("*At my work I always persevere, even when things do not go well*") of the UWES-17 were relatively low in one/two of the five samples. Moreover, the theoretically based structure of the UWES-9 also showed weakness. This shortcoming, however, seems to be related to one error covariance between absorption items 4 ("*I am immersed in my work*") and 5 ("*I get carried away when I'm working*"), as the model fit clearly improved after allowing the error variances of these items to be correlated. This finding indicates that these items share some combined variance which the absorption factor cannot explain. As this error covariance appeared in all of the five samples, it seems that these two items overlap and to some extent measure the same thing. However, future studies need to replicate this finding before further conclusions can be drawn.

In line with the previous CFA studies, the results of this study reveal that work engagement can be considered both as a one-dimensional and as a three-dimensional construct, depending on the research purpose. High correlations between the three factors (from 0.83 to 0.97) would indicate a one-dimensional structure, but the better fit with the data of the correlated three-factor structure supports the three different, though highly correlated dimensions. Therefore, if the purpose is to study work engagement in general, a combined one-dimensional variable may be used, and if the purpose is to study the factors of work engagement, three separate dimensions may be used. However, from a practical viewpoint, the high correlations between the three factors indicate substantial overlap between them, and thus restrict their use as separate dimensions. Therefore, it seems to be reasonable to use the three factors separately only when conducting CFA and SEM analyses. The proposed solution is, however, largely a pragmatic one, which leaves unresolved the ultimate question of the one- vs. three-dimensionality of work engagement. In future research, it would, therefore, be worthwhile to pay attention to the criterion validity of work engagement.

4.2 The UWES-9 Measures Work Engagement similarly among Different Occupations and Over Time

The second hypothesis that the correlated three-factor structure of the UWES-17 and the UWES-9 would show factorial group invariance was only partially supported. In line with the results of the 14-item and 15-item versions of the UWES (see Schaufeli et al. 2002a; Xanthopoulou et al., in press), the group-invariance assumption of the correlated three-factor structure of the UWES-17 was not supported (H2). Specifically, while the factor structure of the UWES-17 was similar across the occupational groups, the size of the factor loadings differed between the groups. Thus, the UWES-17 did not measure work engagement similarly among different occupations. As a matter of fact we cannot be sure what construct was measured by the UWES-17. However, in contrast to the previous group-invariance study of the UWES-9 (Schaufeli et al. 2006), the group-invariance assumption of the correlated three-factor structure of the UWES-9 was relatively well supported (H2). The structure of the UWES-9 remained largely the same across the five samples, which means that participants with different occupations interpreted the scale in a conceptually similar manner. Thus, the UWES-9 seems to have good construct validity.

The third hypothesis positing factorial time invariance for the correlated three-factor structure of the UWES-17 and the UWES-9 was also only partially supported. The factor structure of the UWES-17 was similar over time but the size of the factor loadings differed between the two time points. Thus, the UWES-17 did not measure work engagement similarly over time and the time-invariance assumption of the correlated three-factor structure of the UWES-17 was not supported (H3). Moreover, the structure of the UWES-9 did not fully meet the criteria of factorial time invariance either, as the size of the factor loadings differed over time. However, the differences were very small, varying from 0.01 to 0.04, and thus, for all practical purposes, meaningless. It was, therefore, concluded that the correlated three-factor structure of the UWES-9 was relatively time-invariant (H3) and the UWES-9 measured work engagement rather similarly over the three-year time-period. This also indicates that the short scale has good construct validity.

In all, both versions of the UWES verified the theory of work engagement as three dimensional; however, contrary to the UWES-17, the correlated three-factor structure of the UWES-9 remained relatively unchanged across both samples and time. Although the main purpose of the study was not to compare these two versions of the UWES, the results show, in line with the previous study (Schaufeli et al. 2006), that the use of the 9-item version of the scale can be recommended. The shorter version of the scale is also preferable for practical reasons—to reduce the likelihood of attrition a scale measuring a particular construct should have as few items as possible while remaining reliable and valid. However, more analyses on the psychometric qualities of the UWES-9 are needed, particularly on the structural invariance of the scale.

4.3 Work engagement is a Highly Stable Construct

The fourth hypothesis, that the rank-order stability of work engagement would be relatively high, was fully supported. However, as the structure of the UWES-17 did not remain unchanged over time, the stability of work engagement was studied only for the UWES-9. The stability of work engagement was very high (standardized stability coefficients varied between 0.82 and 0.86) and thus, as theoretically expected, the feelings at work engagement tended to be highly stable and long-lasting over the three-year follow-up (H4). The stability of work engagement is considered to be similar to that of its negative opposite—burnout (for the stability of burnout, see Schaufeli and Enzmann 1998). This assumption has also received support in previous longitudinal studies on work engagement (Llorens et al. 2007; Mauno et al. 2007; Schaufeli et al. 2006). In the present study, however, the stability coefficients of work engagement turned out to be somewhat higher, probably owing to the use of SEM, which yields error-free stability coefficients.

According to the definition, work engagement reflect on employee's present, though persistent and pervasive, state of mind and not a personality trait, which is a durable disposition reflecting a person's typical reaction (Schaufeli and Salanova 2007; Schaufeli et al. 2002b). The high stability coefficients found for work engagement in this study raise, however, an important further question: how much influence do personal factors have on work engagement? The role of personality in work engagement is not yet well understood, although a recent study (see Langelaan et al. 2006) revealed that work engagement was related to high levels of extraversion and low levels of neuroticism. However, more studies on work engagement and personality are needed before further conclusions can be drawn. It is also important to bear in mind the context-specificity of the data. The longitudinal data set was restricted to Finnish dentists and was female-dominated. The respondents were highly educated, most had a permanent job contract and a long career history as a dentist and they experienced work engagement rather often (see Table 1).

In order to generalize the findings of this study, the stability of work engagement needs, therefore, to be investigated in a variety of other (unstable) contexts as well. It would also be interesting to study the stability of work engagement over a longer period with several measurements in order to investigate its stability in the long term. A longer follow-up with several measurement points would also allow investigation of the developmental trajectories of work engagement; utilizing a person-oriented approach would yield a more specific understanding of stability/change in work engagement than the conventional methods of the variable-centered approach (see, e.g., Laursen and Hoff 2006; Magnusson 1998).

4.4 Study Limitations

The present study has some limitations which need to be acknowledged. The main limitation is that the data consisted only of Finnish employees, who were mainly highly educated white-collar workers. Thus, the limitations on the sample restrict generalization of the findings and the results can be best generalized to Finnish white-collar workers. Since the UWES is expected to measure work engagement despite occupation or professional field, and since the structure of the UWES was not flawless even across the present white-collar occupations, the psychometric properties of the Finnish translation of the scale need also to be studied among blue-collar workers. The second limitation is that sample attrition analyses were not possible for all the samples. Therefore, it is possible that the samples obtained in the original studies were to some extent selective and so not representative with respect to those occupational groups. Finally, with respect to the structure of the UWES, one limitation is that the theoretically based correlated three-factor structure was not flawless in either version of the scale. However, overall the structure of the UWES-9 was good. On the other hand, the use of a multi-sample design, longitudinal data and sophisticated statistical methods can be considered the special strengths of this study. It should also be noted that this study was the first to examine the error-free rank-order stability of work engagement.

5 Conclusions

Happiness in life comes by many routes. Seen in this light, developing one’s strengths and virtues in the major realms of living—of which work is one—becomes an important task. Work engagement with its positive outcomes both in and outside work (e.g., Schaufeli and Salanova 2007) seems to be among this desired task. Furthermore, since research on work-related happiness and positive well-being as well as the positive approach as a whole in the field of occupational health psychology is still rather new, few reliable measures have as yet been developed to evaluate the positive pole. The UWES-9 seems to be a sound measure of work engagement and the use of the 9-item version of the scale can be recommended in future research on occupational well-being.

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Appendix

Work and Well-being Survey (UWES) ©

The following 17 statements are about how you feel at work. Please read each statement carefully and decide if you ever feel this way about your job. If you have never had this feeling, write "0" (zero) in the space preceding the statement. If you have had this feeling, indicate how often you feel it by writing the number (from 1 to 6) that best describes how frequently you feel that way.

	Almost never	Rarely	Sometimes	Often	Very often	Always
0	1	2	3	4	5	6
Never	A few times a year or less	Once a month or less	A few times a month	Once a week	A few times a week	Every day

1. At my work, I feel that I am bursting with energy (VI1)*
2. I find the work that I do full of meaning and purpose (DE1)
3. Time flies when I'm working (AB1)
4. At my job, I feel strong and vigorous (VI2)*
5. I am enthusiastic about my job (DE2)*
6. When I am working, I forget everything else around me (AB2)
7. My job inspires me (DE3)*
8. When I get up in the morning, I feel like going to work (VI3)*
9. I feel happy when I am working intensely (AB3)*
10. I am proud of the work that I do (DE4)*
11. I am immersed in my work (AB4)*
12. I can continue working for very long periods at a time (VI4)
13. To me, my job is challenging (DE5)
14. I get carried away when I'm working (AB5)*
15. At my job, I am very resilient, mentally (VI5)
16. It is difficult to detach myself from my job (AB6)
17. At my work I always persevere, even when things do not go well (VI6)

* Shortened version (UWES-9); VI = Vigor; DE = Dedication; AB = Absorption

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IS WORK ENGAGEMENT RELATED TO HEALTHY CARDIAC AUTONOMIC ACTIVITY? EVIDENCE FROM A FIELD STUDY AMONG FINNISH WOMEN WORKERS

by

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Is work engagement related to healthy cardiac autonomic activity? Evidence from a field study among Finnish women workers

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The present study investigated whether work engagement is related to and can explain healthy cardiac autonomic activity as indicated by decreased heart rate (HR; i.e., sympathetic and parasympathetic activity) and increased high-frequency power (HFP) of heart rate variability (i.e., parasympathetic activity). A total of 30 healthy Finnish female cleaning workers underwent an ambulatory monitoring period of two nights and two regular workdays, and mean values of work period HR and HFP were utilized as dependent variables. Correlations revealed that work engagement was, as hypothesized, negatively related to HR and positively to HFP. Furthermore, in hierarchical linear regression analysis, work engagement accounted for an additional 19% of the variance explained in HFP, independent of individual baseline, age, Body Mass Index, physical fitness, and medication. However, the explanation rate for HR did not reach statistical significance. The findings suggest that work engagement is associated with healthy, adaptable cardiac autonomic activity, particularly increased parasympathetic activity.

Keywords: work engagement; cardiac autonomic activity; heart rate; heart rate variability; ambulatory

Introduction

The association between occupational well-being and cardiac autonomic activity has been widely studied, but the interest of these studies has mainly been in the negative aspects, that is, in work-related stress and burnout and increased risk for cardiovascular diseases (for reviews, see Belkic, Landsbergis, Schnall, & Baker, 2004; Melamed, Shirom, Toker, Berliner, & Shapira, 2006). However, the positive aspect – positive occupational well-being and cardiovascular health – has surprisingly received little attention (Van Doornen et al., 2009). Thus, the existing studies are inadequate to understand the full complexity of psychological well-being at work and its psychophysiological correlates. According to positive psychology, well-being and health are more than just the absence of unwell-being and ill-health (e.g., Seligman, 2002; Seligman & Csikszentmihalyi, 2000). Instead, they should be studied in their own right; hence, studies on how to prevent sickness are not enough, but we also need studies on how to create and maintain good health. The present study addresses this issue by investigating the linkages between *work engagement*, a construct indicating individuals' positive well-being at work (Leiter & Bakker, 2010; Schaufeli, Salanova, González-Romá, & Bakker, 2002), and healthy cardiac autonomic activity, assessed via heart rate (HR) and heart rate variability (HRV), among Finnish female cleaning workers in a daily life setting.

Defining work engagement

Work engagement refers to a positive, fulfilling, work-related affective-motivational state of mind and it is considered to be a truly positive indicator of occupational well-being (Leiter & Bakker, 2010; Schaufeli & Bakker, 2010; Schaufeli et al., 2002). Specifically, work engagement is characterized by three highly related dimensions: vigor, dedication, and absorption. *Vigor* refers to high levels of energy and mental resilience while working and the willingness to invest effort in one's work. *Dedication* is characterized by experiencing a sense of enthusiasm, inspiration, and pride in one's work. *Absorption* refers to being fully concentrated and deeply engrossed in one's work, feelings of happiness while working intensely, and the sense of time passing quickly. Thus, engaged individuals have high levels of energy, identify strongly with their work, and are often so immersed in their work that time flies. Furthermore, work engagement

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is a long-lasting and pervasive mental state that is not focused on any particular object, event, individual, or behavior, and is a relatively stable phenomenon (Schaufeli & Bakker, 2010; Schaufeli et al., 2002). In fact, a three-year longitudinal study in Finland showed that experiences of work engagement are highly stable; the proportion of the variance of the second measurement time explained by the first measurement time for each dimension varied between 67 and 74% (see Seppälä et al., 2009).

Recent studies have revealed that work engagement results in positive outcomes in both work and nonwork domains (for reviews, see Bakker, 2008; Bakker, Schaufeli, Leiter, & Taris, 2008; Halbesleben, 2010; Schaufeli & Salanova, 2007). It has been shown, for example, that work engagement is positively associated with positive work-related attitudes, commitment to the job and organization, and better performance at work. Furthermore, work engaged individuals more often experience positive emotions, have good mental health, and recover from the workday better. Recent studies have also shown that the work engaged individuals have better psychosomatic and physical health, and work engagement has been related, for example, to fewer self-rated psychosomatic symptoms such as headaches, stomach aches, and cardiac complaints. However, thus far, there is no knowledge on how work engagement relates to physiological health outcomes, and evidence of the possible link between work engagement and physiological health is lacking.

Defining HR and HRV

The association between occupational well-being and cardiac autonomic activity is mediated primarily by the autonomic nervous system, which can be illustrated by using HR and HRV (Berntson et al., 1997; Task Force Guidelines, 1996). The autonomic nervous system consists of two different components: the sympathetic and the parasympathetic nervous systems. In general, the sympathetic component activates the body to respond to demands, and the parasympathetic component promotes restorative and vegetative functions and fast regulation of different physiological stages (Brownley, Hurwitz, & Schneiderman, 2000; Guyton & Hall, 2006).

Furthermore, sympathetic stimulation increases HR and decreases HRV, whereas parasympathetic (i.e., vagal, parasympathetic nerve fibers mostly exist in the vagus nerve) stimulation causes mainly the opposite effects (Brownley et al., 2000; Guyton & Hall, 2006). However, regulation of HR is the result of a dynamic interaction between the sympathetic and parasympathetic nervous systems, and thus, at any time, the sympathetic and parasympathetic components produce a combined effect, that is, sympathovagal balance (Berntson, Cacioppo, & Quigley, 1993; Thayer & Brosschot, 2005). The analysis of HR and HRV enables indirect (i.e., noninvasive) evaluation of this sympathovagal balance (Berntson et al., 1997; Task Force Guidelines, 1996). Furthermore, evaluation of HR and HRV enables assessment of the interaction between psychological states and cardiac autonomic activity (Berntson et al., 1997; Porges & Byrne, 1992; Thayer & Brosschot, 2005).

The normal resting HR of an adult is 60–80 beats per minute (bpm); however, challenging circumstances (e.g., work-related stress) or exercise can increase HR (i.e., decrease in parasympathetic and increase in sympathetic activity), while, in contrast, a resting HR below 60 bpm is common during sleep (i.e., increase in parasympathetic and decrease in sympathetic activity; Brownley et al., 2000; Guyton & Hall, 2006). Therefore, in a healthy adult, HR is not constant and, as a matter of fact, even at rest HR fluctuates continuously around its mean value. Actually, the greater the range of the phasic increases and decreases of HR, the healthier is the individual (e.g., Porges & Byrne, 1992; Thayer & Lane, 2007). The HRV describes these variations between consecutive instantaneous HR, although, in practice, HRV usually measures the variation between consecutive heartbeats (i.e., heartbeat-to-heartbeat interval [RRI]; Task Force Guidelines, 1996).

The HRV tends to be combined within several discrete frequency bands (i.e., HRV distributes as a function of frequency) and the relative contribution (i.e., power) of these bands to the original heart signals can be determined (Task Force Guidelines, 1996). The clearest of these bands is at the respiratory frequency, and to date, a clear consensus exists that the respiratory frequency band (i.e., high-frequency power [HFP] of HRV) is mainly influenced by parasympathetic activity, and thus, it has been accepted as a marker of parasympathetic activation of HR (Berntson et al., 1997; Grossman & Taylor, 2007; Task Force Guidelines, 1996). Furthermore, parasympathetic activation is generally agreed to have an important role in cardiac health and disease and decreased parasympathetic activation of the heart (i.e., decreased HFP) has been associated with elevated risk for cardiovascular disease and even mortality (for a review, see Thayer & Lane, 2007).

In sum, increased HRV is linked to good health. However, temporary increases in HR and decreases in HRV (i.e., decreases in parasympathetic activity and increases in sympathetic activity) are natural and normal responses to daily demands. Autonomic imbalance, on the other hand, and especially sympathetic dominance and long-term decreased parasympathetic activity, results in cardiovascular ill-health, as the demands on the autonomic system become excessive (see Thayer & Lane, 2007). Thus, the combined effect of the sympathetic and parasympathetic nervous system is important for dynamic flexibility and cardiovascular health.

Work engagement and cardiac health

To the best of our knowledge, only one study exists on the relationship between work engagement and cardiac autonomic activity (Van Doornen et al., 2009). In this study, HR, HFP, and pre-ejection period (PEP; i.e., indicator of cardiac sympathetic activation) were assessed among male managers by using a daily life setting over a regular workday and subsequent night. Mean values of the variables used were computed for three different conditions: sitting at work, sitting in leisure time, and sleep time. Finally, it was tested whether the work engaged group ($n = 29$) differed from the burned-out (i.e., the antipode of work engagement; for more information, see, e.g., Maslach, Schaufeli, & Leiter, 2001) group ($n = 30$) and/or control group ($n = 29$) with respect to HR, HFP, and/or PEP. The study showed that the cardiac autonomic activity of the work engaged participants did not, however, differ from that of the other two groups in any of the investigated variables either across the three conditions (sitting at work, sitting in leisure time, and sleep) or condition specifically (Van Doornen et al., 2009). Thus, highly work engaged individuals did not show any favorable cardiac autonomic profile compared to the burned-out and control groups.

Although published studies on work engagement and cardiac autonomic activity are rare, a few noteworthy studies exist on a somewhat similar positive, though nonwork-related, construct as work engagement. According to a recent review, positive affect (i.e., a feeling that reflects a level of pleasurable engagement with the environment; see Watson, Clark, & Tellegen, 1988) seems to be associated with parasympathetic control (Pressman & Cohen, 2005). However, the findings do not show any consistent pattern, and evidence for both an increase and decrease in parasympathetic activity exists. Moreover, although both ambulatory assessment (i.e., systematic collection of psychological and/or physiological data in real-life settings outside the laboratory) and laboratory settings have been used, most of these studies are experimental studies in which a short (state-like) positive affect is influenced in a laboratory setting.

In some experimental and ambulatory studies, highly activated positive affects (e.g., happiness and joy) have been associated with both increased and decreased HR (e.g., Neumann & Waldstein, 2001; Steptoe & Wardle, 2005), while in others, positive affects have shown no association with HR (e.g., Shapiro, Jamner, & Goldstein, 1997). Furthermore, the results of ambulatory and laboratory studies on positive affect and HRV are inconsistent: in some studies, positive affects have been related to increased (e.g., Bacon et al., 2004) and decreased (e.g., Frazier, Strauss, & Steinhauer, 2004) HRV, and in others, positive affects have not shown any association with HRV (e.g., Hanson, Godaert, Maas, & Meijman, 2001). In general, arousal seems to be an important component in the association between positive affects and cardiac autonomic activity. Therefore, highly activated positive affects appear to be related to increases in sympathetic and decreases in parasympathetic activity. However, the magnitudes of these activities have been smaller than those with highly activated negative affects, such as anger and fear (Pressman & Cohen, 2005). On the other hand, the duration of responses after negative affects has been more prolonged than after positive affects, in other words, cardiac activation after negative affects lasts longer (Brosschot & Thayer, 2003; see also Fredrickson, Mancuso, Branigan, & Tugade, 2000). Overall, the relationship between positive affects – assessed in relation to work or globally – and healthy cardiac autonomic activity remains unclear and requires more research.

Study aims

The main aim of the present study was to investigate linkages between work engagement, used as an indicator of positive well-being at work, and HR and HRV, used as indicators of healthy cardiac autonomic activity. Specifically, the study examined whether work engagement is related to and explains lower HR and increased HFP. The study was conducted among Finnish female cleaning workers ($n = 30$) in a daily life setting over an ambulatory monitoring period of two consecutive working days and two preceding nights. Our hypothesis, based on the indirect findings of previous studies on positive affects (Pressman & Cohen, 2005), states that work engagement is related to and explains lower HR and higher HFP.

Method

Participants

The sample of this study consisted of 120 female workers in a municipal-owned cleaning company in Central Finland in 2006. Of the original sample, 57 females participated in the study (response rate 47.5%). However, due to physiological assessments, exclusion criteria were established for certain medical conditions (e.g., cardiovascular disorders, falling ill during the monitoring period, serious depression, or pregnancy), antihypertensive medication (β-blocker or other antihypertensive), or indications of arrhythmia or bundle branch blocks. Moreover, this study concerned cleaners only, and the cut-off score for the percentage error of the ambulatory monitoring was set to 10. Therefore, 23 participants were excluded for medical reasons, three because of equipment failure (too high error percentage), and one participant because of work role differences (she worked as a supervisor), resulting in a final sample of 30 participants.

The mean age of the respondents was 46.0 years (standard deviation [SD] = 11.1, range = 24–63). Most (82%) had completed an intermediate-level education (i.e., vocational school) or had a low educational level (i.e., no vocational training or course-based education). All the participants worked as cleaners doing similar cleaning tasks in similar environments (i.e., municipal buildings; e.g., schools, offices). Nearly all (87%) were permanently employed, working full-time (90%). Participants' work experience ranged between one and 41 years and mean job tenure was 16 years (SD = 11.8). During the ambulatory monitoring, the average working time per day varied between 6.5 and 9.4 hours. All participants had the same work schedules during the monitoring and all worked in a morning shift.

Nearly all of the participants reported good or satisfactory self-rated general health (93%) and good or satisfactory physical fitness (97%). The mean Body Mass Index (BMI, computed as the weight in kilograms divided by the square of height in meters) of the participants was 25.0 (SD = 3.3, range = 18.7–33.3); two of the participants had BMI over 30. Most of the participants (93%) reported drinking caffeinated beverages, five reported moderate alcohol intake and 11 smoked during the monitoring period. In all, 16 of the participants were using medication (antihistamines for allergic rhinitis, oral contraceptives, hormonal therapy for menopausal symptoms, lipid-lowering medication, and/or hormonal therapy for hypothyroidism) and/or natural remedy.

Procedure

Before the ambulatory monitoring, the participants completed a questionnaire on demographics such as age, educational level, years of services, hours worked weekly, general health status, health behavior, medication, and physical activity and sleep habits. A research assistant visited the participants at their workplace on Monday or Tuesday afternoons to start the ambulatory monitoring. After giving detailed instructions, weight and height were measured. Participants also received written instructions for possible problems with recordings, such as imperfect electrode contacts, and in case of problems, a contact person was available during waking hours.

Two adhesive electrodes were placed on the chest for the ambulatory electrocardiogram (ECG) measurements. The ECG was recorded continuously for three nights and two working days (recordings length: 54–56 hours), and thus, the cleaners wore the device throughout the measurement period except for short periods of showering. The ECG data were stored on the device (for more information on the ECG recordings, see section Measuring HR, HRV, and physical activity). To ensure good ecological validity, participants were instructed and allowed to maintain their normal daily routines. Thus, the consumption of, for example, cigarettes, alcohol, and caffeinated beverages were not prohibited. During the ambulatory monitoring, participants completed a detailed diary on their daily activities (e.g., start of sleep time, waking-up time, working time, physical activity during free time, alcohol and caffeine intake, number of cigarettes, possible medication, and acute sickness).

On Thursday or Friday morning, the research assistant came back to the workplace and removed the electrodes and the recording device. During the following week, the participants completed an extensive questionnaire, including the measure of work engagement (Utrecht Work Engagement Scale [UWES], see section Measuring work engagement). Participants received a summary of their ambulatory recordings from an occupational health nurse and a physician provided personal feedback if the ambulatory recordings revealed any medical problems. The study protocol was approved by the Ethical Committee of the Central Finland Health Care District.

Measuring work engagement

Work engagement was assessed with the Finnish translation of the short version of the UWES, the UWES-9 (Hakanen, 2009; Schaufeli, Bakker, & Salanova, 2006). The UWES-9 consists of nine items on the three underlying dimensions of vigor, dedication, and absorption (Schaufeli et al., 2006). Vigor was measured with three items (e.g., 'At my work, I feel bursting with energy'), dedication with three items (e.g., 'I am enthusiastic about my job'), and absorption with three items (e.g., 'I feel happy when I am working intensely'). Items were judged on a seven-point scale (0 = *never* and 6 = *every day*). The mean total score of the UWES-9 was used in this study, calculated as the mean of all nine items. The internal consistency (Cronbach's alpha) of the UWES-9 was 0.89. Furthermore, in a previous study, the UWES-9 has shown good construct validity in Finnish samples (Seppälä et al., 2009). The respondents reported feelings of work engagement rather often; the majority of the answers were in category 5 ('A few times a week'). The mean level for work engagement was 3.9

(SD = 1.2, range = 0.8–5.6), which is rated as 'moderate work engagement' according to a Finnish normative sample (N = 16,335; see Hakanen, 2009).

Measuring HR, HRV, and physical activity

Physiological variables reflecting cardiac autonomic activity were assessed by using an Alive Heart Monitor ECG (model HM120, Alive Technologies Pty, Ltd, Australia).

The ECG signal was transformed to RRI (i.e., RR intervals) with software provided by the manufacturer (ats2RR.exe – program, Alive Technologies Pty, Ltd, Australia). The RRI data were further analyzed by the Firstbeat Health heartbeat analysis software application (version 3.0.0.9; Firstbeat Technologies Ltd, Finland). The RRI data were first scanned through an artifact-detection filter to perform initial correction of falsely detected, missed, and premature heartbeats, which were subsequently accepted or overruled by visual inspection. Next, the artifact-corrected RRIs were resampled at a sampling frequency of 5 Hz by using linear interpolation to obtain an equidistantly sampled time series (for more detailed information, see Saalasti, 2003). From the resampled data, the software application calculates HR and HRV indices by using the short-time Fourier transform method. In this study, the variables used were HR and HFP (0.15–0.40 Hz). The HR is considered an indicator of both parasympathetic and sympathetic activity of the heart and HFP an indicator of parasympathetic activity as well as HRV (Guyton & Hall, 2006; Task Force Guidelines, 1996).

Alive Heart Monitor includes also a dual-axis accelerometer (ADXL311, Analog Devices, Inc., United States), which can measure both dynamic acceleration (e.g., movement and vibration) and static acceleration (e.g., gravity). The Alive Heart Monitor was worn on the left side of the waist, and thus, it measured acceleration in the anteroposterior (x) and vertical (y) direction. The magnitude range of the accelerometer is $\pm 2g$ s ($g = 9.81\,\text{m/s}^2$) and frequency bandwidth is 0–20 Hz. The acceleration signal is digitized by an 8-bit A/D-converter at a sampling rate of 75 Hz. After filtering, the digital integration was applied for one-minute epochs. Activity counts were computed individually for x- and y-accelerations and for the vector magnitude of these activity counts (calculated as $(x^2 + y^2)1/2$). The computations were done using the ATSAnalyser software supplied by the manufacturer (Alive Technologies Pty, Ltd, Australia). In this study, vector magnitude was used to represent physical activity, as it takes into account acceleration in both measurement directions. Average value was computed from the 1-min activity counts to describe the physical activity of the subjects at the investigated period of time.

The entire ambulatory monitoring period was finally divided into selected segments for analysis: the whole work periods (including rest periods) and night periods. However, to improve the accuracy and comparability of the night measurements, due to very different bedtimes and sleep durations (5.4–8.7 hours), only the first 4 hours of the night periods, starting 30 min after going to bed, were used in the analyses (see, e.g., Hynynen, Vesterinen, Rusko, & Nummela, 2010). After that, mean values of HR and HFP were calculated for the investigated segments of two work periods and the two preceding nights. Thus, we aggregated the measuring period by computing mean scores, as this procedure should reduce unpredictable confounding influences (see, e.g., Manuck, 1994).

Control variables

Possible confounding factors, such as age, BMI, physical fitness, physical activity during work period, duration of work period, caffeine and alcohol consumption, cigarette smoking, and the use of medication and/or natural remedy were included as control variables in the analyses because of their expected influence on HR and HRV (e.g., Carter, Banister, & Blaber, 2003; De Meersman & Stein, 2007; Dietrich et al., 2006; Myrtek, Fichtler, Strittmatter, & Brügner, 1999; Thayer & Lane, 2007; Watanabe et al., 2002). Physical fitness (i.e., maximum oxygen uptake, ml/kg/min) was estimated by the Firstbeat Health software application (version 3.0.0.9; Firstbeat Technologies Ltd, Finland) according to the method of Jackson et al. (1990). This method of estimation requires the following input parameters: age, weight, height, gender, smoking habits, and physical activity class.

Age, BMI, and physical fitness were included as individual background confounding variables; the other confounding variables were added into the analyses if they showed a significant correlation with the dependent variables. Furthermore, the mean values of HR and HFP of the first four hours of the two preceding nights (i.e., individual baseline) were included to control for the influence of the individual baseline level on HR and HRV (e.g., Martinmäki, Rusko, Kooistra, Kettunen, & Saalasti, 2006) and to reveal the aggregate cardiac activity response to various repeated demands during the workday (see Vrijkotte, Riese, & De Geus, 2001; see also Manuck, 1994).

Data analysis

The descriptive data analysis was carried out with SPSS 15.0 for Windows. Spearman correlations were used to examine the interrelationships between the study variables. Next, hierarchical linear regression analyses, also performed with SPSS 15.0, were used to examine whether work engagement significantly added to the explanation rate of HR and HFP, beyond other factors theoretically and/or empirically related to ambulatory HR and HRV. Because HFP was not normally distributed, natural log-transformed values (ln) were used in the hierarchical linear regression analyses. Furthermore, if not normally distributed, confounding variables were normalized, with the exception that cigarette smoking, alcohol consumption, and medication were added to the further analyses as dichotomous variables because either they were highly skewed or the answers were in only two or three categories. Hierarchical linear regression analyses were conducted separately for both dependent variables (mean values of HR and HFP for the two work periods) and independent variables were entered one at a time into the analyses. Specifically, the analyses were performed as follows: in Model 1, possible confounding variables were entered in the analyses, and in Model 2, possible confounders and work engagement were entered.

Results

Descriptives

Table 1 presents the means, SDs, and the Spearman correlations between the study variables. First, we can see that the mean HR for the two nights was 65.8 bpm (SD = 7.1) and the mean HR for the two work periods was 93.0 bpm (SD = 9.5). The mean HFP and lnHFP for night periods was 1265 ms^2 (SD = 1215) and 6.8 ln (ms^2) (SD = 0.9), and for work periods, it was 366 ms^2 (SD = 329) and 5.6 ln (ms^2) (SD = 0.8). The HR at night (i.e., individual baseline) correlated with HR at work (0.59, $p = 0.001$) and HFP at night (i.e., individual baseline) showed an association, though not significant, with HFP at work (0.35, $p = 0.06$). Second, work engagement was negatively correlated with work period HR (–0.37, $p = 0.05$) and positively with work period HFP (0.44, $p = 0.02$). However, the correlations between work engagement and night period HR (–0.34, $p = 0.08$) or night period HFP were not significant (0.23, $p = 0.25$), although the correlation between work engagement and night period HR almost reached statistical significance. Thus, in line with the hypothesis, the preliminary analyses indicated that an association existed between work engagement and decreased HR and increased HFP.

Third, of the individual background confounding variables, age was negatively related to work and night period HR (–0.49, $p = 0.006$; –0.60, $p = 0.00$, respectively) and to work period HFP (–0.40, $p = 0.03$). However, BMI or physical fitness showed no significant correlation with neither of the dependent variables. Of the other confounding variables, only medication showed significant negative correlations with work period HR (–0.42, $p = 0.02$) and with work period and night period HFP (–0.39, $p = 0.04$; –0.36, $p = 0.05$, respectively). Therefore, as the other confounding variables showed no significant relations with the dependent variables, they were excluded from the further regression analyses (see Table 1).

Hierarchical linear regression models of HR and HFP

Table 2 presents the results of the HR and HFP regression models. The first model accounted for 41% of the total variance in HR. However, only the explanation rate of the individual baseline level (32%) was significant; although the explanation rates of age (7%) and medication (8%) almost reached the level of statistical significance ($p = 0.09$; $p = 0.06$, respectively). In Model 2, the explanation rate of the individual baseline level (32%) was significant, but of the other confounding variables, only medication showed a significant negative effect on HR, explaining 11% of the additional variance. Specifically, as medication was inversely related to HR, medication decreased HR. In contrast to our hypothesis, after controlling for the confounding background variables, work engagement did not have a significant negative effect on HR ($\beta = -0.28$, $p = 0.07$), and the explanation rate of work engagement (7%) did not reach statistical significance. The total amount of the variance in HR explained by the final model was 51%.

Furthermore, the first model accounted for 22% of the total variance in HFP. The explanation rate of the individual baseline level (18%) was significant; however, none of the explanation rates of the other confounding variables were significant. In addition, in Model 2, of the confounding variables, only the explanation rate of the individual baseline level (19%) reached the level of significance. On the other hand, in line with the hypothesis, work engagement showed a significant positive effect on HFP ($\beta = 0.48$, $p = 0.009$) and explained an additional 19% of the variance in HFP, even after controlling for the individual baseline level, age, BMI, physical fitness, and medication. The total variance explained by the final model was 39%.

Discussion

The present study investigated the linkages between work engagement and healthy cardiac autonomic activity among Finnish female cleaning workers in a daily life setting over two workdays and nights. The results showed an association between work

Table 1. Means, standard deviations, and Spearman correlations of the study variables.

Variables	*M*	SD	1	2	3	4	5	6	7	8	9	10	11	12	13
1.Work engagement	3.9	1.2													
2. HR (work)	93.0	9.5	–0.37*												
3. HR (night)	65.8	7.1	–0.34	0.59**											
4. HFP (work)	366	329	0.44*	–0.14	0.15										
5. HFP (night)	1265	1215	0.23	0.30	–0.09	0.35									
6. Age	46.0	11.1	0.19	–0.49**	–0.60***	–0.40*	–0.29								
7. Body Mass Index	25.0	3.3	–0.10	0.06	0.19	–0.30	0.03	0.18							
8. Physical fitness	27.0	6.6	–0.06	0.06	0.12	0.32	0.11	–0.63***	–0.67***						
9. Caffeine	7.0	3.2	–0.20	0.15	–0.10	–0.01	–0.11	0.02	–0.03	–0.07					
10. Smoking (y/n)	—	—	–0.20	0.29	0.21	0.15	–0.12	–0.20	–0.32	0.25	0.49**				
11. Alcohol (y/n)	—	—	0.07	–0.16	0.03	0.28	0.11	–0.11	0.05	0.05	–0.41*	–0.16			
12. Medication (y/n)	—	—	–0.05	–0.42*	–0.20	–0.39*	–0.36*	0.26	0.06	–0.04	–0.27	–0.26	–0.12		
13. Duration (minutes)	488	43.5	–0.08	0.00	0.24	0.06	–0.13	–0.08	0.07	0.02	0.05	0.20	–0.12	0.16	
14. Physical activity (work)	274	46.7	–0.07	0.00	–0.22	–0.03	0.18	0.22	0.00	–0.12	0.20	–0.09	–0.03	–0.15	–0.18

Notes: *M* = mean; HR = heart rate; HFP = high-frequency power; SD = standard deviation.
*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

Table 2. Hierarchical linear regression models explaining mean levels of HR and HFP during work period.

	Entered variables	HR ΔR^2	HR B	HFP ΔR^2	HFP β
Model 1 ($n = 30$)	1. Baseline	0.319**	0.315	0.184*	0.337
	2. Age	0.070	–0.427	0.049	–0.258
	3. BMI	0.004	–0.045	0.073	–0.356
	4. Physical fitness	0.035	–0.240	0.017	–0.165
	5. Medication	0.079	–0.301	0.027	–0.187
		Total $R^2 = 0.507$, Total adj. $R^2 = 0.405$		Total $R^2 = 0.350$, Total adj. $R^2 = 0.215$	
Model 2 ($n = 28$)	1. Baseline	0.316**	0.197	0.188*	0.164
	2. Age	0.075	–0.473	0.034	–0.327
	3. BMI	0.004	–0.101	0.075	–0.234
	4. Physical fitness	0.053	–0.310	0.008	–0.157
	5. Medication	0.107*	–0.371*	0.030	–0.243
	6. Work engagement	0.066	–0.275	0.190**	0.477**
		Total $R^2 = 0.621$, Total adj. $R^2 = 0.513$		Total $R^2 = 0.525$, Total adj. $R^2 = 0.390$	

Notes: HR = heart rate; HFP = high-frequency power; BMI = Body Mass Index; Baseline = the mean values of HR and HFP of the first 4 hours of the two preceding nights; Model 1 = model with confounding variables; Model 2 = model with confounding variables and work engagement; Total R^2 = explanation rate of the model; Total adj. R^2 = explanation rate of the model adjusted for the number of explanatory variables; ΔR^2 = change in explanation rate for each variable; β = standardized beta-coefficients from the final step of the models.
*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

engagement and HR and HRV. Work engagement was significantly related to HR and HFP, and the direction of these associations was as hypothesized; higher work engagement was related to lower HR and higher HFP during work time. Furthermore, work engagement showed a significant positive effect on HFP and accounted for an additional 19% of the variance explained in HFP, even after controlling for the individual baseline level, age, BMI, physical fitness, and medication, which are generally known to affect HFP (e.g., Carter et al., 2003; De Meersman & Stein, 2007; Dietrich et al., 2006; Martinmäki et al., 2006; Thayer & Lane, 2007). However, the hypothesis that work engagement would improve the explanation of HR was not supported, as work engagement did not have a negative effect on HR and the explanation rate between work engagement and HR was nonsignificant.

In line with the previous findings on positive affects and increased parasympathetic activity (Pressman & Cohen, 2005), our findings suggest that work engagement is connected to increased parasympathetic activation. Thus, work engagement seems to be related to healthy, balanced, and adaptable cardiac autonomic activity. Furthermore, as parasympathetic activity has an important role in cardiac health and diseases (for a review, see Thayer & Lane, 2007), it is possible that one mechanism underlying the relationship between work engagement and psychosomatic and physical health (e.g., Bakker, 2008; Bakker et al., 2008; Halbesleben, 2010; Schaufeli & Salanova, 2007) is dynamic activity of the autonomic nervous system and reduced parasympathetic withdrawal during work period, in particular.

Against our expectations, work engagement did not improve the explanation of HR. Although work engagement was related to lower HR, work engagement did not account for the additional variance in HR, and thus, our hypothesis was only partially supported. This result is partly consistent with a previous study where work engagement showed no link to favorable cardiac autonomic profile in male managers (Van Doornen et al., 2009). Furthermore, null findings exist on the relationship between positive affects and HR (Pressman & Cohen, 2005). However, the participants, research methods, and research frame of the above-mentioned studies, including both ambulatory and laboratory studies, different gender and occupational groups, and shorter measuring periods (Pressman & Cohen, 2005; Van Doornen et al., 2009), were very different from those in this study and thus not strictly comparable. In addition, the wide variability in the results of studies on positive affects and cardiac autonomic activity in general is probably due to differences linked to participants, context, and physiological recording and processing (see Pressman & Cohen, 2005). Therefore, to allow comparisons, studies using similar designs and methods are needed.

Despite the considerable evidence linking work unwell-being (i.e., burnout and work-related stress) with increased risk of cardiovascular diseases and cardiovascular-related events (for reviews, see Belkic et al., 2004; Melamed et al., 2006), there is still no clear consensus on the cardiovascular psychophysiological mechanisms underlying this relationship. In addition, although thus far rare, a few results linking positive affects with reduced incidence of cardiovascular diseases have been published (see, e.g., Davidson, Mostofsky, & Whang, 2010). Therefore, future studies could also investigate the possible direct relationships between work engagement and (reduced) incidence of developing cardiovascular diseases or cardiovascular-related events.

An interesting result, although beyond the scope of this study, is that the correlation between work engagement and work period HFP was significant, while the correlation between work engagement and night period HFP was not. Although the difference in the correlation coefficients was rather small, the relationship between work engagement and HFP seems to be somewhat work-related, and work engagement experienced during the daytime might not carry over into the nighttime and influence HFP during sleep. Previously, work engagement has been associated with feelings of recovery: daily recovery during leisure time had a positive effect on work engagement on the next working day (Sonnentag, 2003). Thus, in light of this finding, stronger correlations would have been expected between work engagement and night period (i.e., recovery period) HFP. In future, a daily-based assessment of work engagement (see, e.g., Sonnentag, Dormann, & Demerouti, 2010) would offer a fruitful starting point to study the relationship of daily changes in work engagement and corresponding daily changes in cardiac autonomic activity.

Finally, although physical activity is an important determinant of HR and HRV (e.g., Carter et al., 2003; Myrtek et al., 1999), in this study, it did not show any association with HR or HFP and was therefore excluded from the further regression analyses. It might seem that the present accelerometer did not measure physical activity during cleaning work accurately. However, the mean activity counts of the cleaning work performed in the present sample (274 counts/min) corresponded to activity counts of light physical activity (such as 'vacuum-cleaning,' 252 counts/min) obtained from our preliminary study, which included 25 different everyday activities and exercises. Furthermore, the preliminary study revealed that the activity counts of the present method correlated significantly with oxygen consumption measured with a spirometer (0.89, $p = 0.00$; Oxygen Mobile Jaeger, Viasys Healthcare, Inc., Germany) and with activity counts measured with an accelerometer worn on the wrist (0.81, $p = 0.00$; Actiwatch Plus, Cambridge Neurotechnology Ltd., United Kingdom; for more information, see Ajoviita, 2007; see also Freedson, Melanson, & Sirard, 1998). It is thus possible that the lack of association is due to the great variation in the physical fitness of the participants (coefficient of variation 24%). The same or even higher level of physical activity expended in cleaning work induces a much lower HR for workers with a high level of fitness compared to those with a low level of fitness; thus, those with a low level of physical fitness may have a higher HR, despite the fact that they have a lower level of physical activity. Therefore, the differences in physical fitness may have partly masked the influence of physical activity on HR and HRV (e.g., Carter et al., 2003; Myrtek et al., 1999).

Limitations and contributions

Some limitations need to be acknowledged when interpreting the present results. The limitations of the sample, that is, gender, socioeconomic status, occupational group, small sample size, and low participation rate (48%) restrict the generalizability of the findings. Furthermore, we do not have any information of those who did not participate in the study, and thus, we were unable to perform attrition analysis. Therefore, it is possible that the sample was to some extent selective and not totally representative in relation to the original sample. On the other hand, the response rate is consistent with the average response rate in studies that utilize data collected from individuals (Baruch & Holtom, 2008) and, with respect to small sample size, it should be noted that the sample sizes of previous ambulatory studies on work engagement or positive affects and cardiac autonomic activity have been rather similar (see Pressman & Cohen, 2005; Van Doornen et al., 2009).

In addition, although, the findings propose a link between work engagement and healthy cardiac autonomic activity, we cannot infer the direction of causality from the data used. It is possible that work engagement promotes healthy cardiac autonomic activity; however, it is equally possible that 'cardiac healthy' workers are more likely to report high work engagement. A somewhat related issue is that we cannot exclude the possibility that lifestyle factors and health behavior may explain the link between work engagement and HR and HFP; thus, it is possible that the sample was indirectly biased by the healthy worker effect. However, 11 of the 30 participants were smokers and two of the participants had BMI over 30, both of which are associated with decreased parasympathetic activity (e.g., Dietrich et al., 2006; Thayer & Lane, 2007).

We cannot exclude the possibility of a third variable that may cause the link between work engagement and HR and HFP. Most of the participants reported 'good' or 'satisfactory general health,' and therefore a potential confounding factor could be general health. We did, however, control for this explanation by including self-rated general health in the preliminary analyses. Yet, it did not show a significant association with either HR or HFP, and thus, general health does not explain the relationship in the present study. Furthermore, we cannot exclude the issue of personality or dispositional differences; it is possible that the participants who had high levels of work engagement were also more engaged in other aspects of their lives and the results reflect individual differences in 'life engagement' in a broader sense. Recent studies have shown that work engaged individuals are also active in other aspects of their lives (Schaufeli & Salanova, 2007). Furthermore, according to the definition, work engagement can be considered a domain-specific psychological state that corresponds with positive affectivity, which is a context-free dispositional trait (see Schaufeli & Bakker, 2010). It is therefore possible that some employees are dispositionally more likely to be engaged at work. However, the role of dispositional differences in work engagement is not yet fully understood and it might be advisable in future studies to include a broader range of measurements of underlying characteristics.

Finally, the hypotheses of this study were not fully supported, and therefore, the suggestion of healthy cardiac autonomic activity in work engaged individuals should be interpreted with caution. However, although the explanation rate between work engagement and HR was nonsignificant ($\Delta R^2 = 0.07$, $p = 0.07$), we would speculate that a tendency toward this effect exists, and thus, it warrants further study, preferably with larger sample sizes.

The present study also contributes importantly to the existing literature. First, we focused on occupational well-being, that is, work engagement, instead of unwell-being (i.e., burnout or work-related stress) which, thus far, has predominated the research on the relationships between work-related well-being and cardiac autonomic functioning. To our knowledge, this is the second study to investigate the associations between work engagement and cardiac autonomic activity, and thus, the present results also add insights on the cardiovascular psychophysiological mechanisms linking positive occupational well-being and cardiovascular health. Second, the study focused on cleaning workers – an occupational group that is usually ignored in occupational health research – and found that cleaning workers frequently experience work engagement. It was important, if perhaps somewhat unexpected, to find that work engagement can also be experienced in blue-collar occupations, and thus, it can be suggested that blue-collar workers should be included to a greater extent in future studies on work engagement. Third, this study has a good ecological validity; we studied employees in a daily life setting over long, dynamic, measurement period and allowed them to maintain their normal lifestyle. Finally, we aggregated the measurement periods, thereby reducing the influence of various random effects during the workday, and we also controlled for many confounding variables in the regression analyses.

Conclusions

The study aimed to clarify the possible association between work engagement and cardiac autonomic activity. The findings suggest that a link exists between work engagement and healthy cardiac autonomic activity, especially increased parasympathetic activity. Thus, in daily life, work engagement seems to be connected to something as complex as parasympathetic activity, which might be a one mediator of the relationship between work engagement and physical health. Despite the fact that it is impossible to control all the potential confounding influences on HR and HFP when studying real humans in natural settings, we dare to suggest that in the light of the positive health relations found in this study, every effort should be made in workplaces to promote employees' work engagement.

Disclosures

Heikki Rusko is currently a stockowner of Firstbeat Technologies Ltd.

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