Relationship between psychosocial strains at the workplace, depression, and cognitive deficiencies

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Abstract

The subject of mental disorders and work is of high priority for occupational safety and health, in particular where job stresses lead to depression and impairment of work ability. Factors potentially contributing to depression and work ability impairment include psychosocial work characteristics (PWC), burnout, cognitive deficits, and aging. Referencing the Job-Demand Resources (JD-R) model, burnout is viewed as mediating the association between PWC and depressive symptoms, but the mediating relationship between PWC and work ability remains to be tested. Further, cognitive deficits may be a marker for chronic problems with burnout, depression and work ability. The current project studied how these factors relate to one another, based on a sample of 402 working nurses in a large private health system in the United States. Participants completed baseline assessments of PWC, burnout, depressive symptoms, cognitive performance, and work ability. In addition, follow-up assessments of these factors (except cognitive performance) were conducted over 12 months. Results confirmed the JD-R model in finding that burnout mediated the association between PWC and chronic depressive symptoms, but the reverse was not found for depressive symptoms mediating the association between PWC and chronic burnout. In addition, higher burnout was associated with worse work ability over 12 months, including effects on both psychological and physical dimensions, whereas depressive symptoms affected psychological work ability only. Cognitive performance was found to have an inconsistent association to burnout, depressive symptoms, and work ability, though slowing of reaction time was found in association to both cross-sectional and longitudinal measures of burnout. Aging was found to be generally associated with lower burnout and depressive symptoms, but older workers were vulnerable to greater work ability impairment with increasing burnout symptoms. These findings highlight that burnout is conceptually distinct from depression, is a major driver of health impairment in the domains of depressive symptoms and work ability, and may also be associated with cognitive slowing. These findings recommend more research on interventions to prevent the conversion of acute job strain from PWC to chronic burnout, which may have downstream benefits for reducing depressive symptoms and improving work ability. Increased monitoring of workplace psychosocial strains is also recommended. This study was part of a collaborative project with the Federal Institute for Occupational Safety and Health (BAuA), which included use of measures common to studies conducted by the BAuA in Germany, thereby providing needed validation in a U.S. occupational sample. These two countries have robust business relationships that could be further strengthened with shared objectives for occupational health. The current collaborative project provides an example of research that can benefit the health of workers of both countries.

Keywords: depression, burnout, cognition, information, processing speed, psychosocial working conditions, nursing

Zum Zusammenhang zwischen psychischen Belastungen am Arbeitsplatz, Depression und kognitiven Defiziten

Kurzreferat

Das Thema der psychischen Beeinträchtigungen und Störungen im Arbeitskontext ist für die Arbeitssicherheit und den Gesundheitsschutz sehr wichtig, besonders wenn psychische Belastung am Arbeitsplatz zu Depressionen und Beeinträchtigungen der Arbeitsfähigkeit führt. Zu den Faktoren, die potentiell zur Entstehung von Depressionen und Beeinträchtigungen der Arbeitsfähigkeit führen, gehören psychosoziale Arbeitsmerkmale, Burnout, kognitive Defizite und das Altern. Mit Bezug auf das Job-Demand-Resources-Modell, JD-R, mediiert Burnout die Beziehung zwischen psychosozialen Arbeitsmerkmalen und depressiven Symptomen, jedoch muss dessen vermittelnde Rolle für den Zusammenhang zwischen psychosozialen Arbeitsmerkmalen und der Arbeitsfähigkeit noch überprüft werden. Ferner können kognitive Defizite ein Kennzeichen für chronisches Burnout, Depressionen und Einschränkungen der Arbeitsfähigkeit sein. Das vorliegende Projekt, das auf einer Stichprobe von 402 berufstätigen Krankenpflegenden eines großen, privaten medizinischen Zentrums in den USA basiert, untersuchte, wie diese Faktoren in Beziehung zueinander stehen. Zum ersten Messzeitpunkt beantworteten die Studienteilnehmer Fragen zu psychosozialen Arbeitsmerkmalen, Burnout, depressiven Symptomen, kognitiver Leistungsfähigkeit und Arbeitsfähigkeit. Zusätzlich wurden Folgeerhebungen dieser Faktoren (mit Ausnahme der kognitiven Leistungsfähigkeit) über einen Zeitraum von 12 Monaten durchgeführt. Die Ergebnisse bestätigten das JD-R-Modell dahingehend, dass Burnout den Zusammenhang zwischen psychosozialen Arbeitsmerkmalen und chronisch depressiven Symptomen vermittelte. Umgekehrt fungierten depressive Symptome jedoch nicht als Mediator zwischen psychosozialen Arbeitsmerkmalen und chronischem Burnout. Außerdem war schweres Burnout mit geringerer geistiger und körperlicher Arbeitsfähigkeit über einen Zeitraum von 12 Monaten assoziiert, wohingegen depressive Symptome nur die geistige Arbeitsfähigkeit beeinflussten. Kognitive Leistungsfähigkeit wies keine eindeutigen Beziehungen zu Burnout, depressiven Symptomen und Arbeitsfähigkeit auf, jedoch wurde eine verlangsamte Reaktionszeit in Verbindung mit Burnout sowohl bei Querschnitt- als auch bei Längsschnitt-Messungen beobachtet. Altern ging allgemein mit vermindertem Burnout und depressiven Symptomen einher, jedoch waren ältere Arbeitskräfte mit zunehmenden Burnout-Symptomen anfälliger für Beeinträchtigungen der Arbeitsfähigkeit. Diese Ergebnisse zeigen auf, dass Burnout sich konzeptuell von Depression unterscheidet, einen wichtigen Treiber für gesundheitliche Beeinträchtigung auf dem Gebiet der depressiven Symptome und Arbeitsfähigkeit darstellt und auch in Verbindung mit kognitiver Verlangsamung gebracht werden kann. Die Ergebnisse sprechen für einen erhöhten Bedarf an Interventionsforschung zur Prävention von Fehlbeanspruchung in Richtung chronisches Burnout bei akuter Arbeitsbelastung. Derartige Maßnahmen könnten auch vorteilhaft sein für die Verringerung depressiver Symptome und die Verbesserung der Arbeitsfähigkeit. Eine verstärkte Überwachung psychosozialer Belastungen am Arbeitsplatz ist zu empfehlen. Diese Studie war Teil eines Projektbündels der BAuA, die mit dieser vergleichbare Messinstrumente einschloss und somit die notwendige Validierung anhand einer betrieblichen Stichprobe aus den USA lieferte. Die beiden Länder unterhalten stabile Beziehungen, die mit gemeinsamen Projekten zur Gesundheit am Arbeitsplatz weiter verstärkt werden können. Das aktuelle Gemeinschaftsprojekt stellt ein Beispiel für Forschung zum Nutzen der Gesundheit der Arbeitnehmer beider Länder dar.

Schlagwörter: Depression, Burnout, Kognition, Informationsverarbeitung, Verarbeitungsgeschwindigkeit, psychosoziale Arbeitsbedingungen, Krankenpflege

1 Introduction

1.1 Depression as an occupational health risk

Depression is a major public health threat that has become the world's leading cause of global disability (WORLD HEALTH ORGANIZATION, 2017). Worldwide, depression is the most prevalent single mental disorder (MURRAY et al., 2013), and has increased 18% in prevalence from 2005-2015 (WORLD HEALTH ORGANIZATION, 2017). In Europe, depression is estimated to account for 15% of all days lived with disability (WORLD HEALTH ORGANIZATION, 2012). The health issues associated with depression include increased risk for stroke, cardiac disease, diabetes, and multiple pain-related conditions (GOODWIN, 2006; GOLDEN et al., 2008) as well as increased mortality over the lifespan (CARNEY et al., 2002; CUIJPERS et al., 2013). As with health, the economic costs of depression are also a significant disability; for instance, depression in 2004 was estimated to cost the European economy € 188 billion, which was equivalent to 1% of Gross Domestic Product (SOBOCKI et al., 2006). Over half this cost was estimated as due to indirect costs including absenteeism and disability pensions (OLESEN et al., 2012). In Germany, lost days of work due to mental or emotional distress (anxiety, burnout, depression) were estimated to cost the economy € 9 billion per year (NINK, 2016). In the U.S. economy, depression was estimated to cost $210.5 billion in 2010, with 50% of this figure attributed to workplace costs (GREENBERG et al., 2015). Symptoms associated with depression can potentially affect multiple aspects of worker health and safety, including cognitive functions, decision-making, motivational performance, and interpersonal interactions. The workplace safety issues associated with depression include errors, accidents, and injuries on the job (STEWART et al., 2003; ADLER et al., 2006). From an employer perspective, depression is associated with absences, reduced productivity and increased attrition from the workforce (BECK et al., 2011). Thus, better understanding of factors that contribute to depression in the workplace could have important implications for public health, safety, and economic productivity.

1.2 Definition, prevalence, and demographics of depression

Depression reflects a mood state characterized by pervasive sad mood and low response to positive stimuli. A clinical diagnosis of Major Depressive Disorder (MDD) encompasses a range of symptoms that must include sadness or decreased interest (anhedonia), but may also include loss of concentration, psychomotor slowing, sleep disturbance, appetite disturbance, self-denigrating thoughts, and suicidality. According to DSM-V diagnostic criteria (AMERICAN PSYCHIATRIC ASSOCIATION, 2013), a diagnosis of MDD must include 5 of 9 symptom criteria, be present for at least 2 weeks, and not be explainable by another medical condition. In addition, the change in mood must cause a significant impairment in work or social function. Like

the DSM-IV-TR, the ICD-10 criteria for depression include depressed mood or anhedonia, but additionally include fatigability as a core symptom (WORLD HEALTH ORGANIZATION, 2004). In Europe, lifetime prevalence of MDD is approximately 10%, while in Germany the lifetime prevalence of MDD was estimated to be 11.5% with a 12-month prevalence of 5% (ANDRADE et al., 2003). In the U.S., the lifetime prevalence of depression has been estimated at 12% for men and 20% for women. Research across multiple countries has found the prevalence of depression is approximately twice as high among women compared to men (WEISSMAN et al., 1996; VAN DE VELDE et al., 2010). Worldwide, the highest prevalence rates of depression occur among individuals of working age (OORTWIJN et al., 2011). In the U.S., higher rates of depression are also found among individuals with fewer than 12 years of education, and at lower income levels. In the majority of studies in the U.S., (non-Hispanic) whites have higher prevalence of depression than individuals from black ethnic/racial groups (KESSLER et al., 2003; WILLIAMS et al., 2007). Studies have found that the number of individuals with subsyndromal depression is approximately comparable to the rates of those with MDD (PIETRZAK et al., 2013), which highlights both the prevalence and potential health burden of depressive symptoms generally, irrespective of formal diagnosis. For the purposes of the current report, unless otherwise specified, we use the terms depression and depressive symptoms to characterize broadly the state of elevated mood symptoms rather than the formal diagnosis entity. We deem this appropriate based on evidence that sub-diagnostic levels of depressive symptoms also impair health (CUIJPERS et al., 2013), and work performance (BECK et al., 2011), and are a robust predictor of future diagnosis of MDD (PIETRZAK et al., 2013).

The objective of the current project is to better understand multiple factors that contribute to depression in the workplace, and how depression and these associated factors influence the ability to work. This starts with a review of current theory and research regarding these factors, with a specific focus on psychosocial job stressors, burnout, and cognition, and the interrelationships among these factors. Finally, we discuss the relevance of these findings to older workers.

1.3 Job stressors

While the etiology of depression is multifactorial in the broader lives of many individuals, depression in the workplace is often precipitated by job-related stressors (EU-OSHA, 2014). Stress levels related to work have been adversely influenced by several major changes in the economies of developed countries, including globalization of trade, deregulation of labor practices, and the growth of information- and service-based sectors. Technological advances have driven many improvements in the rate and efficiency of work output, and with corresponding reductions in labor. As argued by SPARKS and colleagues (SPARKS et al., 2001), the transformation of the global workplace has resulted in higher work-related demands, less worker autonomy, decreased managerial support, and more job insecurity. For instance, the trend toward leaner, more efficient workforces often necessitates more work output from fewer individuals, with fewer positions for managerial support. Technology can more closely track, predict, and control production activities, which can result in

changes that limit worker autonomy in decision making. There has also been a shift from manufacturing jobs toward information and service-oriented jobs, many of which are characterized by irregular and part-time schedules, lack of health and vacation benefits, and temporary work contacts, all of which increase job insecurity. As will be discussed further in subsequent sections, each of the factors discussed by SPARKS and colleagues has been associated with depressive symptoms. Although there is general agreement that specific psychosocial work characteristics (PWC) contribute to stress-related emotional disorders, there is still disagreement on what unifying characteristics explain these associations. Several models have been presented to explain the dynamics existing among PWC and emotional health. Two of the most influential models are the Job Demand-Control model and the Job Demands-Resources model.

1.3.1 Conceptualizations of job characteristics and stress

1.3.1.1 Job Demand Control (JDC) model

Perhaps the most influential model of job stress is the Job Demand-Control (JDC) model (KARASEK et al., 1981; KARASEK & THEORELL, 1990), which is typically assessed with the Job Content Questionnaire (JCQ: KARASEK et al., 1998). The assumption of the JDC model is that characteristics of the job itself are the main source of stress. The key constructs in this model are psychological job demands and job control. Psychological Demands reflect the pace and workload of the job, such as whether there is sufficient time to do the work, whether the pace is too fast, and whether there are conflicting demands placed on the worker. The Decision Latitude of a job is reflected in a combination of Skill Discretion and Decision Authority. Skill Discretion reflects the variety and creativity inherent in the job tasks, while Decision Authority reflects the worker's opportunity to make decisions about how to coordinate and execute the job tasks. Combining the dimensions of Psychological Job Demands and Decision Latitude produces four categories of job stress: 1) high strain (high demand, low control), 2) passive (low demand, low control), 3) active (high demand, high control), and 4) low strain (low demand, high control). Within the strain hypothesis of the JDC model, high strain jobs are most likely to be associated with physical and mental illnesses.

The JDC model came to prominence over three decades ago because of the association between high strain jobs and cardiovascular disease (KARASEK et al., 1981; PIEPER et al., 1989), but the JDC model has increasingly been studied with respect to mental health. One systematic review by (BONDE, 2008) found that high job strain in the JDC model was consistently associated with increased risk of depression. Specific studies find this association to hold across countries, including Germany (DRAGANO et al., 2008), United States (MAUSNER-DORSCH & EATON, 2000), Canada (WANG et al., 2009), Finland (AHOLA et al., 2006), and Japan (INOUE et al., 2010). A large cohort of 7732 workers from the Whitehall II study was examined for the association between JDC-based job strain and MDD risk over 10 years, and found that repeated job strain was associated with a 2.19 odds ratio of MDD risk, based on the presence of high job strain in 2 of 3 timepoints assessed (STANSFELD et al., 2012). There is also evidence of a protective benefit of higher

job control, which is associated with lower rates of long-term sick leave due to depression (CLUMECK et al., 2009; INOUE et al., 2010).

Subsequent work on the JDC model led to the addition of a support dimension that functions as a moderator of job strain, which is described as the Demand-Control-Support Model (JDCS). In the updated JDCS model, supportive relationships with supervisors and coworkers serve to buffer the negative effects of high strain jobs (JOHNSON & HALL, 1988). Thus, according to this hypothesis, jobs with the combination of high demand, low control, and low social support ("isostrain") have the greatest risk for adverse outcomes. For instance, a study of Norwegian workers (N = 5562) found that the combination of these factors in the isostrain model had a stronger association to cross-sectional depression symptoms than demand, control, or support alone (SANNE et al., 2005). A study in a Canadian sample (N = 7,484) found that low social support was associated with greater psychological distress (VERMEULEN & MUSTARD, 2000). In the previously referenced study on JDC job strain by STANSFELD and colleagues, there was also a finding that low social support was associated with an odds ratio of 1.6 for MDD over a 10-year follow up (STANSFELD et al., 2012). Because the JDC model is used more than the JDCS model, we will use the acronym JDC to describe the general model, unless support is a specific component of the referenced study.

1.3.1.2 Job Demands-Resources (JD-R) model

There are limitations to the fact that much of the research on stress associated with PWC is based on measures reflecting the JDC model. The main limitation is that a focused theory of job strain like JDC overlooks other relevant PWC that are not included in the specific theoretical model. As a result, a restricted theoretical model like JDC may be limited in capturing the full range of determinants of job stress as they relate to mental health outcomes. This is reinforced by RUGULIES and colleagues (RUGULIES et al., 2006), who found that a range of specific PWC contributed to the incidence of severe depressive symptoms over five years, including quantitative demands, influence at work, job insecurity, possibilities for development, and social support at work. One model of job stress that fits this more multi-dimensional approach is the Job Demands-Resources (JD-R) model (DEMEROUTI et al., 2001). This model theorizes a dynamic balance between job demands and job resources (DEMEROUTI et al., 2001; BAKKER & DEMEROUTI, 2007). Job demands reflect characteristics of the work that require sustained physical or psychological effort, and which can result in physical or psychological costs when this effort is overtaxed. Job resources are characteristics that aid in the management of demands, help achieve work goals, or promote personal growth and learning. Job resources are presumed to offset or buffer job demands, but can also independently foster work engagement. The theoretical model supporting the JD-R framework assumes two processes: one, an energy depletion process that occurs when high job demands exhaust emotional, cognitive, and physical reserves; and two, a motivational process, in which the lack of resources to offset job demands leads to disengagement from work goals (SCHAUFELI & BAKKER, 2004). Although the JD-R model is broadly consistent with the Job-Demand-Control model (KARASEK, 1979; KARASEK & THEORELL, 1990), it is not restricted to a limited range of PWC specified by JDC theory. Rather, the JD-R approach incorporates a broad range of

job demands and job resources, which can occur on personal, social, and organizational levels. The JD-R assumes each workplace has a distinct work culture that contributes to employee well-being, and the flexibility of the JD-R framework allows it to be tailored to a greater variety of work settings than if the definitions of job demands and job resources were more narrowly specified (SCHAUFELI & TARIS, 2005)

The initial presentation of the JD-R framework (DEMEROUTI et al., 2001) argued that chronic high job demands, in the absence of adequate recovery, lead to the depletion of physical and psychological (i.e., emotional and cognitive) resources. In addition, a lack of job resources was viewed as interfering with the fulfillment of job demands, leading to a withdrawal of motivational energy as a protective strategy, otherwise described as disengagement. The broad distinction in this model is that sustained high job demands are associated with exhaustion, whereas sustained lack of resources are associated with disengagement (BAKKER et al., 2004; BAKKER et al., 2005). In addition, to these “main effects” (SCHAUFELI & TARIS, 2014), the JD-R model predicts that high levels of job resources may buffer the association of high job demands to exhaustion (BAKKER et al., 2005). In support of this, research studies found significant interactions between job demands and job resources in the theorized direction in approximately 60% of cases (BAKKER et al., 2005; XANTHOPOULOU et al., 2007); however, the size of these interactions in practical terms was often small to negligible. In addition, a comprehensive study by Hu and colleagues (HU et al., 2011) found that the interaction of job demands and job resources on burnout added little beyond the simple additive effects.
The initial conceptualization of JD-R framework was subsequently revised to provide a clearer distinction among the associations of job demands and resources to the outcomes of burnout and disengagement (SCHAUFELI & BAKKER, 2004). In the revised framework, burnout is a unitary construct representing a health impairment process that can be caused by energetic depletion from chronic high job demands and low job resources, and which can lead to adverse health outcomes including depression (SCHAUFELI & TARIS, 2014). Further, burnout is hypothesized to mediate the association between job characteristics and health impairment outcomes like depression. The revised JD-R reframed the concept of “disengagement” to “work engagement” to represent a motivational process that is theorized to be related to organizational outcomes like job turnover, and which is posited to be less directly related to depression and adverse health outcomes. In this revision, high job demands are theorized to be more strongly related to burnout, with additional weaker contributions from low job resources. In contrast to burnout, work engagement is strongly related to job resources, but not to job demands. Given that engagement is theorized to be related to organizational outcomes rather than personal health outcomes like depression, the current study will focus predominantly on 1) the exhaustion-burnout dimension of the JD-R model, 2) its association to job demands and job resources, and 3) whether burnout has a mediating role in how these factors are related to depressive symptoms

1.3.2 Major approaches to the conceptualization of burnout

Burnout has been described as a behavioral reaction resulting from the cumulative effects of stressors in the workplace (DEMEROUTI et al., 2001; MASLACH et al.,

2001; SHIROM, 2003). The prevalence of mild burnout symptoms (i.e., experienced monthly) was estimated at 25.2%, with severe burnout (i.e., symptoms experienced once a week or daily) estimated at 2.4%, (AHOLA et al., 2006). Burnout is also associated with adverse work and worker-health outcomes, even after controlling for mental disorders and physical illness (AHOLA et al., 2009; FRAGOSO et al., 2016). Among the first and most enduring models of burnout has been articulated by MASLACH and colleagues (MASLACH et al., 2001), while a more recent model has been proposed by DEMEROUTI and colleagues in the context of the JD-R model (DEMEROUTI et al., 2001). While the current project utilizes the JD-R model of burnout rather than MASLACH'S model, it is important to discuss similarities and differences between the two.

1.3.2.1 Maslach´s model of burnout

MASLACH and her research colleagues conceptualize burnout as consisting of three key dimensions: 1) exhaustion, 2) detachment and cynicism, and 3) inefficacy (or reduced personal accomplishment). In this model, exhaustion is the central quality of burnout, defined as a "feeling of being overextended and depleted of one's physical and emotional resources." (MASLACH et al., 2001), pg. 399). The central role of exhaustion is consistent with other models (DEMEROUTI et al., 2001; SHIROM, 2003); however, MASLACH argues that exhaustion alone does not capture the important dimension of how individuals perceive their relationship to their work. If the work context engenders exhaustion, the individual modulates their relationship to their job by creating emotional distance from the stressor, such as via detachment. Inefficacy may be related to either exhaustion or detachment, and is portrayed as a reaction to the realization that his or her performance or relationship to the work is non-optimal. It is characteristically expressed as a sense of reduced personal accomplishment and a negative evaluation of one's work.

1.3.2.2 The JD-R model of burnout

An alternative model of burnout is articulated within the Job Demands-Resources (JD-R) framework. This model has been articulated by a group of collaborating researchers (DEMEROUTI et al., 2001; BAKKER et al., 2004; SCHAUFELI & BAKKER, 2004). As previously mentioned, evolution of the JD-R has come to include both burnout and work engagement outcomes, with the former reflecting a health impairment process and the latter reflecting a motivational process. The current research, however, is focused on the health impairment process. This model postulates that the conditions of high job demands combined with limited job resources lead to chronic energy depletion and decline in motivational energy. In this model, burnout is an endpoint of the health impairment process, which can include both emotional exhaustion and disengagement (BAKKER & DEMEROUTI, 2007). Whereas MASLACH's model emphasizes affective exhaustion (MASLACH et al., 2001), the JD-R model incorporates physical and cognitive exhaustion as well (DEMEROUTI et al., 2010). Disengagement reflects emotional distancing from work, along with a negative attitude toward one or more aspects of one's job. In the JD-R model, the one of the key precipitants of burnout is chronic high job demands. In

early conceptualizations of the JD-R, higher levels of job demand were assumed to be associated with higher levels of exhaustion, whereas lower job resources were assumed to be associated with higher levels of disengagement. Overall, the JD-R model posits a more direct and specific relationship between job characteristics and burnout than does MASLACH's model. In the current project, we focus on the exhaustion component of the JD-R burnout model rather than both exhaustion and disengagement, based on a systematic review defining exhaustion as the core component of burnout (SEIDLER et al., 2014).

1.4 The relationship between burnout and depression

There is emerging evidence suggesting causal and temporal relationships between burnout and depression. In examining the relationship between burnout and depression, studies have found both similarities and differences in their etiology, context and symptoms. Whereas both burnout and depression are linked to stressors, burnout is theorized to be context-dependent to occupational stressors (MASLACH et al., 1996; MASLACH et al., 2001), while depression is theorized to be context-free. Burnout is theorized to consist of the core symptom of exhaustion, or the sense of being energetically depleted by job demands (SEIDLER et al., 2014). In MASLACH's model, the depletion is conceptualized as primarily emotional in nature (MASLACH et al., 1996), whereas in the JD-R model exhaustion can take the form of emotional, cognitive, and physical depletion (DEMEROUTI et al., 2010). This multidimensional symptom pattern is similar to some depression features, such as fatigue, concentration problems, loss of motivation, and sleep problems (GROSSI et al., 2015). Yet burnout and depression are conceptualized by several symptoms that do not overlap, in part due to the context in which they are presumed to occur. For instance, burnout remains a syndrome reflecting behavioral exhaustion and a withdrawal response from stress at work (DEMEROUTI et al., 2010); as such, the symptoms do not typically extend to outside hobbies and activities, or to social and interpersonal functioning outside of work. In addition, symptoms of work-related disengagement and cynicism are not central to the diagnosis of depression. Depression, on the other hand, includes more extreme emotional symptoms including debilitating sadness, extensive loss of positive emotion, pervasive feelings of guilt and worthlessness, agitation, and suicidality (AMERICAN PSYCHIATRIC ASSOCIATION, 2013). Consistent with these differences, studies confirm the dimensional distinction of these conditions (BAKKER et al., 2000) and demonstrate that variance in depression is only partly explained by exhaustion-related and depersonalization burnout (26% and 13%, respectively; SCHAUFELI & ENZMANN, 1998). Another study found 20% shared variance between burnout and depression, which was not based on overlapping items in the measurement of these two constructs (MCKNIGHT & GLASS, 1995). This supports that burnout is not merely as subtype of depression occurring within the context of work. Though cross-sectional studies generally have found depression and burnout to be related (BIANCHI et al., 2015), longitudinal research is important to understanding whether and how burnout influences the development and persistence of depression in the workplace.

To date, a limited number of studies have examined the longitudinal relationship between burnout and depression (MCKNIGHT & GLASS, 1995; AHOLA & HAKANEN, 2007; HAKANEN & SCHAUFELI, 2012; TOKER & BIRON, 2012; ARMON et al., 2014). Studies assessed burnout and depression over timeframes ranging from 18 months to 5 years. Two studies used structural equation models to examine cross-lagged relationships between burnout and depression symptoms, in which exhaustion and depersonalization domains were included as a latent variable (MCKNIGHT & GLASS, 1995; HAKANEN & SCHAUFELI, 2012). Both studies found stronger support for burnout preceding depression than the converse of depression preceding burnout; however, the evidence for a temporal sequence between the two conditions was equivocal (MCKNIGHT & GLASS, 1995). Two other studies focused on the exhaustion dimension of burnout only, with respect to its association to depressive symptoms. One study found that increased burnout symptoms from Time 1 to Time 2 increased depression symptoms from Time 2 to Time 3 over a period of 5 years (TOKER & BIRON, 2012); moreover, this study found a reciprocal effect for depressive symptoms on burnout symptoms over the same lagged period, and that the effects were of comparable magnitude in both directions (i.e., burnout preceding depression and depression preceding burnout). Another study followed 4,861 individuals over 18 months, and found that burnout increased depressive symptoms in two groups of individuals: those with chronic medical illnesses, and those without (ARMON et al., 2014). They found that the association between burnout and depressive symptoms was stronger among those with chronic medical illnesses. These findings are in contrast to the studies by MCNIGHT et al. (MCKNIGHT & GLASS, 1995) and HAKANEN et al. (HAKANEN & SCHAUFELI, 2012), which did not find a reciprocal relationship between burnout symptoms and depressive symptoms. This could be explained by the use of the exhaustion dimension only by TOKER & BIRON and ARMON et al., which suggests a stronger association between exhaustion and depressive symptoms than for other dimensions of burnout.

While a modest number of studies have examined the longitudinal association between burnout and depression, even fewer have examined the longitudinal association from PWC to depression via burnout, in which the mediating role of burnout is a central construct of the JD-R model. The most definitive study to date (AHOLA & HAKANEN, 2007) tested whether job strain (operationalized as a quotient of JCQ job demand/job control) was associated with depression symptoms and mediated by burnout, as assessed by the MBI (weighted sum of the three scales). In this 3-year follow-up of Finnish dentists, the authors found that while a higher job strain ratio predicted depressive symptoms, the significance of the association disappeared when adjusting for the effects of burnout. When testing for reciprocity, they found that job strain predicted burnout, but was only partially mediated by depression symptoms; that is, high job strain leads indirectly to depression via burnout, whereas job strain leads directly to burnout and also indirectly via increased depression symptoms. Thus, this study supports the health impairment pathway of the JD-R model, but using a JDC-based measurement of job strain. This pathway model remains to be tested in a manner that accounts for the wider range of job demands and resources that is typically implied by the JD-R framework (i.e., a multi-dimensional model)

1.5 Psychosocial strain, mental health, and cognition

1.5.1 Cognition in the workplace

In a post-industrial economy, the increasing number of jobs related to technology, communications, and human services brings an increasing demand for cognitive flexibility among workers, relative to the manufacturing jobs that dominated the economy of the preceding century. Workers in these growth sectors are frequently required to rapidly hold multiple sources of information in attention, screen out competing or distracting information, and shift focus to redeploy cognitive resources to the next pressing demand. Cognitive functions generally have capacity limits, which can be taxed by excessive work demands. For instance, there is a long-held limit of 3-5 meaningful items an individual can maintain in working memory (COWAN, 2010). It has also been shown that switching between two cognitive tasks decreases the efficiency and accuracy in both tasks (DUX et al., 2009). When individuals are working close to the limits of their cognitive processing capacity, inefficiencies (e.g., slowness) or errors in performance are more likely to occur. While slowness and errors in some jobs may be a source of frustration to customers and workers, slowness and errors in the job of a nurse or safety officer could have more serious consequences.

In addition to potential safety concerns related cognitive overload, there is some evidence to suggest it may be a risk to individual well being. As we have reviewed in previous sections, excessive work demands can create job strain, which at extreme endpoints may have a lasting negative impact on cognition. To date, there are only a handful of studies that have examined the association between job strain and lifelong cognition. ANDEL and colleagues (ANDEL et al., 2011) used the JDC model to operationalize job strain in a prospective study of Swedish workers (N = 827); they found that low job control in midlife was associated with lower performance on a brief cognitive screening measure in late life, whereas having an active job was associated with better cognitive performance. SEIDLER et al. (SEIDLER et al., 2004) found in a German sample that intellectually challenging work, socially challenging work, and flexible work were associated with lower risk of dementia. Another study based on the JDC model (ELOVAINIO et al., 2009) evaluated the cumulative effects of job strain in the Whitehall II cohort (N = 4146), finding a broad negative association between cumulative high job strain and cognitive performance at mean time of 6 and 12 years post-exposure (including adjustment for depressive symptoms); however, this was significantly attenuated to a sole finding of lexical fluency after adjusting for employment grade. In another study based on the Whitehall II study (N = 4531), ELOVAINIO and colleagues (ELOVAINIO et al., 2012), also examined a more specific feature of job strain–organizational justice. In this study, they found that lower levels of organizational injustice in the two earliest study waves were associated with worse cognitive performance approximately 10-15 years later on measures of reasoning, vocabulary and verbal fluency, which was independent of occupational grade, depression, hypertension, and job strain. These studies suggest that job strain may contribute to a long-term health impairment process by which cognitive functioning may be adversely affected much in the same way job strain affects long-term physical health. One argument explaining these associations is that

chronic job stress precipitates conditions like burnout and depression, which under chronic conditions may deplete cognitive reserve. Projects that can examine the effects long-term job strain in working life over decades of time are rare, but there is important information to be gained from understanding the relationships among job strain, cognition, and mental health over shorter periods of time, particularly if this research can highlight factors that may respond to intervention.

1.5.2 Burnout and cognition

Within the context of the current project, it is important to review the potential effects of burnout on cognitive function. Research has found associations between subjective cognitive complaints and burnout symptoms (STENFORS et al., 2013). Research from the Bristol Health and Stress Study (N = 3,111) found that self-reported cognitive failures were related to self-reported work stress, and that cognitive failures themselves were associated with a higher rate of self-reported injuries on the job (WADSWORTH et al., 2003). BRIDGER et al. (BRIDGER et al., 2010) studied cognitive failures using the Cognitive Failures Questionnaire (CFQ: BROADBENT et al., 1982) in the Naval Service Stress Study (N = 791), and found that higher levels of job strain over a one-year period were associated with a higher self-report of cognitive failures. Both of these studies, however, suffer from method bias because associations between self-reported job strain and self-reported cognitive failures may be inflated by the shared method of self-report. This issue was addressed in a cross-sectional study by VAN DER LINDEN et al. (VAN DER LINDEN et al., 2005), who found that burnout was associated with both higher subjective complaints on the CFQ as well as objective decrements in performance on a test of sustained attention. In addition, higher subjective complaints were associated with more inhibition errors on the Sustained Attention to Response Test (SART), and greater performance variability on the Bourdon-Wiersma test, suggesting some ecological validity for self-reported cognitive failures on the CFQ as a possible indicator of cognitive deficits. The limitation to this study, however, is that it included a group of individuals across multiple occupations who were out of work due to burnout, and a comparison group from a single occupation who were functioning in the workplace.

Beyond subjective complaints, however, there is evidence that objectively assessed cognitive deficits are associated with a clinical diagnosis of burnout. SANDSTROM and colleagues (SANDSTROM et al., 2005) examined cognitive function cross-sectionally in a sample of 67 women treated for chronic burnout, compared with 15 healthy controls. Results found that the burned out group performed worse than the control group on a test of nonverbal memory (Rey Complex Figure) and on measures of auditory and visual attention (IVA test). Another study (OHMAN et al., 2007) examined 19 individuals on stress-related sick leave compared with 19 matched controls, finding deficits in episodic memory, attention/processing speed (Digit Symbol), working memory (Trail Making B), and letter fluency. OSTERBERG and colleagues (OSTERBERG et al., 2012) studied 65 burnout patients (meeting criteria for exhaustion disorder) and 65 matched controls, and found that the burned out group performed worse on an attentional task (WAIS Digit Symbol), but not other neuropsychological measures. OOSTERHOLT and colleagues (OOSTERHOLT et al., 2012) investigated cognition in pre- and post-treatment for burnout, with 16

patients and 16 matched controls. Results indicated that the patient group had baseline deficits on an updating-type test of executive function (2-back task), and no improvement in cognitive performance after 10 weeks of treatment, despite improvement in burnout symptoms during this interval. A study of 29 women on long-term sick leave due to burnout and 28 matched controls found the burnout group to have worse performance on tests of working memory (Digit Span); however, the results were confounded by comorbid depression in many members of the burnout group (RYDMARK et al., 2006). Finally, JONSDOTTIR and colleagues (JONSDOTTIR et al., 2013) took the condition of burnout a step further by defining a burnout-like clinical condition called exhaustion disorder (JONSDOTTIR et al., 2009; GLISE et al., 2012). Their study reported results on a group with a clinical diagnosis of exhaustion disorder (n = 33) compared to healthy controls (n = 37). The group with exhaustion disorder showed the greatest deficit on Digit Symbol, Digit Span, and an index of memory retention. As with the participants in the studies by RYDMARK et al. and OSTERBERG et al., these participants had severe burnout symptoms characterized by inability to maintain full time work and presence of comorbid depression in the study sample.

One major limitation of most extant studies of burnout and cognition is that the samples are composed of individuals who experienced burnout to the severity that they left their job, and in some cases converted to depression. In many cases, these studies did not control for depressive symptoms, which confounds interpretation of whether cognitive findings are related to depressive symptoms rather than burnout. The fact that mental health distress led to job disability speaks to the clinical severity of the underlying symptoms, and it is likely that cognitive performance may be different among individuals who experience burnout while capable of remaining on their jobs. In one of the two cognitive studies published to date on working individuals with burnout, VAN DER LINDEN and colleagues tested 13 burned out teachers (on disability leave), compared to 16 teachers who reported burnout and remained working, and to 14 controls (VAN DER LINDEN et al., 2005). They found a “dose dependent” effect of burnout on the SART measure of response variability (control > working burnout > work leave burnout), and that the disability burnout group was worse than the controls on SART inhibition, with no differences seen in the working burnout group. This study, however, did have the confound that the working burnout group also had higher depression scores than the control group.

The studies reviewed above indicate that it is important to better understand whether burnout symptoms among working individuals may have a unique association to cognitive performance, independent of depressive symptoms. These studies also show that careful methodological control for depressive symptoms and the ability to function at work are both important.

1.5.3 Depression and cognition

In the context of the current research project, it is important to review the cognitive features of depression, which have been studied more extensively than those of burnout. Research on cognitive deficits in MDD has shown that depressed individuals as a group tend to have worse performance relative to non-depressed comparison groups on a number of neuropsychological measures (VEIEL, 1997; ZAKZANIS et

al., 1998; MCDERMOTT & EBMEIER, 2009; LEE et al., 2012), with the most consistent deficits occurring in the domain of executive functions, which includes attentional switching (PAELECKE-HABERMANN et al., 2005; WAGNER et al., 2012), response inhibition (NAKANO et al., 2008; WAGNER et al., 2012), and working memory (Trivedi, 2014). In general, depressed individuals have been characterized as disproportionately compromised relative to nondepressed on tasks that are cognitively effortful, but they demonstrate less relative deficit on tasks that are "automatic" in nature (HARTLAGE et al., 1993; COHEN et al., 2001; HAMMAR & ARDAL, 2012). Although most studies compare acute depressed individuals with MDD to never-depressed control samples, there is some evidence that individuals remitted from depression perform modestly worse than never-depressed controls (PAELECKE-HABERMANN et al., 2005), though in some cases differences are found only on select measures (NAKANO et al., 2008). Studies do reveal important areas of variability, such as findings that older individuals with MDD demonstrate more deficits than younger individuals with MDD (BOONE et al., 1995; ELLIOTT, 1998; SCHWEITZER et al., 2002). With respect to severity and chronicity of depression, studies finding that differences relative to controls are smaller and more equivocal among individuals with mild compared to severe depression symptoms (MCDERMOTT & EBMEIER, 2009), and among individuals with fewer prior MDD episodes compared to those with more (PAELECKE-HABERMANN et al., 2005). In fact, one systematic review found that cognitive performance of individuals with only a single episode of MDD was not significantly different from controls, but that deficits were more consistently found with increased number of episodes (HASSELBALCH et al., 2012).

The evidence regarding depression and cognitive function provides some context to the research regarding burnout and cognitive function. It suggests that symptoms may need to be severe to produce significant changes in cognition, and further supports arguments that cognitive deficits identified in burnout groups had a severity of symptoms akin to, or overlapping with, MDD. In addition, cognitively affected individuals in many studies were often on work leave or disability, which underscores the severity of their symptoms. Little research has been devoted to whether subsyndromal levels of depressive symptoms affect cognitive performance, and few studies have focused on cognitive function among individuals who remain working with symptoms of burnout or depression. This is important, however, in light of findings that chronic emotional disturbance is associated with a higher likelihood of cognitive deficits, and highlights the importance of early intervention on burnout or depressive symptoms.

1.5.4 The argument for studying executive functions

The preceding review included a trio of cognitive processes that appear to be most vulnerable to symptoms of burnout and depression, and which have been collectively characterized as executive functions. Executive functions is a term that is frequently used to describe a set of higher order cognitive processes, including adaptive responses to feedback or contingency changes, response inhibition, and working memory (CHAN et al., 2008). These processes function as a general purpose, top-down control mechanism for guiding instrumental human activity, including emotional control (PHILLIPS et al., 2003; OCHSNER & GORSS, 2005). Defining the nature of

executive functions has long been a point of contention in cognitive psychology and clinical neuropsychology (MONSELL, 1996). To address these diverging viewpoints, MIYAKE et al. (MIYAKE et al., 2000) used confirmatory factor analysis to determine a parsimonious taxonomy of executive functions, and found three separable factors of: 1) task switching (or shifting), 2) updating of working memory, and 3) response inhibition. This taxonomy remains generally accepted. As posed in this study, each individual factor represents a circumscribed lower order function that can be operationalized in a precise cognitive paradigm. Further, other evidence suggests that each factor is important to higher order executive abilities necessary for successful function in social and occupational domains (JEFFERSON et al., 2006), particularly after a major depressive episode (WOO et al., 2016). We will discuss each of the three factors in turn, along with findings related to burnout and depression

1.5.4.1 Task switching

Task switching is well reviewed in work by MONSELL and colleagues (ROGERS & MONSELL, 1995; MONSELL, 2003). It is defined as the ability to switch between task sets, and is seen as a central aspect of executive control (NORMAN & SHALLICE, 1986). Perhaps the most common explanation of task switching is disengagement from a task set that has become irrelevant to goals, along with active engagement of the task set that is currently goal-relevant. Task-switching is an important ability in complex workplaces, where multiple events require ongoing monitoring and action. The work style associated with this has frequently been referred to as “multi-tasking”; however, research has clarified that multi-tasking is actually task-switching (DUX et al., 2009).
A key parameter in task-switching paradigms is switching costs, which is presumed to measure cognitive rigidity due to difficulty abandoning a currently irrelevant task causing proactive interference (GAJEWSKI et al., 2010). Mixing costs, by contrast, reflect the ability to maintain multiple tasks in working memory. Generally, response to a task takes longer on a switch trial than a non-switch trial. Two studies examining burnout found no speed-differences in association with burnout (GAJEWSKI et al., 2017; SOKKA et al., 2017), however, one of these studies did find a higher error rate in severe burnout but not mild burnout (SOKKA et al., 2017). Task-switching deficits have been identified in depression using paper-and-pencil tasks (MEIRAN et al., 2011; DE LISSNYDER et al., 2012; POTTER et al., 2012), but a weakness of these types of measures is that they do not sufficiently isolate task-switching relative to other cognitive and motor processes in the task. Based on the widely used nature of the task-switching paradigm in cognitive psychology research, it is important to examine its association to symptoms of burnout and depression in the workplace.

1.5.4.2 Updating and monitoring (working memory)

Updating is part of the construct of working memory (SMITH & JONIDES, 1999). Updating requires the ability to monitor incoming information for task relevance, constantly refreshing the content of working memory by replacing old and irrelevant information with newer task-relevant information. This ability requires active

manipulation of working memory contents, as opposed to passive storage of information. As a general paradigm, an individual receives items to be recalled, followed by a second attention-demanding task between this initial encoding and its subsequent short-term recall. Reading Span (DANEMAN & CARPENTER, 1980) and Operation Span (TURNER & ENGLE, 1989) are common tasks used to assess this updating function, with Operation Span having more cross-cultural utility than Reading Span. As noted by Engle (ENGLE, 2001), working memory span is associated with performance of a wide range of higher order tasks, related to success in work and daily life, such as following complex directions, and interacting with more than one individual at time in the workplace. Working memory capacity is also strongly associated with fluid intelligence (ENGLE et al., 1999).

There were no studies we could find that examined the Operation Span paradigm in association with burnout symptoms. Several studies found deficits in burnout using neuropsychological tests that including updating demands (RYDMARK et al., 2006; OSTERBERG et al., 2009), though these findings may have been confounded by comorbid depression. There were also no specific studies we could identify on the Operation Span paradigm in depression; however, differences in depression are common with other updating-like measures, including Digit Span (HALVORSEN et al., 2012); and n-back (HARVEY et al., 2004; ROSE & EBMEIER, 2006). As with task-switching, Operation Span is a widely used paradigm in cognitive psychology research, and this is why it is important to study its association to symptoms of burnout and depression in the workplace.

1.5.4.3 Response inhibition

Response inhibition involves an individual's ability to deliberately suppress automatic or prepotent responses when irrelevant to a goal. The Stroop task is the most commonly used cognitive paradigm for the construct of inhibition. The original Stroop task (STROOP, 1935) is a paper-and-pencil task that required reading of words and naming of colors, followed by a condition in which the individual is presented with color names printed in different colors of ink, but rather than reading the words, the individual is asked to state the color of the ink in which the name is printed. This response requires inhibiting the more prepotent and automatic response of reading the name of the color word in order to produce the correct response of stating the ink color. Response inhibition is an important workplace ability. Inhibition processes help screen out irrelevant information that may result in errors in a distracting environment (KERNS et al., 2004). There were no studies we could find that associated higher job strain with lower inhibition performance in the absence of burnout. A few studies have found burnout to be associated with worse performance on the Stroop Test, but these groups had a clinical diagnosis of chronic stress or exhaustion disorder (OHMAN et al., 2007; OSTERBERG et al., 2012; JONSDOTTIR et al., 2013). Stroop inhibition deficits in depression are well established (GOHIER et al., 2009; HAMMAR et al., 2011; HASSELBALCH et al., 2012).

Much of the research on executive functions discussed in the review above comes from the neuropsychological research literature, which more commonly uses "paper-and-pencil" assessments of cognitive function, and which often engage multiple cognitive and motoric processes, such as visual scanning or motor praxis, which can

confound precise interpretation of the target process. Cognitive psychological paradigms are more often computerized and designed to isolate the target cognitive process from other confounding cognitive processes. In many cases, the outcome measure is based on reaction time, which can be measured reliably and is sensitive to differences on the order of milliseconds (ms). Unfortunately, the field of cognitive psychology less frequently undertakes research related to emotional or workplace behaviors, so the majority of research comes from paper-and-pencil measures used in more clinically oriented research. Examining burnout and depression with precise, computerized cognitive measures is a gap in current research knowledge that is important to address, as it may provide a more precise understanding of cognitive processes affected by symptoms of burnout and depression.

1.6. Work ability

One of the principal goals of occupational safety and health programs is to foster a healthy work environment, which can be reflected in the longevity of an individual's ability to work. To a degree, workers who have to leave employment due to mental or physical disability represent a failure of these programs. Work disability at any age is both a personal and social burden, but this has been an issue of increasing attention in developed countries, as population aging has increased dramatically due to gains in wealth and health over the last several decades. This has shifted the age dependency ratio such that fewer younger workers are supporting a greater number of retired individuals, and the challenging economics of this have compelled many countries to raise retirement and pension ages to encourage individuals to work longer. If one of the principal goals of occupational safety and health programs is to promote the longevity of healthy work, it is important to study factors that may undermine this goal. In the case of the current project, this entails understanding how psychosocial strains, burnout, depression, and cognition impact work ability.

Much of the research on understanding and promoting work ability uses the Work Ability Index (WAI). This widely used questionnaire assesses workers' perceived performance of their job relative to its mental and physical demands (TUOMI, 1998). Studies have found the WAI to predict multiple psychosocial and health outcomes, including increased healthcare utilization (BETHGE et al., 2015), retirement due to disability (ROELEN et al., 2014), and functionality and well-being in retirement (TUOMI et al., 2001). Research across countries and occupations has generally found work ability to decline with age, physical decrements, and chronic medical conditions (CAMERINO et al., 2006). One study in a sample of Brazilian civil servants (N = 600) reported lower WAI total score with increased age, female gender, non-white status, and education lower than university degree (GODINHO et al., 2016). Another Brazilian study, however, reported no age or gender differences on the WAI in a sample of workers in higher education (N = 360 (PADULA et al., 2012).

1.6.1 Psychosocial strain and work ability

Several studies have identified associations between psychosocial working conditions and work ability. In a systematic review conducted by VAN DEN BERG et al., a majority of studies found high psychological demands and low autonomy to be associated with lower work ability, both separately and in combination (VAN DEN BERG et al., 2009). Much of this research is consistent with a conceptualization of job strain either modeled on JDC theory or directly assessed by the JCQ (MAZLOUMI et al., 2012; GHARIBI et al., 2016); however, BERNBURG and colleagues (BERNBURG et al., 2016) used the Copenhagen Psychosocial Questionnaire (COPSOQ), which is often used in the context of a broad JD-R framework, and found that high quantitative demands were associated with lower work ability. For the most part, these studies reflect a broader construct of high psychological demands (e.g., pace, workload, deadlines, competing demands) that are similar across the major models of job stress. In addition to these more conventional demands, studies have also found that higher levels of job insecurity are associated with lower levels of work ability (NUBLING et al., 2006; MAZLOUMI et al., 2012). Specifically in the construction of the COPSOQ, quantitative demands are regarded as a stressor in the context of workplace tasks, while job insecurity is regarded a stressor at the level of individual person-work interface (KRISTENSEN et al., 2005).

The majority of studies reviewed support the notion that high levels of adverse psychological job demands are detrimental to work ability, but fewer have studied the beneficial role of job resources, as would be proposed from the JD-R framework. Unfortunately, few studies have directly examined work ability from the perspective of the JD-R framework, but some studies looking at analogous resources support the conceptualization that the availability or job resources is beneficial to work ability. For instance, one study focusing on co-worker and supervisor support from the JCQ found that higher levels of these resources were associated with better work ability (MAZLOUMI et al., 2012). Another study used the Health and Safety Executive instrument (HSE) and found that the resources of better managerial support and greater clarity of job roles were each associated with higher work ability (GHARIBI et al., 2016). In a different study using the HSE, GUIDI and colleagues found that greater control, role (clarity), and the organization's ability to communicate and manage change were associated with higher work ability (GUIDI et al., 2012); however, in contrast to GHARIBI et al., managerial support was not significant.

A study by AIRILA et al. is especially pertinent to the current research (AIRILA et al., 2014). They tested a structural equation model that found baseline work engagement to mediate the association between job resources (operationalized as supervisory relations, interpersonal relations, task resources) and work ability 10 years later. Of note, the job resources latent variable had a direct relationship to predicting work ability when alternate models were evaluated. The pertinence of this study to the current project is that while AIRILA et al. tested the motivational/work engagement pathway of the JD-R framework, limited research has been done to test the exhaustion-burnout/health impairment pathway

1.6.2 Mental health and work ability

While there have been a number of studies examining the role of psychosocial job stressors on work ability, there are been fewer studies on the psychological conditions that arise from stress, namely, burnout and depressive symptoms. As mentioned in prior sections of this report, burnout is associated with multiple adverse health outcomes, including heart disease (TOKER et al., 2012), diabetes (MELAMED et al., 2006), and depression (HAKANEN & SCHAUFELI, 2012). Several studies have found burnout at varying levels of severity to be associated with poor work ability, but many have been cross-sectional (for example, RUITENBURG et al., 2012; FRAGOSO et al., 2016). Only a few studies have examined the association between depressive symptoms and work ability. A cross-sectional study of Brazilian civil servants found the presence of significant depressive symptoms to be strongly associated with lower work ability (GODINHO et al., 2016). Another cross-sectional study of Thai workers found that higher depressive symptoms were associated with lower work ability among men, but not among women (KAEWBOONCHOO et al., 2011). There is a paucity of non-cross-sectional studies, but one longitudinal study of individuals with work dysfunction and comorbid psychiatric disorders (mood and anxiety) examined changes in work ability following psychotherapy and psychoanalysis treatments (KNEKT et al., 2011). The study found that both types of treatment were associated with reduced depression symptoms and improved work ability, with relatively better outcome over five years for the psychoanalysis treatment

1.6.3 Cognition and work ability

Research is sparse on the association of cognitive performance to work ability. One cross-sectional study of nurses (N = 750) examined the association between WAI and perceived cognitive failures (CFQ), finding that a lower work ability was associated with higher perception of cognitive failure (ABBASI et al., 2016). The limitation to this study is method bias, in that the CFQ is a subjective measure, as are parts of the WAI. Another study, which was cross-sectional and examining Korean workers in a heavy industry sector (N = 100), found a modest zero-order correlation between higher WAI total score and performance on a brief mental status measure (CHUNG et al., 2015). The weakness of this study was the relatively older age of the sample, with a mean age of 57.8 and narrow age range of 55-60. The generalizability of such a sample appears limited by both age and occupational sector, as well as a limited statistical analysis.

1.6.4 Psychological versus physical dimensions of work ability

Clinicians generally assess the WAI as a total score and researchers have generally considered this measure to be a unidimensional scale; however, research suggests that the WAI consists of more than one dimension. In one such study (conducted with support from the BAuA), MARTUS and colleagues (MARTUS et al., 2010) examined a sample of German workers from different occupational groups, and found marked improvement in a bi-dimensional solution consisting of subjective and health-related work ability. Similar dimensionality was reported in the European Nurses' Early Exit

(NEXT) Study (RADKIEWICZ et al., 2005), wherein the authors found a two-dimensional solution in 8 of 10 European countries. These studies suggest a psychological dimension of work ability that includes a subjective appraisal of work ability and mental resources, and a physical dimension of work ability that includes an objective characterization of health based on accumulated medical conditions and injuries. For the purposes of the current project, we refer to these as psychological and physical dimensions, respectively. Given that there is evidence of at least two dimensions of work ability, it is important to examine this further, as the effects of PWC, burnout, depressive symptoms, and cognition, could have different influences on these individual dimensions. There is limited information on how a bi-dimensional model of work ability is associated with these factors, and this is an important research gap to address because it could indicate different interventions for psychological versus physical dimensions of work ability.

1.7 The older worker

A range of demographic and social factors are leading to a “graying” labor force in many countries. The global workforce includes a larger proportion of older workers than ever, and those numbers are increasing (TOOSI & TORPEY, 2017). The aging shift in the workforce is attributable to factors including better health, increased life expectancy, and lower birth rates. Over time, these factors have led to higher age-dependency ratios, and resulting increases in the age of entitlement to retirement benefits (SOCIAL SECURITY ADMINISTRATION, 2016). Consequently, labor force participation after age 65 continues to rise in developed economies including Europe and the U.S. (HE et al., 2016). Additionally, work and retirement trends indicate that individuals plan to work until later ages, including later retirement, phased retirement, and bridge employment (CAHILL et al., 2015; FISHER et al., 2016). These trends lead to important research questions regarding how to maintain work ability for an aging workforce.

2 Synthesis

The preceding review provides sufficient evidence to suggest that job stressors, burnout, depression, cognitive deficits, and reduced work ability may be interrelated, but by what mechanisms? A theoretical model often associated with job strain, burnout, and depressive symptoms is the Conservation of Resources Theory (COR (HOBFOLL & SHIROM, 2001); likewise, it can be extended to stress-related cognitive deficits and impaired work ability. COR theory posits that emotional, physical, and cognitive functioning can be seen as personal resources, which can become depleted when taxed by chronic stressors, such as high job demands and low job resources. Individuals with depleted personal resources are less resilient (and thus more vulnerable) to further resource depletion, which can lead to symptoms of chronic burnout and depressive symptoms, and in the longer term, to various forms of health impairment. This relationship of burnout and depressive symptoms to health impairment is well articulated by SCHAUFELI and TARIS in their critical review of the JD-R framework (SCHAUFELI & TARIS, 2014), however, COR theory is less well-developed with respect to cognitive function and work ability.

As it relates to COR theory, the preceding conceptualization of executive functions is that increases in the number and/or complexity of stressors entering the cognitive space (e.g., stressful ruminations, high work demands, fatigue, demotivation) require increased control to maintain stable cognitive performance. Whether excessive cognitive demands can substantively impair work ability is a matter that needs further research. On the one hand, KAHNEMAN argued in his seminal treatise on attention that it is difficult to significantly impair work-related cognitive performance, due to the human ability to maintain goal-directed attention when required (KAHNEMAN, 1973). On the other hand, some researchers have argued that this “protected” status of cognition can be compromised by an individual’s competing needs to preserve cognitive or emotional resources, consistent with COR theory (HOBFOLL, 1998), 1998). Similarly, as argued in HOCKEY’s theory of compensatory control (HOCKEY, 1997), which is often invoked with COR theory, individuals lacking sufficient reserve in an endogenous dimension, such as emotional energy (due to symptoms of burnout or depression), may suffer disproportionate decline in executive function performance when the exogenous dimensions of tasks (speed, accuracy, or complexity) become more demanding. Interestingly, HOCKEY cites KAHNEMAN’s classic work (KAHNEMAN, 1973) as support for the “energetic” dimension of his model, arguing that over an extended period, this cost may have physical and mental consequences, including “affective states, emotional stability, autonomic and endocrine activation, and low-priority behavioral activity (pg. 331).” Yet KAHNEMAN’s own writing seems to suggest a different interpretation. Whereas HOCKEY appears to be framing basic attentional and executive function processes as “low priority behavioral activity,” KAHNEMAN appears to be framing cognition as higher priority activity from which individuals can summon energetic reserves when required. If HOCKEY’s perspective is correct, then we would expect cognition to be affected by relatively low levels of cognitive stress, such as low levels of burnout and depressive symptoms, and possibly even from chronic high job demands alone. If KAHNEMAN’s perspective is correct, we would expect goal-directed cognition to be resilient to mild-to-moderate levels of emotional perturbation, and be affected only at the highest levels of

symptom severity, such as clinically significant burnout and depression. This would suggest that the degree of cognitive disruption may be conditional on the degree of disruption in mental health indicators, namely burnout and depressive symptoms.

To our knowledge, the debate between goal-oriented cognition as a robust versus a vulnerable function in the context of workplace stressors has not been adequately examined, including adequate subjective assessments of PWC and emotional states (burnout and depressive symptoms) in conjunction with objective assessments of cognitive performance. One logical idea extending from the COR theory is that cognitive deficits may be conditional on the level of resource depletion; that is, the severity of burnout and/or depressive symptoms. Another idea is that cognition itself may be a marker for the severity of resource depletion; that is, cognitive deficits may reflect the severity of resource depletion, and as such, they may be an indicator for the severity or chronicity of burnout and depressive symptoms over time.

With respect to cognitive aging, much research has demonstrated a broad reduction in intra-individual cognitive performance with healthy (non-demented) older adults across of range of cognitive abilities (SCHAIE, 1994; SALTHOUSE, 2001; SALTHOUSE, 2004; HULTSCH, 2010). Research shows that depending on the domain assessed, decline can occur starting from the late the 20's to mid-40's (SALTHOUSE, 2004; SINGH-MANOUX et al., 2012). These domains include consistent age-related deficits in executive functions of updating (VAN DER LINDEN et al., 1994; CHEN & LI, 2007), task switching (MEIRAN et al., 2001; REIMERS & MAYLOR, 2005), and inhibition (HASHER & ZACKS, 1988; UTTL & GRAF, 1997; HASHER et al., 2007). In the context of work, older adults who are experiencing normal age-related decrements in cognitive resources may be more susceptible to resource depletion at very high or sustained levels of job strain. This is consistent with findings that older workers experience more stress from high workloads and time demands (OSIPOW et al., 1985), and consequently need higher levels of job characteristics like job control and flexibility to cope with these demands (SHULTZ et al., 2010). Applied to COR theory, it can be proposed that cognitive control over stressful inputs requires additional recruitment of neural resources, and that this added neural demand has a greater energetic cost for the older individual relative to the younger individual. This, in turn, may result in greater cognitive deficits under conditions of job strain, burnout, and depression. On the other hand, the requirements of cognitive work for most individuals may be such that there is sufficient cognitive capacity to perform adequately with age, and that cognitive and attentional resources can be deployed when required (KAHNEMAN, 1973).

Additionally, the question of resource conservation in the context of work ability has not been adequately tested. COR theory would suggest that ongoing stress related to PWC, burnout, and depressive symptoms would compromise work ability over time, but is this depletion psychological, physical, or both? And is it greater with age? Knowing the answers to these questions may lead to better protection of personal resources tailored to psychological and physical domains specifically, with the goal of preserving work ability with age. And as with burnout and depressive symptoms, it is possible that cognitive deficits may be a marker of vulnerability for decreased work ability over time.

2.1 Basis for the current project

The subject of mental disorders and work is of high priority for occupational safety and health. The study of work-related causes of mental disorders and their consequences for employee performance is one of the major challenges of occupational health research. A connection between work and mental disorders is particularly seen in burnout and depression symptoms, in which there may be a reciprocal relationship. High job strain due to PWC may predispose individuals to depression via burnout. Individuals with high stress jobs have been estimated to have 1.5 times the depression rate of the general population (WULSIN et al., 2014). Depressed individuals report more cognitive lapses at work (ADLER et al., 2006), which makes depression a potential safety issue in certain job types, and a drain on productivity regardless of job type (STEWART et al., 2003).

There is evidence in the research literature that deficits in cognitive skills known as executive functions are adversely affected by burnout and depression (see section 1.5 above); an alternate argument extending from COR theory may be that deficits in these abilities predispose individuals to depression and burnout in the context of high job strain. At this point, it is unclear how the relations among burnout, depressive symptoms, and executive functions are influenced by PWC, and how this impacts work ability. We are interested in quantitatively estimating the direct and indirect associations that exist among PWC, burnout, depressive symptoms, executive functions, and work ability. Moreover, it is also important to know whether any potential relationships among these factors are differentially affected by aging. Additionally, our study aims to add a 12-month longitudinal component to a research literature characterized largely by cross-sectional designs. This will allow us to better identify possible causal relationships of PWC, burnout, and executive function deficits in predicting adverse outcomes of chronic depressive symptoms and reduced work ability.

2.1.1 Basis for collaboration

Collaboration between countries on the topic of occupational health, in this case the German BAuA and Duke University in the United States, is an important research strategy in a globalized workforce and economy. As of 2015, the U.S. was Germany's 4th largest supplier of goods, and its leading export market. In addition, German firms and their U.S. affiliates employ over 670,000 individuals in the U.S. (BUREAU OF EUROPEAN AND EURASIAN AFFAIRS, 2016). These shared economic ties could be further strengthened with shared objectives for occupational health. Unfortunately, many measures common to European occupational health research are not widely used in the U.S. The current project focuses on measures of PWC, burnout, depressive symptoms, cognition, and work ability that are common to other projects conducted by the BAuA, in the interest of harmonizing these measures for comparison of research questions across the two countries. The occupation chosen for the current study is nursing, which is relevant to both countries based on a shortage of qualified nurses to meet the needs of an aging population in both Germany (MAIER & AFENTAKIS, 2013) and the U.S. (NATIONAL CENTER FOR HEALTH AND WORKFORCE ANALYSIS, 2017). The rationale for nursing as a study

population is further discussed in section 3.1.1.1. Thus, research collaborations on occupational health between German and U.S. institutions will provide important benefits to the workers, public health, and economies of both countries

2.2 Research questions

The current project attempts to resolve several questions relating to psychosocial job strain and the chain of potential effects related to burnout, depressive symptoms, cognition, and work ability.

Research Question 1: What aspects of PWC (job demands and resources) contribute to depressive symptoms over time, and are they mediated by burnout symptoms?

This includes examining whether different profiles of PWC predict burnout and depressive symptoms, and whether job demands are moderated by job resources as predicted by the JD-R framework. Few studies have examined PWC, burnout, and depressive symptoms together longitudinally, and to our knowledge this would be the first to use the COPSOQ as a measure of PWC in these examinations.

Research Question 2: Is cognitive performance adversely affected by PWC, and if so, are the associations more pronounced for job demands or job resources?

If COR theory is correct, it would be important to know what types of job-related characteristics are most strongly associated with cognitive performance.

Research Question 3: Does cognitive performance predict emotional and physical resource depletion over time?

According to a stringent interpretation of COR theory, individuals who experience a decrement in executive functions in the context of acute burnout or depressive symptoms are exhibiting a weakness in their compensatory control, which may be marker for vulnerability to chronic depletion. In this project, we include emotional depletion as assessed by burnout, depressive symptoms, and psychological work ability. We include physical depletion as assessed by physical work ability.

Research Question 4: How do PWC, mental health, and cognitive performance relate to aging?

In an aging work force, it is important to understand how age may be related to PWC, and whether relationships of PWC to mental strain, cognition, and work ability are different in younger workers versus older workers. Maintaining mental health, cognitive health, and work ability may require different approaches depending on the age of the worker.

3 Methods

3.1 Design

The study design included cross-sectional assessment of all study variables, with longitudinal of assessment of burnout, depressive symptoms, and work ability. Assessment of psychosocial job stressors, burnout symptoms, depressive symptoms, cognition, and work ability were obtained at baseline, with a follow-up of selected measures of burnout, depressive symptoms, and work ability over a 12-month period. The initial visit was conducted in private testing rooms located in Duke Medicine facilities throughout the Raleigh-Durham area, located in the U.S., state of North Carolina.

3.1.1 Selection of subjects, recruitment, and compensation

We recruited 402 participants aged 25+, actively working in nursing field for at least 2 years. We recruited individuals who work within the Duke University Health System. Initial recruitment contact was by Email solicitation. Employee Email addresses were provided by nursing management at Duke after filtering for inclusion criteria. Recruitment was augmented by informational flyers posted around work facilities. For confidentiality purposes, nursing management at Duke was not informed about whether any specific individual participant enrolled in the study. Participants were compensated for the initial visit, and separately for completion of the 12 follow-up questionnaires. The completion rates for follow-up questionnaires appear in Table 3.1. The flowchart of recruitment appears in Figure 3.1. The study was approved by the Institutional Review Board of the Duke University Health System.

Table 3.1 Completion rates for monthly questionnaires

Follow Up	Sent	Completed	% Complete
Month 1	395	384	97.2
Month 2	398	390	98.0
Month 3	397	378	95.2
Month 4	401	377	94.0
Month 5	394	358	90.8
Month 6	393	348	88.5
Month 7	395	349	88.3
Month 8	395	344	87.0
Month 9	391	344	90.0
Month 10	391	3418	87.2
Month 11	391	335	85.7
Month 12	391	352	90.0

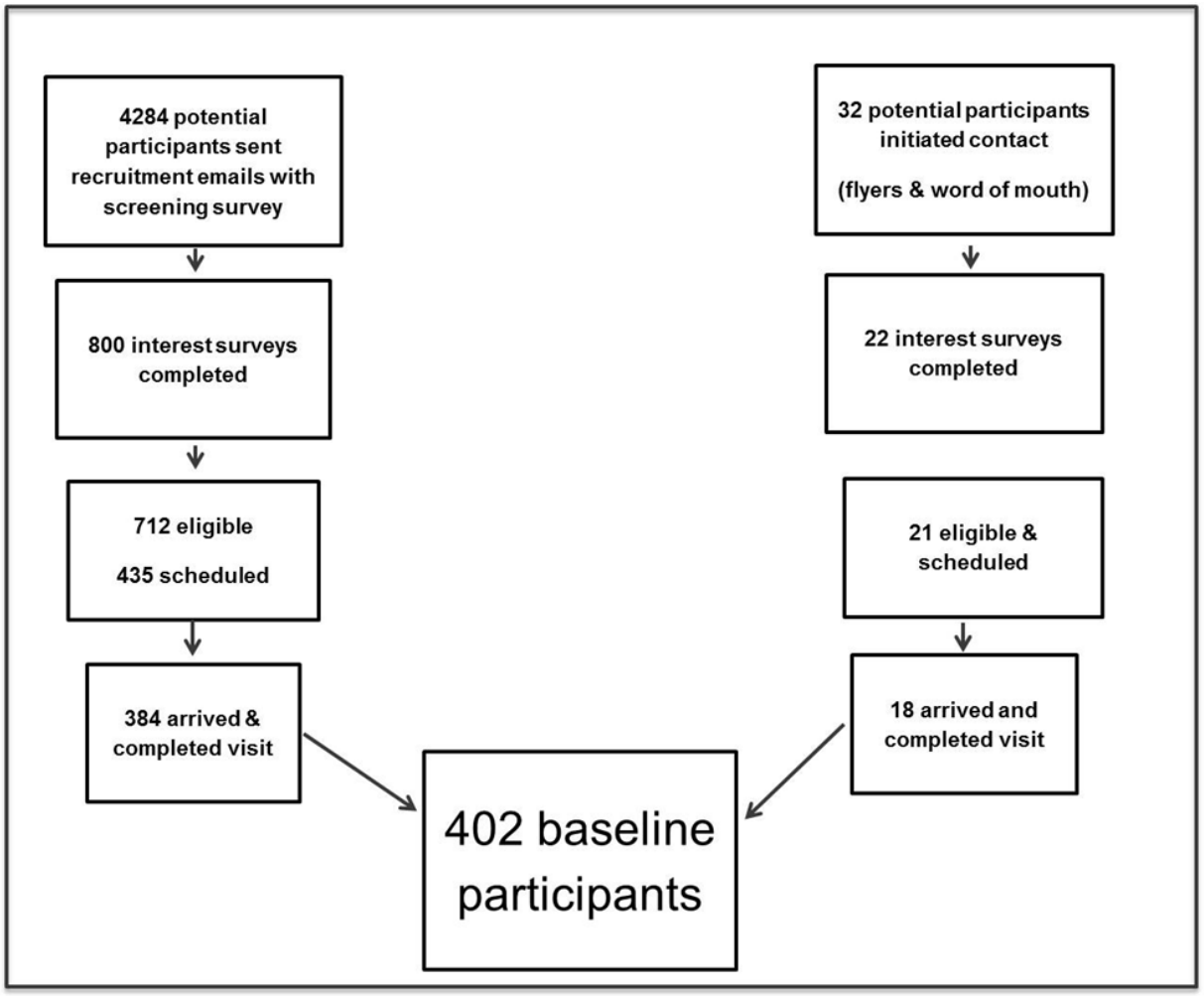


Figure 3.1 Flow of recruitment

3.1.1.1 Rationale for nurses as a study sample

The nature of work in the nursing profession puts nurses at high risk for experiencing burnout and depression, which makes them an appropriate population for this topic of study. Nursing is recognized as a high strain profession with higher-than-average rates of job burnout and turnover (AIKEN et al., 2001; AIKEN et al., 2013). This is due in part to the characteristics of the job, which are recognized as emotionally, physically, and cognitively demanding. Burnout among nurses is positively correlated with exposure to poor prognosis in patients, the amount of time spent with patients, and the intensity of patients' emotional demands (BAKKER et al., 2000). There are long shifts and often day-to-day contact with sick and/or dying patients. The high extrinsic efforts spent and the low extrinsic rewards obtained are both prevalent in nursing, and are both associated with burnout (BAKKER et al., 2000) and intent to leave the nursing profession (LI et al., 2011). One study found nearly half of nurses reported high levels of burnout, and more than half of the nursing staff indicated they were going to leave their job due to dissatisfaction (COETZEE et al., 2013). In addition, a large study of nurses in the U.S. found rates of depression at 18%, which is approximately twice the national prevalence (LETVAK et al., 2012).

3.1.1.2 Exclusion criteria

Presence of neurological conditions (seizures, severe brain trauma, stroke) that might confound results of cognitive testing, and anyone on active work leave.

3.1.2 Baseline assessment

After completion of informed consent, baseline assessment occurred face-to-face with a trained research technician, and involved completing computerized assessments of cognitive function and questionnaires on psychosocial work characteristics, burnout, depression, and work ability. The battery included additional related measures, which were not directly relevant to the current report. These measures are presented in Annex 1.

3.1.2.1 Psychosocial work characteristics (PWC)

Our goal in this study was to consider a range of possible psychosocial stressors for their contribution to burnout, depressive symptoms, and work ability. The Copenhagen Psychosocial Questionnaire (COPSOQ) was developed by Kristensen and Borg (KRISTENSEN et al., 2005) to be theory based, but not beholden to a single theoretical perspective. The COPSOQ is guided by several principles, including: 1) assessment across different levels of analysis (organization, department, person-work interface, and individual), 2) multiple dimensions including work tasks, organization of work, interpersonal relations at work, cooperation, and leadership; 3) relevant moderators of work stress, including support, feedback, commitment, and health; and 4) applicability to a wide range of job settings. The COPSOQ is frequently used in studies based on the JD-R framework (CLAUSEN et al., 2012; CLAUSEN et al., 2014), and also includes scales consistent with the JDC.

We administered the following scales selected from the PUMA study (BORRITZ et al., 2006): 1) Quantitative Demands, 2) Cognitive Demands, 3) Influence at Work, 4) Degree of Freedom at Work, 5) Possibilities for Development, 6) Role Clarity, 7) Social Support, 8) Quality of Leadership, 9) Insecurity at Work. Specific items were selected for suitability to compare across German and American samples. These items were assessed at baseline, month 3, and month 6. The specific items are presented in Annex 2.

Quantitative Demands were assessed by 5 items answered on a 5-point scale. For example: “Do you have to work very fast (Always, Often, Sometimes, Seldom, Never/hardly ever)?”

Cognitive Demands were assessed by a single screening item on a 5-point scale: “Do you have to keep your eyes on lots of things while you work (Always, Often, Sometimes, Seldom, Never/hardly ever)?”

Influence at Work was assessed by 4 items on a 5-point scale. For example: “Do you have a large degree of influence concerning your work (Always, Often, Sometimes, Seldom, Never/hardly ever)?”

Degree of Freedom at Work was assessed with 4 items on a 5-point scale. For example: “Can you decide when to take a break (Always, Often, Sometimes, Seldom, Never/hardly ever)?”

Possibilities for Development was assessed with 4 items on a 5-point scale. For example: “Do you have the possibility of learning new things through your work (To a very large extent, To a large extent, Somewhat, To a small extent, To a very small extent)?”

Role Clarity was assessed with 3 items on a 5-point scale. For example: “Does your work have clear objectives (To a very large extent, To a large extent, Somewhat, To a small extent, To a very small extent)?”

Social Support was assessed with 2 items on a 5-point scale: “How often do you get help and support from you colleagues (Always, Often, Sometimes, Seldom, Never/hardly ever)?”

Quality of Leadership was assessed with 4 items on a 5-point scale. For example: “To what extent would you say that your immediate supervisor makes sure that the individual member of staff has good development opportunities (To a very large extent, To a large extent, Somewhat, To a small extent, To a very small extent)?”

Insecurity at Work (Job Insecurity) was assessed with 2 items on a dichotomous (yes/no) scale: 1) “Are you worried about becoming unemployed?”, and 2) “Are you worried about it being difficult for you to find another job if you became unemployed.”

3.1.2.2 Burnout

We assessed burnout symptoms with the Oldenburg Burnout Inventory (OLBI: (DEMEROUTI et al., 2010). The OLBI was been widely used to assess burnout in studies related to the JD-R framework. This questionnaire consists of two eight item scales (Exhaustion and Disengagement). The Exhaustion scale assesses the extent to which one’s emotional, physical, and cognitive resources have been compromised, and includes items such as “I can tolerate the pressure of my work very well” and “during my work, I often feel emotionally drained”. The Disengagement subscale was not used in the current report. Exhaustion items are scored on a four point Likert-type scale ranging from “strongly agree” to “strongly disagree”. Scores on negatively worded items are reversed before items are averaged, yielding scale scores ranging from one to four. Measures of OLBI Exhaustion were collected at baseline and each monthly follow-up.

3.1.2.3 Depressive symptoms

We assessed depressive symptoms with the Patient Health Questionnaire (PHQ-9: (KROENKE et al., 2001; KROENKE & SPITZER, 2002). The PHQ-9 was used to assess depressive symptomatology. This self-report measure assesses the frequency of nine depression symptoms over the previous two weeks (diminished interest in pleasurable activities, feeling down, sleep problems, diminished energy, appetite problems or overeating, feelings of failure, concentration problems, slowed speech or actions, and suicidal thoughts). Each item assesses symptom frequency, on a 0-3 scale ("not at all", "several days", "more than half the days", "nearly every day"), resulting in a total score with a possible range of 0-27. The validity of the PHQ-9 was demonstrated by Kroenke et al. (2001), who found that a cutoff score of 10, designed to represent having five or more symptoms on 'more than half the days', achieved 88% sensitivity and 93% specificity in relation to clinical diagnosis. Measures of PHQ-9 depression were collected at baseline and each monthly follow-up.

3.1.2.4 Work ability

We assessed work ability with the Work Ability Index (WAI: TUOMI et al., 1998; ILMARINEN, 2007). The WAI was used to assess health status and work ability. Items include: 1) Current work ability compared to lifetime best, 2) Work ability in relation to demands of the job, 3) Number of current diseases diagnosed by a physician, 4) Estimated work impairment due to diseases, 5) Sick leave in the past year, 6) Own prognosis of work ability 2 years from now, 7) Mental resources. The total score is the sum of the 7 questions, which vary in their scaling. The total score ranges from 7 (bad) to 49 (very good). The WAI was assessed at baseline and month 12. In addition, Item 1 "Current work ability compared with the lifetime best" was assessed monthly.

3.1.2.5 Executive functions

We administered computerized measures of task switching, updating (Operation Span), and inhibition (Stroop). These versions were obtained from the Federal Institute for Occupational Safety and Health (BAuA), and modified for use in English.

Task switching
The task-switching paradigm was similar to that from previous work by the BAuA (SCHAPKIN et al., 2014). The stimuli in the task-switching paradigm were the digits 1–9, excluding the number 5. Stimuli were presented in white on a black computer screen 3 mm above a white fixation point. A cue indicating the relevant task was presented below the fixation point. The cue "NUM" (representing "Number" prompted for a response indicating whether the number presented was greater or less than 5. The cue "PAR" (representing "Parity") prompted for a response indicating whether the number presented was odd or even. The cue was presented in the single tasks only. In the memory-based mixed block (see below) three letters (XXX) were presented instead of the informative cue. Responses consisted of pressing a button on one of

two computer mouses, one for each hand. The stimulus–response mapping was overlapping; that is, responses according to ‘smaller than five’ and ‘even’ were assigned to the same mouse button on one hand and ‘larger than five’ and ‘odd’ to the same mouse button on the other hand. This mapping assignment was counterbalanced across participants

At the start of each trial, there was presentation of the fixation point for 500 ms. In the single-task blocks, a cue stimulus was presented for 1000 ms, which remained visible when the digit was presented. A response had to be given within 2500 ms after target-onset. A feedback color (green: correct, red: incorrect) appeared 500 ms after the response, followed by a white fixation point for 500 ms before the next trial. There were 65 single-task trials for each of the NUM and PAR tasks. The single-task blocks were important for assessing single task performance, and to become familiar with the two tasks before they were administered together as the mixed block. In the memory-based mixed block, the two tasks were presented in mixed order and the participants were instructed to switch the task after every two trials in the following order: “NUM, NUM, PAR, PAR, NUM, NUM, PAR, PAR….”. A stimulus prompt of “XXX” was presented instead of the actual cue, which forced participants to mentally track the actual trial sequence. When three consecutive errors were made, or no response within the 2500 ms interval was given, cues were presented for the next two trials, helping the participants to regain the task sequence. The mixed block consisted of 130 trials. The frequency of task switch in the memory-based block amounted to 50% of trials. The participants were provided with on screen instructions, and the administrator verbally queried for understanding of the task before beginning. The instructions encouraged quick and accurate responses. Variables of interest were single-task reaction time (RT), switching costs, mixing costs. We also examined total errors.

Stroop test

We used a modified, computer-based, color-word interference test based on the Stroop paradigm (STROOP, 1935). The stimuli consisted of the words “red,” “green,” “yellow”, and “blue” presented in one of the four colors on a black computer screen. Presentation time was 500 ms. Participants were instructed to respond to the font color in which the word was displayed, and to ignore the color name represented by the word itself. Participants responded to a mouse button with a colored key matched to the color response. There was a two-button mouse for each hand, and two color keys per mouse (left mouse: yellow button, green button; right mouse = red button, blue button. Response time was up to 4000 ms, followed by a feedback color (green: correct, red: incorrect) for 4000 ms and a white fixation point 2000 ms before the next trial. The color of the font in the display corresponded to its word meaning in 50% of the trials (compatible), whereas in the remaining 50% of the trials word color and meaning did not correspond (incompatible). In the Stroop paradigm, compatible trials generally produce faster response times than incompatible trials. The Stroop interference effect assessed in the current study was the difference in mean response time in milliseconds between the compatible and incompatible trials. This difference was the variable of interest, which we describe as Stroop interference. We also examined total errors

Working memory (updating)
This was assessed by the Automated Operation Span task (AOSPAN). Methods are described in UNSWORTH et al. (UNSWORTH et al., 2005). This computerized task begins with a practice session composed of three sections. The first practice session was simple letter span (4 trials). A series of letters appeared on the computer screen and the participants were instructed to recall the letters in the same order as presented. Each letter appeared for a duration of 800 ms. At recall, the letters were presented in a 4 x 3 matrix (F, H, J, K, L, N, P, Q, R, S, T, Y). Participants indicated recall by clicking the box next to the appropriate letters in the correct order. After recall, the program provided feedback about the number of letters correctly recalled. The second practice session was math (15 trials). Participants were presented a math operation (e.g., (1*2) + 1= ?). Participants were instructed to solve the operation as quickly as possible and then click the mouse to advance to the next screen. On the next screen a digit was presented and the participants were required to click either a “true” or “false” box indicating whether the digit represented the correct answer to the operation. Participants were given accuracy feedback after each operation. The time allowed to solve equations during the actual test was based on individual practice performance. The participant’s mean response time plus 2.5 standard deviations was used as the time limit for the math portion during the full task. The third practice session required participants to perform both letter recall and math operations together (3 trials).

In the actual task condition, participants first saw and answered the math operation, then saw the letter to be recalled. Participants exceeding the time limit for the math operation were advanced to the next task and their response was counted as an error. The purpose of this was to prevent participants from rehearsing the letters during the math operations. The task was composed of three sets of each set size (3-7), resulting in 75 letters and 75 math problems. The order of set sizes was random for each participant. There was an 85% accuracy criterion for math operations to encourage participants to place equal emphasis on both letters and math. The variable of interest was the absolute span score, which is the sum of all perfectly recalled sets. We also examined total task errors.

3.1.3 Follow-up assessment

Participants were contacted by a study coordinator monthly by email. The email included a secure link to complete a brief online assessment of PWC, burnout symptoms, depressive symptoms, and work ability. The link anonomized responses, but did allow monitoring of individual questionnaire completion. The follow-up period was 12 months (i.e., 12 follow-up questionnaires). The OLBI and PHQ-9 were assessed monthly, the COPSOQ scales were assessed at months 3 and 6. The WAI was assessed at month 12; in addition, WAI question 1 was assessed monthly. Data capture for questionnaires was managed with REDCap Survey (HARRIS et al., 2009), using an encrypted connection and a password linked to the participant.

3.2 Data analysis and statistical considerations

3.2.1 Data description

We examined descriptive statistics to understand the study sample and properties of the assessment measures, including means, standard deviations, distribution statistics, and zero-order correlations.

3.2.2 Model testing

We used linear regression models to test hypotheses related to burnout, depressive symptoms, and cognition. For most comparisons, we used a hierarchical approach to variable entry based on the hypothesized ordering of influences. Hierarchical regression provides a model comparison framework to examine if our predictor variables explain a statistically significant amount of variance in our outcome variables, after accounting for all other variables. Typically, demographic characteristics were entered as a block in the first regression step. PWC were entered in the second step when testing outcomes of burnout and depressive symptoms. Burnout was entered in the third step when testing outcomes of depressive symptoms. Regression modeling, as well as descriptive statistics, were conducted in the SAS software package version 9.3 (SAS INSTITUTE, 2013).

We used structural equation modeling (SEM) to test latent paths of 1) PWC demand and resources to burnout and depressive symptoms, and 2) PWC, burnout, and depressive symptoms to psychological and physical work ability. To do this, we first tested the fit of a confirmatory factor analysis (CFA) model of PWC demands and resources, consistent with the JD-R model. We then tested relationships in each step in the path model: 1) from the independent variables of PWC demands and resources to mediating variables burnout and depression, and 2) from these to outcome variables to psychological and physical work ability. After this, we tested each of eight indirect paths from independent variables, to mediating variables, to outcome variables, in separate SEM models. Then, we tested all eight paths in one model. Finally, we tested a SEM model with only significant paths. SEM was conducted in MPlus (MUTHEN & MUTHEN, 2004).

4 Results

4.1 Sample characteristics

The demographic characteristics of this sample are shown in Table 4.1. Demographic representation is broadly consistent with our targets, and thus appears to approximately represent the racial and ethnic demographics of the nursing profession in the U.S., with a mild over-representation of African American individuals based on local demographics.

Table 4.1 Participant characteristics

Characteristic	n (%)	RN	CNA & LPN
	402	375	27
Age: mean = 41.7, SD = 11.3 (range = 25-70)			
Sex Female	373 (93%)	352	22
Male	29 (7%)	23	5
Education			
High School Diploma/Some College	12 (3%)		12
Associates Degree	106 (26%)	102	4
Bachelor's Degree	232 (58%)	224	8
Master's Degree	44 (11%)	42	2
Doctoral Degree	1 (0.25%)	1	0
Other	5 (1%)	4	1
Race			
Amer Ind/Alaska Native	2 (0.5%)	1	
Asian	20 (5%)	20	
Native HI/Otr Pac Islander	1 (0.25%)	1	
Black/African American	56 (14%)	34	21
White	310 (78%)	305	6
Multi-racial	6 (2%)	8	
Unknown/Unreported	2 (0.5%)	6	
Ethnicity			
Hispanic/Latino	13 (3%)	13	1
Not Hispanic	379 (95%)	355	25
Unknown	5 (1%)	4	1
Marital Status			
Unmarried	116 (30%)	102	7
Married/legal equivalent	212 (53%)	205	14
Separated	6 (2%)	6	
Divorced	56 (14%)	50	6
Widowed	7 (2%)	7	
Health			
Hypertension	75 (19%)	43	8
High Cholesterol	31 (8%)	28	3
Diabetes	25 (5%)	16	5

Key: RN = registered nurse, CNA = certified nursing assistant, LPN = licensed practical nurse

4.2 Descriptive statistics for common project measures

Table 4.2 presents descriptive statistics for questionnaires related to the common project measures. We found a modest amount of missing data on the item level. It

was prohibitive to screen intensively for missed or declined items during the assessment, because many of the questionnaire items may assess information that is sensitive to participants. Our protocol was to verbally encourage participants to answer all questionnaires completely, and we designed page breaks in our survey program to minimize item omissions due to visual fatigue. Because missing data is at the item level, it is possible to use imputation methods on most measures to estimate complete scores at the scale level. Because we had adequate sample size for our analyses, we chose not to use imputed scores.

Table 4.2 Descriptive statistics for common project measures

Scale	N	Mean	SD	Minimum	Maximum
Quantitative Demands	402	47.39	14.53	8.33	91.67
Cognitive Demands	401	85.10	19.86	25.0	100.0
Influence at Work	402	34.16	18.78	0	93.75
Degree of Freedom	402	39.14	20.05	0	100
Possibilities f. Development	402	73.67	16.46	0	100
Role Clarity	402	70.07	16.10	0	100
Social Support	402	70.37	18.72	0	100
Leadership	402	55.33	24.36	0	100
Job Insecurity	402	19.40	34.91	0	100
OLBI Exhaustion	402	2.61	0.46	1.13	3.75
PHQ-9	381	5.54	4.85	0	25
Work Ability Index (total)	402	39.47	5.12	21	49

In Table 4.3, we present intraclass correlation coefficients (ICC) for COPSOQ variables over the three times points they are administered. The ICCs suggest adequate reliability over a six-month period, suggesting stability in PWC over time.

Table 4.3 Correlations of COPSOQ scales across follow-up times

Scale	Baseline and Month 3	Baseline and Month 6	Month 3 and Month 6	ICC
Quantitative Demands	$r(375)=.64$, $p<.001$	$r(329)=.62$, $p<.001$	$r(314)=.69$, $p<.001$	.65
Cognitive Demands	$r(370)=.48$, $p<.001$	$r(327)=.45$, $p<.001$	$r(310)=.69$, $p<.001$	.53
Influence at Work	$r(374)=.62$, $p<.001$	$r(329)=.64$, $p<.001$	$r(313)=.68$, $p<.001$	.64
Degree of Freedom	$r(374)=.73$, $p<.001$	$r(329)=.71$, $p<.001$	$r(313)=.74$, $p<.001$	.73
Poss. for Development	$r(374)=.64$, $p<.001$	$r(329)=.63$, $p<.001$	$r(313)=.67$, $p<.001$	.63
Role Clarity	$r(373)=.59$, $p<.001$	$r(329)=.50$, $p<.001$	$r(312)=.50$, $p<.001$	.53
Social Support	$r(374)=.60$, $p<.001$	$r(329)=.58$, $p<.001$	$r(313)=.64$, $p<.001$	.60
Leadership	$r(374)=.63$, $p<.001$	$r(329)=.64$, $p<.001$	$r(313)=.71$, $p<.001$	.66
Job Insecurity	$r(374)=.64$, $p<.001$	$r(329)=.65$, $p<.001$	$r(313)=.67$, $p<.001$	.64

Key: ICC = intraclass correlation

4.3 Prevalence comparison by depressive symptom severity

Data suggest that the study sample of nurses has higher prevalence of depression than general community-based estimates. For example, 20% of the study sample has a PHQ-9 greater than 9 (women and men combined), which is generally viewed as a cutoff for predicting Major Depressive Disorder. In contrast, data from the NHANES study (a large nationally representative study in the U.S.) indicates a cumulative population prevalence of this same range among women to be 8.55% (SHIM et al., 2011). In Table 4.4, we present depression symptom strata matching the NHANES study, for the purposes of descriptive comparison.

Table 4.4 PHQ-9 scores of sample, stratified by severity

Normal (0-4)	Mild (5-9)	Moderate (10-14)	Mod-Severe (15-19)	Severe (20+)
n =190	n = 114	n = 51	n = 21	n = 5
49.87%	29.92%	13.39%	5.51%	1.13%

4.4 Associations PWC to burnout, depressive symptoms, and age

As seen in Table 4.5, symptoms of burnout and depression are significantly associated with nearly all PWC, as assessed by the COPSOQ. The patterns are consistent with the JD-R framework. Higher Quantitative Demands and Cognitive Demands were associated with higher levels of burnout and depressive symptoms. Higher levels of job resources (scales 3-8) were associated with lower levels of burnout and depressive symptoms. In addition, the stressor of higher Job Insecurity was associated with higher levels of burnout and depressive symptoms.

Table 4.5 Correlations among primary study questionnaires

Scale	1	2	3	4	5	6	7	8	9	10
1. QuantD	-	-	-	-	-	-	-	-	-	-
2. CogD	.23**	-	-	-	-	-	-	-	-	-
3. InfWork	-.05	-.05	-	-	-	-	-	-	-	-
4. DegFree	-.10*	-.18**	.46**	-	-	-	-	-	-	-
5. PossDev	.01	.23**	.24**	.22**	-	-	-	-	-	-
6. RoleClar	-.20**	.01	.34**	.30**	.28**	-	-	-	-	-
7. SocSup	-.17**	-.03	.21**	.23**	.25**	.39**	-	-	-	-
8. Leadrship	-.20**	-.14*	.35**	.31**	.28**	.44**	.31**	-	-	-
9. JobIns	.09	-.08	-.09	-.11*	-.21**	-.22	-.17**	-.12*	-	-
10. OLBI_Ex	.41**	.23**	-.30**	-.28**	-.09	-.31**	-.28**	-.40**	.19**	-
11. PHQ-9	.19**	.07	-.19**	-.18**	-.14*	-.29**	-.26**	-.29**	.28**	.57**

N = 402 for correlations with OLBI_EX and n = 381 for PHQ-9. *p<.05, **p<.001. Key: Quantitative Demands, Cognitive Demands, Influence at Work, Degree of Freedom at Work, Possibilities for

Development, Role Clarity, Social Support, Leadership, and Job Insecurity subscales from the Copenhagen Psychosocial Questionnaire (COPSOQ); Olbi_Ex = Exhaustion from the Oldenburg Burnout Inventory; Patient Health Questionnaire-9.

4.4.1 Age differences in PWC

We found that four out of nine COPSOQ scales were significantly associated with age. Older workers reported more Influence at Work, $r(397) = .11$, $p < .05$, and greater Degree of Freedom at Work, $r(397) = .21$, $p < .01$. Older workers also reported fewer Possibilities for Development, $r(397) = -.13$, $p < .05$, and greater Job Insecurity, $r(397) = -19$, $p < .01$.

4.5 Cross-sectional associations of PWC to burnout

We tested models to better understand the unique contributions of PWC characteristics to the severity of exhaustion-related symptoms of burnout at baseline (Table 4.6). Sequential hierarchical models were conducted to assess relationships between PWC (COPSOQ) and burnout symptoms at baseline. These consisted of two steps. In the first, demographic covariates (age, sex, education, and race) were entered. In the second, COPSOQ work characteristics were added to the model. Results from step one indicated higher OLBI Exhaustion at baseline to be associated with younger age (B = -0.005, $p = .02$) and female gender (B = -0.30, $p = .001$), and lower OLBI Exhaustion at baseline to be associated with other race (B = -0.18, $p = .04$). Results from the second step revealed that age and sex retained significance (B = -0.005, $p = .004$ and B = -0.26, $p < .001$). Results also revealed that higher burnout was associated was significantly with higher Quantitative Demands (B = 0.01, $p < .001$), higher Cognitive Demands (B = 0.002, $p = .04$), lower Influence at Work (B = -0.003, $p = .005$), lower Social Support (B = -0.003, $p = .02$), lower Leadership (B = -0.004, $p < .001$), and higher Job Insecurity (B = 0.002, $p = .002$). The directions of these associations are consistent with the JD-R framework.

Table 4.6 Contribution of PWC to baseline OLBI Exhaustion

	Model 1		Model 2	
Variable	B (SE)	*p*-value	B (SE)	*p*-value
Age	-0.005 (0.002)	.02	-0.005 (0.002)	.004
Sex	-0.30 (0.09)	.001	-0.26 (0.08)	<.001
Education				
Associates	-0.12 (0.15)	.42	-0.03 (0.13)	.79
Bachelors	-0.14 (0.15)	.35	-0.05 (0.13)	.70
Masters or Doc	0.07 (0.16)	.66	-0.002 (0.14)	.99
Race				
Black	-0.11 (0.07)	.14	-0.03 (0.06)	.69
Other	-0.18 (0.09)	.04	-0.09 (0.08)	.22
Unknown/Not reported	0.48 (0.32)	.13	0.13 (0.27)	.64
Quantitative Demands	-	-	0.01 (0.001)	<.001
Cognitive Demands	-	-	0.002 (0.001)	.04
Influence at Work	-	-	-0.003 (0.001)	.005
Degree of Freedom	-	-	-0.0009 (0.001)	.42
Possibilities for Development	-	-	0.001 (0.001)	.29
Role Clarity	-	-	-0.0002 (0.002)	.85
Social Support	-	-	-0.003 (0.001)	.02
Leadership	-	-	-0.004 (0.0009)	<.001
Job Insecurity	-	-	0.002 (0.0006)	.002
R^2		.08		.38

n = 387. Education reference category: high school; Race reference category: White

4.5.1 Interactions between PWC and age in predicting burnout

For models of exhaustion-related symptoms of burnout at baseline, a significant interaction was found for Degree of Freedom and age in predicting burnout (B = 0.0002, *p* =.01), with younger age being associated with a stronger association between lower burnout symptoms and higher Degree of Freedom at Work (young: B = -0.009, *p*<.001; mean: B = -0.007, *p*<.001; old: B = -0.004, *p* = .005).

4.6 Cross-sectional associations of PWC to depressive symptoms

We tested models to better understand the unique contributions of PWC to the severity of depressive symptoms (Table 4.7). Sequential hierarchical models were conducted to assess relationships between psychosocial job demands and resources

(COPSOQ) and depressive symptoms. In the first step, demographic covariates (age, sex, education, and race) were entered. In the second, COPSOQ work characteristics were added to the model. Results from step one indicated other race to be associated with lower depressive symptoms (B = -2.73, *p* = .004), while other demographic characteristics were non-significant. In step two, other race retained significance (B = -2.30, *p* = .01) and older age was associated with lower depression symptoms (B = -0.05, *p* = .02). In this step, higher depressive symptoms were associated with higher Quantitative Demands (B = 0.04, *p* = .03), lower Social Support (B = -0.04, *p* = .004), lower Leadership (B = -0.02, *p* = .04), and higher Job Insecurity (B = 0.03, *p*<.001). These patterns are consistent with the JD-R framework: higher levels of stressors in the work environment (Quantitative Demands) and at the person-work interface (Job Insecurity) were associated with higher levels of depressive symptom at baseline. In contrast higher levels of job resources were associated with lower levels of depressive symptoms.

Table 4.7 Contribution of PWC to baseline depressive symptoms

	Model 1		Model 2	
Variable	B (SE)	p-value	B (SE)	p-value
Age	-0.03 (0.02)	.14	-0.05 (0.02)	.02
Sex	-1.61 (0.94)	.09	-1.28 (0.87)	.14
Education				
Associates	-1.77 (1.67)	.29	-1.27 (1.55)	.41
Bachelors	-2.41 (1.63)	.14	-1.74 (1.52)	.25
Masters or Doc	-0.74 (1.76)	.68	-1.61 (1.64)	.33
Race				
Black	-0.44 (0.79)	.58	0.05 (0.76)	.94
Other	-2.73 (0.95)	.004	-2.30 (0.89)	.01
Unknown	0.19 (3.32)	.95	-2.74 (3.11)	.38
Quantitative Demands	-	-	0.04 (0.02)	.03
Cognitive Demands	-	-	0.009 (0.01)	.46
Influence at Work	-	-	-0.01 (0.01)	.35
Degree of Freedom	-	-	0.004 (0.01	.79
Poss. for Development	-	-	0.0002 (0.02)	.99
Role Clarity	-	-	-0.008 (0.02)	.64
Social Support	-	-	-0.04 (0.01)	.004
Leadership	-	-	-0.02 (0.01)	.04
Job Insecurity	-	-	0.03 (0.007)	<.001
R^2		.05		.22

n = 367. Education reference category: high school; Race reference category: White

4.6.1 Interactions between PWC and age in predicting depressive symptoms

We tested interactions between age and PWCs at baseline in predicting PHQ-9 depression at baseline. These were found to be non-significant for all PWCs.

4.7 Interactions of job demands and resources

To examine the JD-R framework more thoroughly, we tested the interactions between job demands (Quantitative Demands) and job resources (Influence at Work, Degree of Freedom, Opportunities for Development, Role Clarity, Social Support, and Leadership) in predicting OLBI Exhaustion and PHQ-9 depressive symptoms at baseline. Each interaction was tested in a separate linear regression model, with covariates of age, gender, education, and race.

For the outcome of burnout, results revealed that Quantitative Demands significantly interacted with Role Clarity (B = 0.0003, p<.01). To interpret this, we conducted simple slopes of OLBI Exhaustion on Quantitative Demands at conditional values of Role Clarity (one standard deviation below the mean, the mean, and one standard deviation above the mean). This indicated that the relationship between greater Quantitative Demands and higher burnout was stronger at higher values of Role Clarity (low: B = 0.008, p<.001; mean: B = 0.01, p<.001; high: B = 0.02, p<.001), whereas intercept values for Quantitative Demand were lower at higher values of Role Clarity. As seen in Figure 4.1, the slopes converage at the level of approximately one standard deviation (SD) in Quantitative Demands (see Figure 4.1), suggesting that there are diminishing benefits of Role Clarity at above-average levels of Quantitative Demand. A significant interaction was also found for Social Support (B = 0.0002, p = .03) and Leadership (B=0.0002, p<.01), indicating that the relationship between Quantitative Demands and exhaustion-related burnout was stronger at higher values of these resource variables, but showing diminshing influence at above average levels of Quantiative Demands. As the patterns of the interaction were similar, we present only Role Clarity as an example (Figure 4.1).

For PHQ-9 depression, a similar pattern of interaction was found for Leadership as was found for burnout (B = 0.001, p = .03), indicating the relationship between Quantitative Demands and depression to be stronger at higher values of Leadership, but diminishing at above average levels of Quantitative Demand.

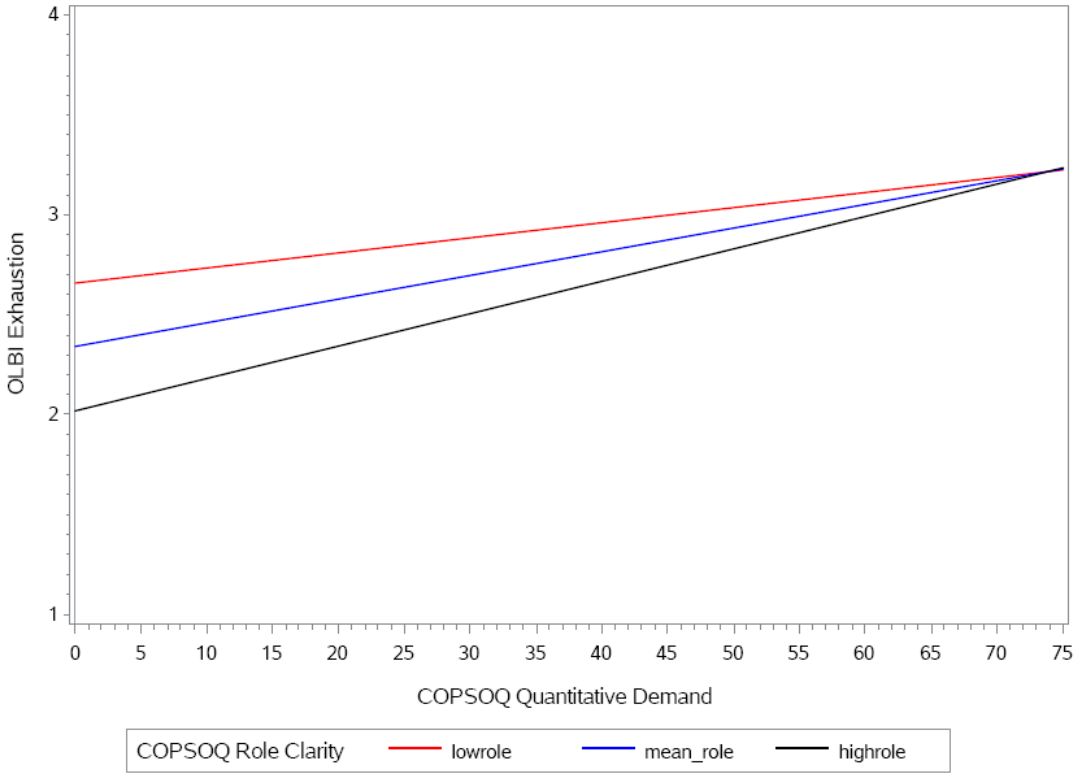


Figure 4.1 Exhaustion regressed on interaction of Role Clarity and Quantitative Demand

4.8 Temporality of burnout and depressive symptoms

Having examined the cross-sectional relationships among PWC, burnout symptoms, and depressive symptoms, we planned to examine these relationships over time. Before proceeding with those models, however, we sought to better understand the possible temporal relationships between burnout and depressive symptoms.

To assess the temporal relationships between burnout and depression, burnout was modeled in three ways. Chronic burnout was assessed by averaging burnout over baseline and the 12 follow-up months, and entering this as a time-invariant factor predicting depression at each month. To assess acute burnout, burnout concurrent with depression at each month was entered as a time-variant factor. Finally, to assess cross-lagged burnout, burnout one month previous to depression at each month (i.e., burnout lagged one month) was entered as a time-variant factor. Time was also included as a predictor, in order to estimate monthly rate of change in depression, and age and sex were included as covariates. To control for baseline depression, those with clinically significant depression (9 or greater on PHQ-9 at baseline) were excluded. Bidirectional effects were also assessed, by entering chronic, acute, and cross-lagged depressive symptoms as predictors of burnout at each month. Similar to models in which depressive symptoms served as the outcome variable, these models controlled for baseline burnout; however, because burnout is

not theorized to be a clinically discreet condition, we chose to exclude those in the top 20th percentile of OLBI Exhaustion.

Findings from linear mixed models on the bidirectional relationship between burnout and depressive symptoms are reported in Tables 4.9-4.11. The intra-class correlation for repeated measures of PHQ-across time was 0.69. Models conditioned on chronic, acute, and cross-lagged burnout indicated that increased chronic, acute, and cross-lagged burnout variables were each associated with increased depression over 12 months, with the strongest associations for chronic burnout (B = 3.76, *t* = 12.19, *p*<.001) and acute burnout (B = 2.81, *t* = 15.68, *p*<.001), and a weaker association for longitudinal burnout (B = 0.93, *t* = 5.48, *p*<.001).

Table 4.8 OLBI Exhaustion predicting temporal profiles of depressive symptoms

	Chronic			Acute			Cross-lagged		
	B	*t* value	*p*-value	B	*t* value	*p*-value	B	*t* value	*p*-value
OLBI Exhaustion	3.76	12.19	<.001	2.81	15.68	<.001	0.93*	5.48	<.001
Time (months)	-0.02	-1.25	.21	-0.002	-0.13	.90	-0.04	-2.30	.02
Age	0.01	0.87	.38	0.004	0.41	.68	-0.008	-0.62	.53
Sex	-0.005	-0.01	.99	-0.17	-0.47	.64	-0.61	-1.22	.22

n = 303 for Chronic and Acute models and n = 302 for Cross-lagged model

Similar patterns emerged for results in the other direction, in which depressive symptoms were used to predict burnout symptoms over 12 months. ICCs revealed a high degree of correlation between repeated observations of these outcomes (OLBI Exhaustion: .75). In models of longitudinal burnout as the outcome, increased chronic, acute, and cross-lagged depressive symptoms were associated with increased burnout, with chronic depressive symptoms demonstrating the strongest association (B = 0.06, *t* = 12.66, *p*<.001), followed by acute depressive symptoms (B = 0.04, *t* = 17.63, *p*<.001) and cross-lagged depressive symptoms (B = 0.01, *t* = 5.03, *p*<.001, see Table 4.9).

Table 4.9 Depressive symptoms predicting temporal profiles of burnout

	Chronic			Acute			Cross-lagged		
	B	*t* value	*p*-value	B	*t* value	*p*-value	B	*t* value	*p*-value
PHQ-9 Depression	0.06	12.66	<.001	0.04	17.63	<.001	0.01	5.03	<.001
Time, in months	-0.009	-5.57	<.001	-0.007	-5.16	<.001	-0.008	-4.86	<.001
Age	-0.002	-1.40	.16	-0.002	-1.57	.12	-0.002	-1.37	.17
Sex	-0.14	-2.41	.02	-0.15	-2.58	.01	-0.14	-2.04	.04

n = 333 for Chronic and Acute models and n = 332 for Cross-lagged model

Based on the preceding results, we decided to use the chronic definition of both burnout and depressive symptoms over the acute and cross-lagged definitions in our subsequent models. Also based on these results, we chose to construct our predictive models by excluding individuals with high baseline burnout symptoms

(>20th%ile) when predicting longitudinal depressive symptoms, and excluding individuals with high baseline depressive symptoms (PHQ-9 >9) when predicting longitudinal burnout symptoms. Models excluding high baseline symptoms produced comparable results to models covarying for baseline burnout and depressive symptom, and we believe that excluding individuals who may have clinically significant symptoms at baseline provides a stronger argument that longitudinal results were not confounded by baseline symptoms than does the approach of covarying for baseline symptoms.

4.9 Predicting chronic depressive symptoms

We conducted sequential hierarchical regression models in four steps to test a fundamental assumption of the JD-R framework, which is the extent to which burnout mediates the association between PWC and chronic depressive symptoms. In the first step, models were conducted to assess PWC and burnout as predictors of chronic depressive symptoms, among those without clinically elevated depression at baseline (baseline PHQ-9 scores >9 were excluded). We used sequential hierarchical regression models in three steps to test these relationships. In the first, demographic covariates (age, sex, education, and race) were entered. In the second step, all work characteristics were added. In the third step, OLBI Exhaustion was entered. The function of this step was to evaluate the change in coefficients associated with job demands and job resources in relation to chronic depressive symptoms when exhaustion was added to the model; that is, whether exhaustion was a mediating variable.

Results from step one indicated all demographic characteristics to be non-significant. In step two, among PWC variables, higher chronic depressive symptoms was predicted by higher Quantitative Demands (B = 0.05, p<.001). In step three, when burnout was added to the model, Quantitative Demands was no longer a significant predictor of depressive symptoms, whereas greater burnout was a significant predictor of higher chronic depressive symptoms (B = 2.22, p<.001). That is, the addition of burnout symptoms fully mediated the association between Quantitative Demands and chronic depressive symptoms. The full model data are presented in Table 4.10.

Table 4.10 Predictors of chronic depressive symptoms, with separate entry for exhaustion (Model 3)

	Model 1		Model 2		Model 3	
Variable	B (SE)	p-value	B (SE)	p-value	B (SE)	p-value
Age	-0.02 (0.01)	.25	-0.02 (0.01)	.16	-0.009 (0.01)	.55
Sex	-0.31 (0.58)	.59	-0.37 (0.55)	.50	0.15 (0.53)	.78
Education						
Associates	1.25 (1.20)	.30	1.56 (1.14)	.17	1.53 (1.09)	.16
Bachelors	1.23 (1.18)	.30	1.41 (1.13)	.21	1.46 (1.07)	.17
Masters/Doc	2.10 (1.27)	.10	1.44 (1.22)	.24	1.36 (1.16)	.24
Race						
Black	-0.28 (0.52)	.59	-0.24 (.52)	.64	-0.14 (0.49)	.77
Other	-0.97 (0.57)	.09	-0.56 (0.55)	.31	-0.47 (0.52)	.37
Unknown	0.03 (1.95)	.99	-1.52 (1.90)	.42	-1.97 (1.81)	.28
QuantD	-	-	0.05 (0.01)	<.001	0.02 (0.01)	.09
CogD	-	-	-0.01 (0.008)	.23	-0.01 (0.008)	.08
InfWork	-	-	-0.01 (0.01)	.19	-0.008 (0.009)	.39
DegFreedom	-	-	0.007 (0.009)	.46	0.01 (0.009)	.24
PossDev	-	-	0.02 (0.01)	.17	0.01 (0.01)	.24
RoleClar	-	-	-0.02 (0.01)	.13	-0.02 (0.01)	.11
SocSup	-	-	-0.01 (0.01)	.21	-0.008 (0.009)	.35
Leadrship	-	-	-0.01 (0.008)	.16	-0.004 (0.008)	.61
JobIns	-	-	0.008 (0.005)	.14	0.004 (0.005)	.37
OLBI_Ex	-	-	-	-	2.22 (0.40)	<.001
R^2	.03		.16		.25	

n = 297. Key: Quantitative Demands, Cognitive Demands, Influence at Work, Degree of Freedom at Work, Possibilities for Development, Role Clarity, Social Support, Leadership, and Job Insecurity subscales from the Copenhagen Psychosocial Questionnaire (COPSOQ); Exhaustion and Disengagement scales from the Oldenburg Burnout Inventory; Patient Health Questionnaire-9

4.10 Predicting chronic burnout

The goal of this model was to examine the extent to which there is a reciprocal relationship in the severity of depressive symptoms predicting the severity of burnout symptoms. We conducted sequential hierarchical regression models in three steps to test COPSOQ work characteristics and depression as predictors of chronic exhaustion-related burnout, among those without elevated symptoms at baseline. In the first step, mean OLBI Exhaustion over follow-up was regressed on demographic covariates (age, sex, education, and race). In the second step, all work characteristics were added. In the third step, PHQ-9 depression was added to test whether depressive symptoms at baseline mediated the association of PWC to chronic burnout. In all of these, those with elevated OLBI Exhaustion at baseline

were excluded. Results from step one indicated greater age to predict lower chronic OLBI Exhaustion (B = -0.004, *p* = .04). In step two, Quantitative Demands (B = 0.008, *p*<.001), Influence at Work (B = -0.003, *p*=.02), and Job Insecurity (B = 0.002, *p*<.001) were significantly associated with chronic burnout, as were age (B = -0.005, *p* = .007) and male sex (B = -0.16, *p* = .04). In the third step, baseline depressive symptoms predicted chronic OLBI Exhaustion (B = 0.04, *p*<.001), while Quantitative Demands (B = 0.007, *p*<.001), Influence at Work (B = -0.003, *p* = .006), and Job Insecurity (B = 0.001, *p* = .03) all retained significance, along with age (B = -0.004, *p* = .02). Thus, while magnitude of depressive symptoms was associated with chronic burnout, it did not mediate the association that some PWC also had with chronic burnout, specifically, Quantitative Demands, Influence at Work, and Job Insecurity. The full model data are presented in Table 4.11.

Table 4.11 Predictors of chronic burnout (exhaustion) symptoms, with mediation by depressive symptoms

	Model 1		Model 2		Model 3	
Variable	B (SE)	p-value	B (SE)	p-value	B (SE)	p-value
Age	-0.004 (0.001)	.04	-0.005 (0.002)	.007	-0.004 (0.002)	.02
Sex	-0.15 (0.08)	.06	-0.16 (0.08)	.04	-0.09 (0.07)	.22
Education						
Associates	-0.006 (0.15)	.97	0.05 (0.14)	.73	0.19 (0.13)	.15
Bachelors	-0.02 (0.15)	.90	0.03 (0.14)	.85	0.20 (0.13)	.14
Masters/Doc	0.07 (0.16)	.66	0.04 (0.15)	.80	0.22 (0.14)	.13
Race						
Black	-0.08 (0.07)	.24	-0.04 (0.06)	.54	-0.06 (0.06)	.32
Other	-0.10 (0.08)	.20	-0.05 (0.07)	.49	0.03 (0.07)	.71
Unknown	0.17 (0.39)	.66	0.09 (0.35)	.79	0.06 (0.32)	.84
QuantD	-	-	0.008 (0.001)	<.001	0.007 (0.001)	<.001
CogD	-	-	0.0008 (0.001)	.46	0.0001 (0.0001)	.57
InfWork	-	-	-0.003 (0.001)	.02	-0.003 (0.001)	.006
DegFreedom	-	-	-0.0002 (0.001)	.85	0.0003 (0.001)	.78
PossDev	-	-	0.0002 (0.001)	.91	0.0003 (0.001)	.80
RoleClar	-	-	0.0003 (0.002)	.85	-0.0002 (0.001)	.87
SocSup	-	-	-0.0006 (0.001)	.63	-0.001 (0.001)	.40
Leadrship	-	-	-0.002 (0.001)	.07	-0.0003 (0.001)	.72
JobIns	-	-	0.002 (0.0006)	<.001	0.001 (0.0006)	.03
PHQ-9	-	-	-	-	0.04 (0.005)	<.001
R^2		.04		.23		.37

n = 326 for Models 1 and 2, and n = 308 for Model 3. Key: Quantitative Demands, Cognitive Demands, Influence at Work, Degree of Freedom at Work, Possibilities for Development, Role Clarity, Social Support, Leadership, and Job Insecurity subscales from the Copenhagen Psychosocial Questionnaire (COPSOQ); Exhaustion and Disengagement scales from the Oldenburg Burnout Inventory; Education reference category: high school; Race reference category: White

4.11 Cognitive performance

4.11.1 Individual characteristics and cognitive performance

We examined bivariate associations of cognitive performance with age and education. Task Switching performance indicated longer (i.e., slower) RT with greater age across a number of conditions: 1) single-task RT, $r(397) = 0.30$, $p<.01$; 2) mixing costs, $r(397) = 0.14$, $p< .01$; and 3) task-switching errors, $r(397)=.28$, $p<.001$. There was no association between switching costs and age. Task Switching performance indicated lower mixing costs among those with a high school education , $F(3,391) = 4.50$, $p = .004$, though results also indicated slower single-task RT with lower education, $F(3,391) = 4.26$, $p<.01$, and greater number of switching errors, $F(3,319) = 6.79$, $p<.001$.

On the Operation Span task (AOSPAN), greater age was associated with smaller absolute span, $r(396) = -0.28$, $p <0.01$, and more errors, $r(396) = .20$, $p<.001$. Lower education was also related to lower absolute span, $F(3, 390) = 3.14$, $p = .03$, and greater number of errors $F(3, 390) = 2.69$, $p = .046$.

On the Stroop task, greater age was associated with a larger interference effect, $r(394) = 0.26$, $p<0.01$, but was not associated with Stroop errors. Education was unrelated to Stroop interference and errors.

4.11.2 PWC and cognitive performance

We found cross-sectional associations between specific cognitive performances and specific PWC as assessed by the COPSOQ scales.

On Task Switching, higher Quantitative Demands was associated with longer single-task RT, $r(400) = .10$, $p<.05$. Higher Cognitive Demand was related to fewer task-switching errors, $r(399) = -.10$, $p<.05$. Higher Possibilities for Development was associated with: faster single-task RT, $r(400) = -.14$, $p<.05$, and fewer task-switching errors, $r(400) = -.14$, $p<.05$. Higher Job Insecurity was associated with slower single-task RT, $r(400) = .23$, $p<.01$.

On AOSPAN, higher Cogntive Demands was associated with larger absolute span, $r(398) = .16$, $p<.01$. Higher Possibilities for Development was associated with larger absolute span , $r(399) = .16$, $p<.01$. Additionally, higher Social Support was associated with higher absloute span, $r(399) = 0.15$, $p<.05$.

On the Stroop test, higher Job Insecurity was associated with a larger interference effect, $r(397) = 0.15$, $p<.01$.

4.11.3 Cross-sectional cognitive performance and burnout

We conducted linear regression models to assess abilities of task switching, updating, and interference as predictors of exhaustion burnout at baseline, controlling for age and education. We also looked at whether these relationships were moderated by age. This revealed longer single-task RT to be related to higher burnout (B = 0.0005, p<.05). We also found AOSPAN errors to interact with age (B=0.001, p<.01). To interpret this, simple slopes of burnout on errors at young age, mean age, and older age were tested. This indicated that the relationship between errors and burnout was significant among young people only (young: B = -0.02, p<.05; mean age: B = -0.006, p =.34; old: B = 0.01, p = .15). This suggests lower errors at higher levels of burnout for younger individuals relative to older individuals.

4.11.4 Cognitive performance and chronic burnout

We conducted linear regression models to assess abilities of task switching, updating, and interference as predictors of chronic burnout, controlling for age and education. We also tested whether these relationships were moderated by age. In doing this, we excluded persons who had elevated exhaustion burnout (20^{th} percentile or higher) at baseline. Findings indicated a significant relationship for single-task RT only, with results indicating longer single-task RT to be related to higher chronic exhaustion burnout (B = 0.0005, p<.01). There were no significant interactions with age.

4.11.5 Cross-sectional cognitive performance and depressive symptoms

We examined associations between depressive symptoms at baseline and cognitive performance, controlling for age and education. We also tested the interaction between cognitive performance and age in predicting chronic depressive symptoms. No main effects were found between cognitive tasks and depressive symptoms. We did find one measure that was moderated by age. Task-switching costs were found to be moderated by age (B = 0.0005, p = .02), with the relationship between greater switch costs and increased depression being significant only among older persons (young: B= -0.001, p =.66; mean: B=0.004, p = .07; old: B = 0.009, p = .004). Thus, our cross-sectional results suggest that older workers may experience greater slowing of task-switching abilities with increased depression relative to younger workers.

4.11.6 Cognitive performance and chronic depressive symptoms

We conducted linear regression models to assess measures of cognitive performance as predictors of chronic depression, controlling for age and education. We also tested two interactions: 1) the interaction with age, and 2) whether these measures interacted with burnout in predicting chronic depressive symptoms. The latter of these was conducted to examine an aspect of COR theory (Section 2.2,

Question 3). We excluded those with clinically elevated depression (PHQ-9 scores > 9) at baseline. Results revealed that all measures of cognitive function were unrelated to chronic depression. In addition, there were no significant interactions with age, and no significant interactions with burnout in predicting chronic depressive symptoms.

4.11.7 Cross-sectional cognitive performance and work ability

We tested the relationship between cognitive performance and work ability at baseline, controlling for age and education. We also tested interactions between cognitive performance and age in predicting work ability at baseline. Results indicated that only Stroop errors predicted baseline WAI total score (B = -0.11, p<.05). Results also indicated a significant interaction between Stroop interference and age (B= -0.0007, p = .02). To interpret this, simple slopes of work ability on Stroop interference at conditional values of age were tested. This indicated that the direction of the relationship between work ability on Stroop interference differed by age (young: B = 0.007, p = .15; mean age: B = -0.0001; old: B = 0.008, p =.08); that is, higher interference scores had a stronger association to lower baseline WAI total score with age.

4.11.8 Cognitive performance and longitudinal work ability

We tested the relationship between cognitive performance and WAI (total score) at follow-up month 12, controlling for age and education. We also tested two interactions: 1) the interaction with age, and 2) whether these measures interacted with burnout in predicting WAI at 12 months. Results indicated that all relationships between cognitive performance and work ability at 12-month follow-up were non-significant. Results did indicate a significant interaction between switch costs and age (B = -0.0005, p = .03). To interpret this, simple slopes of work ability on switch costs at conditional values of age were tested. This indicated that the direction of the relationship between work ability on switch costs differed by age (young: B = 0.006, p = .13; mean age: B = 0.0, p =.98; old: B= -0.006, p =.10); however, the significance for an age-related deficit was marginal.

There were no significant interactions between cognitive variables and baseline burnout in predicting 12-month WAI.

4.11.8.1 Testing a bi-dimensional model of work ability

In keeping with our objective of examining a bi-dimensional model of work ability, we first had to test the dimensionality of the WAI at the 12-month follow-up.

To confirm the factor structure of the WAI and to test the association of age and burnout to work ability at the 12-month follow-up, we used MIMIC models (Multiple Indicators, Multiple Causes), also known as confirmatory factor analysis (CFA) with covariates (JORESKOG & GOLDBERGER, 1975). This method consists of two

steps. In the first, the adequacy of a measurement model is tested. In the second, factors from this model are linearly regressed on covariates, to identify differences in factor means by level of the covariates. In accordance with MARTUS et al. (MARTUS et al., 2010), we tested the adequacy of four CFA measurement models. In model A, we tested a one-factor solution, with all seven WAI items included. For models B and C, we entered items 1, 2, and 7, along with items 4 and 6, to reflect psychological work ability; and items 3 and 5 to reflect physical work ability. To test the assumption of factor orthogonality, we constrained the covariance between factors in Model B to zero. However, this made the model underjustified. To address this, we constrained the factor loadings in this model to equality, so as to have fewer parameters to estimate. In Model C, we tested the same item structure as in Model B, but freely estimated the covariance between factors. We expanded this in Model D, in which we freely estimated factor covariance. In this model, we also cross-loaded items 4 and 6. This was done because these items assess both psychological and physical work ability. We then linearly regressed factors from the best-fitting model on covariates, including centered burnout and centered age at baseline (Model 1); demographic covariates (sex, education, and nurse type; Model 2); and the interaction between burnout and age (Model 3), controlling for any covariates found to be significant in Model 2. For all models, we reported standardized factor loadings, factor covariances, and latent path coefficients where applicable, with their associated standard errors, significance values, and fit statistics (HU & BENTLER, 1999).

Findings for CFA Model A indicated that although all item loadings were significant, a one-factor solution did not adequately fit observed data [$\chi^2(14) = 121.9$, $p<.001$; SRMR = .09; RMSEA = .15; CFI = .74; AIC = 6866.5]. Findings for Model B also exhibited poor fit [$\chi^2(18) = 140.2$, $p<.001$; SRMR = 0.16; RMSEA = .14; AIC = 6876.7]. Findings for Model C appeared to exhibit better absolute fit [$\chi^2(13) = 95.8$, $p<.001$; SRMR = .08; AIC = 6842.4]. However, fit adjusted for model parsimony was poor (RMSEA = .14), as was fit compared to that of the null model (CFI = .80). In contrast, Model D, the two-factor non-orthogonal solution with items 4 and 6 cross-loaded onto both factors, demonstrated good fit on all indices [$\chi^2(11) = 15.4$, $p = .17$; SRMR = .03; RMSEA = .03; CFI = .99], and comparatively greater fit than other models (AIC = 6765.9), including Model C [LRT: $\chi^2(2) = 80.4$, $p<.001$]. The details of the process are presented in Table 4.12. Because this measurement structure demonstrated good fit in this study and in MARTUS et al. (MARTUS et al., 2010), we used this measurement model for to examine its association to baseline cognitive performance, as well as for subsequent models in section 4.14.

Table 4.12 Confirmatory Factor Analysis of bi-dimensional Work Ability Index

	Model A[a]	Model B[b]	Model C[c]	Model D[d]
WAI[e] item factor loadings (est., SE, *p*-value)[f]				
1: Current work ability	0.67, 0.04, <.001	0.69, 0.05, <.001	0.68, 0.04, <.001	0.70, 0.04, <.001
2: Work ability- demands	0.71, 0.04, <.001	0.62, 0.03, <.001	0.73, 0.04, <.001	0.74, 0.04, <.001
7: Mental resources	0.57, 0.05, <.001	0.60, 0.03, <.001	0.58, 0.05, <.001	0.58, 0.05, <.001
4: Disease impairment	0.45, 0.06, <.001	0.54, 0.03, <.001	0.42, 0.06, <.001	0.18, 0.07, .02
6: Work ability prognosis	0.42, 0.06, <.001	0.34, 0.02, <.001	0.41, 0.06, <.001	0.32, 0.06, <.001
3: Diseases	0.30, 0.06, <.001	0.44, 0.04, <.001	0.62, 0.10, <.001	0.68, 0.07, <.001
5: Sick Leave	0.25, 0.06, <.001	0.72, 0.07, <.001	0.51, 0.09, <.001	0.43, 0.06, <.001
4: Disease impairment	-	-	-	0.64, 0.08, <.001
6: Work ability prognosis	-	-	-	0.20, 0.07, .005
Factor Covariance (est., SE, *p*-value)	-	0	0.42, 0.09, <.001	0.27, 0.09, .002
Fit statistics				
χ^2, df, *p*-value	121.9, 14, <.001	140.2, 18, <.001	95.8, 13, <.001	15.4, 11, .17
SRMR[g]	.09	.16	.08	.03
RMSEA[h], 95% CI	.15, .12-.17	.14, .12-.16	.14, .11-.16	.03, .00-.07
CFI[i]	.74	.70	.80	.99
AIC[j]	6866.5	6876.7	6842.4	6765.9

n = 352. [a]Model A: One-Factor Solution; [b]Model B: Two-Factor Solution, 4 and 6 on WAI Psychological, factor covariance constrained to 0; [c]Model C: Two-Factor Solution, 4 and 6 on WAI Psychological, factor covariance freely estimated; [d]Model D: Two-Factor Solution, 4 and 6 on both factors, factor covariance freely estimated; [e]WAI: Work Ability Index; [f]Standardized parameter estimate (est.), standard error, and p-value reported for each coefficient; [g]SRMR= standardized root mean square residual; [h]RMSEA= root mean square error of approximation; [i]CFI= comparative fit index; [j]AIC= Akaike information criterion

4.11.8.2 Cognitive performance and 12-month work ability (bi-dimensional model)

To assess burnout and depression as predictors of physical and psychological work ability, and to assess whether this relationship is moderated by cognitive functioning, WAI factors reflecting physical and psychological work ability were regressed on

OLBI Exhaustion and PHQ-9 depression, in separate models, controlling for age, with each of these predictors being interacted with AOSPAN absolute operation span, Task Switching (switch costs), and Stroop inhibition. Burnout and measures of cognitive performance were non-significant in predicting either WAI dimension. Interactions between PHQ-9 depressive symptoms and measures of cognitive functioning were non-significant in predicting physical work ability. There was a marginally significant interaction for depressive symptoms and Stroop interference in predicting psychological work ability (B = -0.001, p = .057).

4.12 Structural model of bi-dimensional work ability

We used structural equation modeling (SEM) to test latent paths of PWC to burnout and depressive symptoms, to psychological and physical work ability. The initial plan for this model was to integrate preceding analyses to test the direct and indirect relationships among PWC, burnout, depressive symptoms, and cognition in predicting work ability. However, because cognitive measures in preceding models produced limited results pertaining to this question, we omitted these measures in order to test a more parsimonious model. The testing of the bi-dimensional model was presented in section 4.13.8.1.

We first tested the fit of a confirmatory factor analysis (CFA) model of PWC resources. This consisted of a latent factor including Influence at Work, Degree of Freedom, Opportunities for Development, Role Clarity, Leadership, and Social Support as manifest variables. In keeping with a previous CFA analysis done on these data, we correlated the error terms for Influence at Work and Degree of Freedom. The fit was very good for this model ($\chi^2(8) = 5.89$, p = .66; SRMR = .02; RMSEA = 0.0, 95% CI: 0.0, 0.05; CFI = 1.0), and all of the manifest variables loaded significantly. In subsequent discussion, we refer to this variable as “resources”. We refer to the Quantitative Demands variable as simply “demands”.

We then tested relationships for each step in the path model. These consisted of: 1) the path from the independent variables of PWC demands and resources to the mediating variables of burnout and depressive symptoms, and 2) the path from these variables to psychological and physical work ability. When burnout was regressed on the resources and demands and resources variables, both were found to significant (B = -0.02, p<.001 and B = 0.01, p<.001). The resources and demands variables were also found to significantly predict depressive symptoms (B = -0.19, p<.001 and B = 0.04, p=.02). In models of psychological and physical work ability regressed on burnout, depressive symptoms, and age, burnout was found to both predict psychological and physical work ability (B = -0.58, p<.001 and B = -0.82, p = .004), and depressive symptoms was found to predict psychological work ability only (B=-0.07, p<.001).

To test latent paths, we first tested each of eight indirect paths from independent variables, to mediating variables, to outcome variables, in separate SEM models. Models testing paths from resources via burnout revealed significant indirect and direct paths for resources-burnout-exhaustion-psychological work ability (B = 0.02,

p<.001 and B = 0.02, *p* = .04), but non-significant indirect and direct paths for resources-burnout-physical work ability (B = 0.01, *p* = .07 and B = 0.03, *p* = .10). Models testing paths from resources via depressive symptoms revealed significant direct and indirect paths for resources-depressive symptoms-psychological work ability (B = 0.02, *p* = .01 and B = 0.02, *p*<.001), and non-significant indirect and direct paths for the resources-depressive symptoms-physical work ability (B = 0.008, *p* = .34 and B = 0.04, *p* = .06).

Models testing paths from demands via burnout revealed a significant indirect effect and non-significant direct effect for demands-burnout-psychological work ability (B = -0.01, *p*<.001 and B = -0.002, *p* = .55), and a significant indirect path and non-significant direct path for demands-burnout-physical work ability (B = -0.01, *p*<.001 and B = 0.002, *p* = .75). Models testing paths from demands via depressive symptoms revealed significant indirect and direct paths for demands-depressive symptoms-psychological work ability (B = -0.007, *p*<.001 and B = -0.008, *p*=.01), and a significant indirect path and non-significant direct path for demands-depression-physical work ability (B = -0.004, *p* = .02 and B = -0.006, *p* =.39).

We then conducted a model with all paths in it. Results were similar (see Table 4.13, Model 1), though some indirect and direct effects lost significance. Those that lost significance included 1) the direct path of resources in predicting psychological work ability (B = 0.01, *p* = .18), 2) the direct path of demands in predicting psychological work ability (B = -0.004, *p* = .30), 3) the indirect path of demands-burnout-physical work ability (B = -0.004, *p* = .26), 4) indirect path of demands-depression-physical work ability (B = 0.0, *p* = .89). Fit for this full model was somewhat poor ($\chi^2(91)$ = 245.0, *p*<.001; SRMR = .06; RMSEA = .07, 95% CI: .06-.08; CFI = .88).

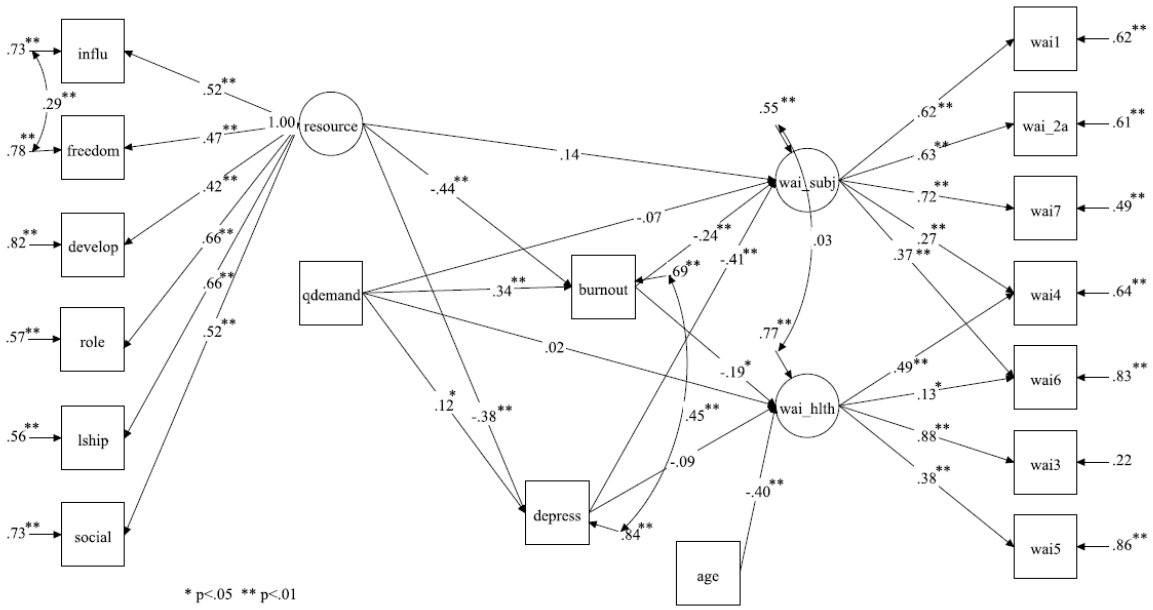
In our final model, we included only indirect paths that were significant in the full model. Also, to account for the unique relationship between exhaustion burnout and depression, we included a residual covariance between these. In addition, we included a direct effect between age and physical work ability, given the association found between these in previous models. We found fit for this model to be adequate ($\chi^2(105)$ = 236.91, *p*<.001; SRMR = .06; RMSEA = .06, 95% CI: .05-.07; CFI = .91). Findings for this model revealed all indirect paths to be significant. This included the burnout-mediated path from resources to psychological work ability (resources-burnout-psychological work ability: B = 0.009, *p* = .01), and the depression-mediated path between resources and psychological work ability (resources-depressive symptoms-psychological work ability: B=0.01, *p*<.001; see Table 4.13 Model 2). There were also significant results for the burnout-mediated path from demands to psychological work ability (demands-burnout-psychological work ability: B = -0.005, *p* = .01), and the depression-mediated path from demands to psychological work ability (demands-depressive symptoms-psychological work ability: B = -0.003, *p* = .02). There was a significant result for the burnout-mediated path from demands to physical work ability (demands-burnout-physical work ability: B = -0.009, *p* = .02). The residual covariance between burnout and depressive symptoms was also significant (B = 0.73, *p*<.001). Figure 4.2 displays relationships among these variables.

Table 4.13 Latent Path Model of WAI Psychological and WAI Physical, burnout, depressive symptoms, work culture, and job demands

	Model 1		Model 2	
	Est.[c]	95% CI	Est.	95% CI
Direct Effects				
burnout on				
resources	-0.03	-0.04, -0.02	-0.02	-0.03, -0.02
demands	0.01	0.007, 0.01	0.01	0.008, 0.01
R^2	.40		.31	
depression on				
resources	-0.26	-0.36, -0.17	-0.19	-0.27, -0.12
demands	0.04	0.002, 0.07	0.04	0.01-0.07
R^2	.27		.16	
WAI Psychological on				
resources	0.01	-0.005, 0.03	0.01	-0.001, 0.004
demands	-0.004	-0.01, 0.003	-0.004	-0.01, 0.004
Burnout	-0.41	-0.74, -0.11	-0.44	-0.76, -0.15
depression	-0.07	-0.10, -0.04	-0.07	-0.09, -0.04
R^2	.41		.45	
WAI Physical on				
resources	0.03	-0.01, 0.08	-	-
demands	0.001	-0.02, 0.02	0.003	-0.02, 0.02
Burnout	-0.45	-1.11, 0.41	-0.83	-1.42, -0.12
depression	-0.005	-0.06, 0.06	-0.04	-0.09, 0.02
Age	-	-	-0.07	-0.09, -0.04
R^2	.08		.23	
Indirect Effects[j]				
resources-burnout-WAI psychological	0.01	0.003, 0.02	0.009	0.003, 0.02
resources-burnout-WAI physical	0.01	-0.01, 0.03	-	-
resources-depression-WAI Psychological	0.02	0.009, 0.03	0.01	0.007, 0.02
resources-depression-WAI Physical	0.001	-0.02, 0.02	-	-
demands-burnout-WAI Psychological	-0.004	-0.008, -0.001	-0.005	-0.009, -0.002
demands-burnout-WAI Physical	-0.004	-0.01, 0.004	-0.009	-0.02, -0.002
demands-depression-WAI Psychological	-0.002	-0.005, 0.0	-0.003	-0.006, -0.001
demands-depression-	0.0	-0.003, 0.002	-	-

WAI Physical				
Covariances				
WAI Psychological with WAI Physical	0.10	-0.08, 0.30	0.04	-0.14, 0.23
burnout with depression	-	-	0.73	0.54, 0.94
Fit statistics				
χ^2, df, *p*-value	245.0, 91, <.001		263.9, 105, <.001	
SRMR[f]	.06		.06	
RMSEA[g], 95% CI	.07, .06-.08		.06, .05-.07, .91	
CFI[h]	.88		.91	

Key: Burnout = Exhaustion scale of Oldenburg Burnout Inventory; Depressive symptoms = PHQ-9; WAI = Work Ability Index. Job demands = Quantitative Demands scale of the Copenhagen Psychological Questionnaire



Key: Quantitative Demands, Influence at Work, Degree of Freedom at Work, Possibilities for Development, Role Clarity, Leadership, Social Support subscales from the COPSOQ; burnout = OLBI Exhaustion, depress = PHQ-9; wai_subj = WAI Psychological; wai_hlth = WAI Physical

Figure 4.2 Latent Path Model of 12-month WAI Psychological and WAI Physical, burnout, depressive symptoms, work culture, and job demands

Findings from the SEM about the relationship of burnout to both psychological and physical work ability, and the relationship of older age to worse physical work ability led us to examine an additional question related to age and work ability in the context of burnout. Consistent with the SEM model, burnout was associated with diminished psychological and physical work ability dimensions (B = -1.06, *p*<.001 and B = -1.02, *p*<.001), while older age was associated with diminished physical work ability only (B = -1.02, *p*<.001). Fit statistics for this model indicated acceptable fit [$\chi^2(21) = 52.15$,

p<.001; SRMR = 0.04; RMSEA = .07; CFI=.94]. Findings did not change markedly with inclusion of covariates (Model 2), though the effect for nurse certification was statistically significant, in that nurses with certifications other than RN exhibited diminished psychological work ability (B = -0.60, *p* = .02). Because nurse certification was significant, it was retained in Model 3, which tested the interaction between age and burnout.

In Model 3, we found significant interactions between age and baseline burnout for both physical work ability (B = -0.06, *p* = .004) and psychological work ability (B = -0.03, *p* = .001), with fit statistics indicating acceptable fit [$\chi^2(31) = 65.98$, *p*<.001; SRMR = .04; RMSEA = .057, 95% CI: .04-.08; CFI = .94]. To interpret the interactions, we tested and plotted simple slopes of age in predicting work ability outcomes at different conditional values of burnout (the mean, and 1.0 and 1.5 standard deviations below and above the mean). As shown in Figure 4.3, findings revealed that at low (1 SD below mean), mean, and high (1 and 1.5 SDs above mean) levels of burnout, higher age increasingly predicted diminished physical work ability (1 SD below: B = -0.04, *p* = .01; mean: B = -0.07, *p*<.001; 1 SD above: B = -0.09, *p*<.001; 1.5 SD above: B = -0.11, *p*<.001), while at very low levels of burnout (1.5 SD below mean), age was unrelated to physical work ability (B = -0.02, *p* = .21). With respect to psychological work ability (see Figure 4.4), results indicated that at mean levels of burnout, age did not predict psychological work ability (B = 0.00, *p* = .93); however, at higher levels of burnout (1 and 1.5 SDs above the mean of OLBI Ex), higher age predicted diminished psychological work ability (1 SD above: B = -0.02, *p* = .009; 1.5 SD above: B = -0.02, *p* = .003). In contrast, at lower levels of burnout (1 and 1.5 SDs below the mean), higher age predicted increased psychological work ability (1 SD below: B = 0.02, *p* = .03; 1.5 SD below: B = 0.02, *p* =.008).

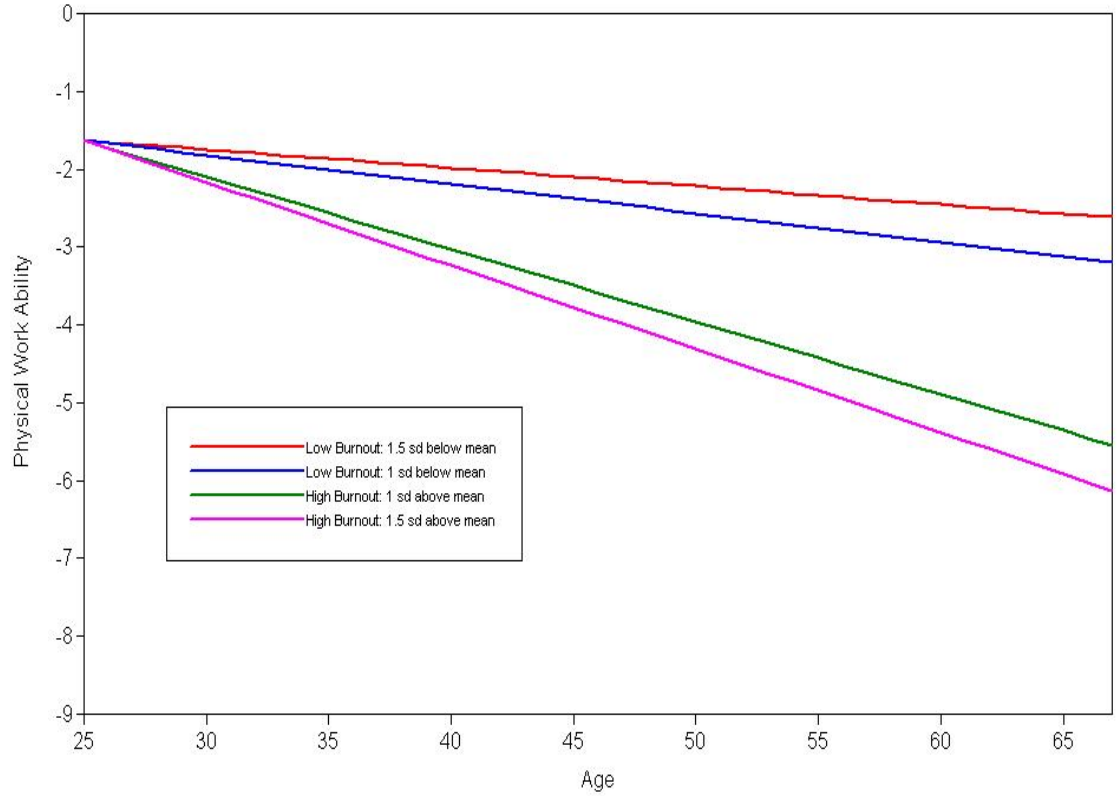


Figure 4.3 Interaction of age and baseline burnout predicting physical work ability

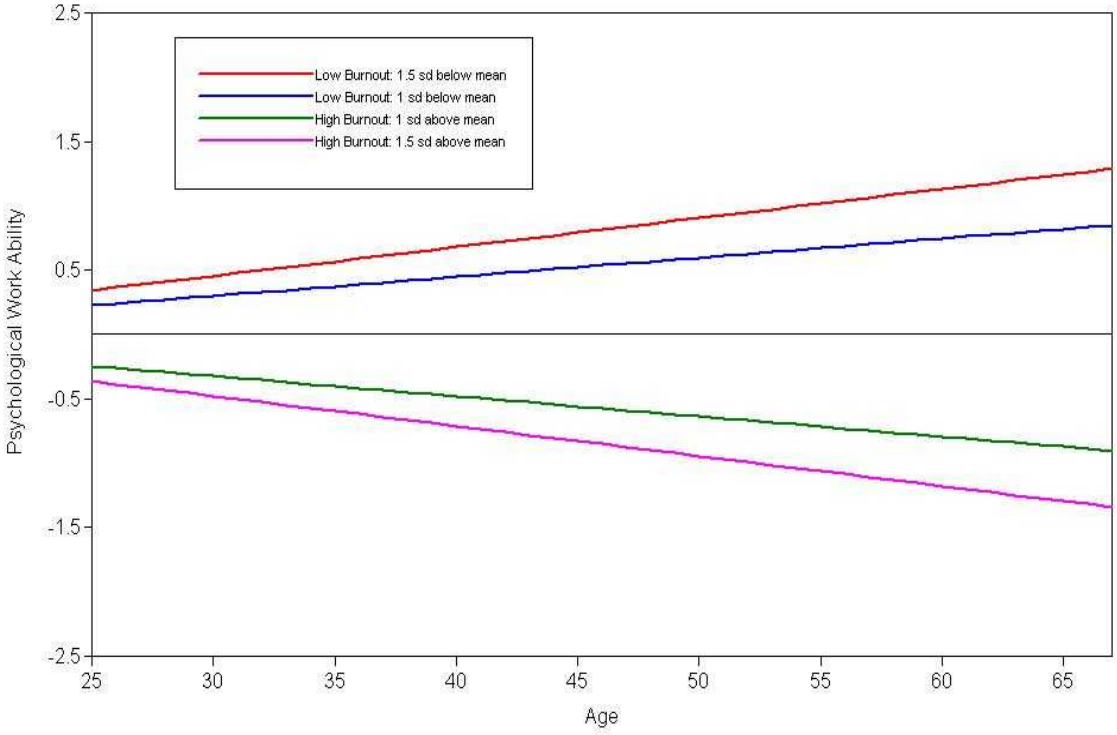


Figure 4.4 Interaction of age and baseline burnout predicting psychological work ability

4.13 Interactions of PWC as job demands and resources (longitudinal)

Based on the results from the preceding section (4.14), we conducted latent variable models to assess Quantitative Demands and the job resource latent factor as predictors of chronic burnout, controlling for age and education. We also tested the interaction between Quantitative Demands and the resource latent factor in predicting chronic burnout. This objective was to further test the role of demand-by-resource interactions in the JD-R model. Results indicated higher Quantitative Demands and lower resources to be associated with higher chronic burnout (B = 0.009, p<.001; B = -0.02, p<.001). Findings also indicated a significant interaction between these two variables (B = 0.001, p = .02). To interpret this, we tested simple slopes of chronic burnout on the resource latent factor at conditional values of Quantitative Demands (1 SD below the mean, the mean, and 1 SD above the mean). This indicated that the relationship between lower resources and higher chronic burnout was stronger at higher values of Quantitative Demands (low: B = -0.01, p<.001; mean: B = -0.02, p<.001; high: B = -0.02, p<.001). This is consistent with the JD-R framework, indicating that Quantitative Demands are more stongly predictive of chronic burnout when job resources are low.

We also conducted latent variable models to assess Quantitative Demands and the resource latent factor as predictors of chronic depression, controlling for age and education, and tested the interaction between Quantitative Demand and the resource latent factor in predicting chronic depression. Results indicated higher Quantitative Demand and lower resources to be associated with higher chronic depression (B = 0.05, p<.001; B = -0.15, p<.001). Findings did not indicate a significant interaction between these two factors (B = 0.07, p = .19).

5 Summary

5.1 PWC, burnout, and depressive symptoms

Analysis of the influences PWC on burnout and depressive symptoms yielded several important results. One of the findings was that PWC as assessed by the COPSOQ broadly followed the JD-R framework, in that job demands or stressors were adverse to emotional health, whereas job resources were beneficial (BAKKER et al., 2005). PWC reflecting greater job demands (Quantitative Demands) or stress (Job Insecurity) were associated with higher levels of burnout and depressive symptoms. Conversely, PWC reflecting greater resources for work organization (Influence, Development, Freedom) and interpersonal factors (Role Clarity, Social Support, Leadership) were associated with lower levels of burnout and depressive symptoms. In cross-sectional analysis designed to identify PWC with unique contributions to burnout and depressive symptoms, we found that Quantitative Demands, Job Insecurity, Social Support, and Quality of Leadership were commonly associated with exhaustion-related both burnout and depressive symptoms, but that no PWC related to work organization were uniquely associated with depressive symptoms in cross-sectional models.

Our testing of moderating effects of job resources falls in line with recent research on the JD-R, which suggests that the buffering effects of resources may be smaller and more selective than portrayed theoretically (HU et al., 2011). Only some PWC had significant demand-by-resource interactions, and there were more interactions found for burnout than for depressive symptoms. Role Clarity, Social Support, and Quality of Leadership each moderated the association between Quantitative Demands and burnout. With respect to depressive symptoms, Quality of Leadership moderated the association between Quantitative Demands and depressive symptoms. This suggests Leadership Quality may be a resource for buffering both burnout and depressive symptoms. Despite the fact that moderators were not entirely consistent across the constructs of burnout and depressive symptoms, the plots of the interactions (Figure 4.1) revealed a common pattern. In each case, differences between low and high levels of the moderating resources were greatest at the lowest levels of Quantitative Demands, but converged to become relatively undifferentiated when Quantitative Demands were approximately one standard deviation above the mean, equivalent to above-average levels of burnout symptoms. Our research appears to suggest that once this threshold of Quantitative Demands is crossed, there is a steep diminishing benefit of these job resources.

Our longitudinal analysis confirmed that there is a strong reciprocal relationship between burnout and depressive symptoms over the period of 12 months, which was consistent across acute, chronic, and cross-lagged measurement approaches. The is the first study we are aware of that examined the temporal relationship in multiple ways, and the broad agreement across the approaches supports that burnout and depressive symptoms mutually influence each other, despite existing as distinct constructs.

Addressing Research Question 1, our longitudinal analysis of chronic emotional health outcomes revealed some similarities to cross-sectional models, but also some differences. The main similarity was the potency of Quantitative Demands on burnout and depressive symptoms. It was the common predictor to both chronic depressive symptoms and chronic burnout symptoms; however, we found that the association between Quantitative Demands and depressive symptoms was mediated by exhaustion-related burnout. This is consistent with a fundamental premise of the JD-R framework that has been examined in few studies (AHOLA & HAKANEN, 2007). The novel contribution of this analysis is that it was done with the COPSOQ.

Of note, while burnout mediated the association of PWC to chronic depression, the converse was not true. Three PWC (Quantitative Demands, Job Insecurity, and Influence at Work) were significant predictors of chronic burnout in models that also included depressive symptoms. One way the longitudinal models differed from the cross-sectional models was the emergence of a job resource variable, specifically Influence at Work, as a predictor of chronic burnout. This reinforces the argument that PWC are more strongly related to burnout than to depressive symptoms, which is also seen by the relatively larger R^2 for models predicting burnout compared to models predicting depressive symptoms.

Finally, we did conduct one analysis that provided stronger support for demand-by-resources interaction in the JD-R model. When we tested a latent variable of job resources composed of weighted contributions of six COPSOQ scales, we did find a significant moderating effect indicating that low job resources increased the adverse effect of Quantitative Demands on chronic burnout (or conversely, that high resources may have a buffering effect). This suggests that it may be more powerful to view job resources as an aggregation of several PWC, rather than just one. This is similar to the idea of a positive “organizational climate,” wherein several positive PWC synergistically contribute to job satisfaction (BRONKHORST et al., 2015). Such an approach would be consistent with the JD-R model, which assumes a distinct work culture for each workplace (SCHAUFELI & TARIS, 2005). Because the specific combination of PWC may differ across occupational settings, research should be conducted to determine which combinations or weightings of PWC are most beneficial within a specific occupation or workplace. For instance, in the case of the current nursing cohort, Quality of Leadership, Role Clarity, and Social Support were particularly salient resources. These characteristics are more consistent with the elements of organizational climate, which is argued to be rooted in social characteristics of work rather than characteristics related to job control.

5.2 Cognitive performance

Addressing Research Question 2, many cognitive findings regarding PWC were modest in the current study, but there were some results of interest. Several baseline PWC were associated with baseline cognitive performance, but findings were not consistent across cognitive measures. This makes it difficult to determine an overall pattern explaining how PWC are related to cognitive function; however, it was

generally the case that higher levels of job demand/stressor (Quantitative Demands and Job Insecurity) were associated worse cognitive performance across some measures, while higher levels of some job resources were associated with better cognitive performances across some measures. Because the data were cross sectional, it is difficult to assess causally whether these cognitive findings were due to something in the nature of the PWC, or whether cognitive performance places individuals in situations where specific PWC are more salient. It was beyond the scope of the current study to assess cognition longitudinally, but more longitudinal research is needed to better understand the nature of these relationships.

Addressing Research Question 3, we did find a pattern of higher burnout symptoms associated with slower single-task reaction time (RT), which was present in both cross-sectional and longitudinal analyses, but which was not associated with depressive symptoms. Our results add to the current literature in finding that RT slowing is associated with burnout symptoms (OSTERBERG et al., 2009; OOSTERHOLT et al., 2014). This includes one project funded by the BAuA that, similar to our results. found RT slowing was more strongly associated with burnout symptoms than with depressive symptoms (GAJEWSKI et al., 2017). This adds a dimension of cognitive data to the argument that exhaustion-related burnout and depression have distinct clinical correlates (BAKKER et al., 2000; SHIROM & EZRACHI, 2003; TOKER et al., 2005; AHOLA et al., 2014). Our findings may reflect the fact that cognitive, physical, and emotional exhaustion as assessed by the OLBI is more homogenous and directly relevant to information processing speed than the more heterogeneous construct of depression as assessed by the PHQ-9. In fact, some evidence suggests the exhaustion dimension of burnout may be more closely related to chronic fatigue than to depression, as chronic fatigue is another stress-related condition associated with deficits in information processing speed (HUIBERS et al., 2003; LEONE et al., 2011).

The finding that none of the measures of executive function were associated with burnout might have been expected because executive functions are often viewed as higher order cognitive processes (DIAMOND, 2013), whereas simple RT is often viewed as a lower order cognitive process. However, several studies have found information processing speed to mediate deficits in executive function in a number of populations, including children (MULDER et al., 2011), older adults (SALTHOUSE, 1996), and individuals with cardiovascular disease (LIEBEL et al., 2017). This suggests information processing speed as assessed by simple RT tasks may be a sensitive predictor of exhaustion in a way that is not as well-captured by measures of executive function. We note that our cognitive findings were in a sample of working individuals, whereas past cognitive findings in burnout were in samples with clinically significant and disabling levels of burnout (OSTERBERG et al., 2012; JONSDOTTIR et al., 2013). We conclude that the association between higher exhaustion-related burnout and slower RT in working adults merits further research.

We generally found weak and inconsistent associations between cognitive performance and the outcomes of depressive symptoms and work ability. We did find some instances of age moderating relatively greater deficits in cognitive performance in cross-sectional burnout, depressive symptoms, and work ability, but these findings were not consistent across measures.

The current cognitive results are consistent with the idea that individuals can generally summon sufficient task-related cognitive resources when required (KAHNEMAN, 1973). There is modest data suggesting information processing speed is adversely affected by higher burnout symptoms, and inconsistent indications that older adults are more vulnerable to deficits in cognition under mental strain. The preponderance of negative findings, however, appears to run counter to the argument of COR theory that cognitive resources are particularly vulnerable to chronic stress (HOCKEY, 1997). Most of the positive findings related to burnout and cognition in the existing literature involved individuals who were suffering from a clinically significant psychological illness, such that they could no longer function at work (OSTERBERG et al., 2012; JONSDOTTIR et al., 2013). Our results suggest individuals who have burnout and depressive symptoms but are unable to functionally work may reflect a different population or different (and more severe) level of illness than those who remain able to work.

Although there are caveats to our findings (see below), we believe these data provide a positive message for cognitive health in the workplace. Although there is modest evidence that individuals with greater symptoms of exhaustion-related burnout have slower reaction times, these findings were not seen on tests of executive functions. One possible interpretation is that individuals suffering from non-disabling levels of job stress, burnout, and depressive symptoms may show some level of enhanced attentional control (KAHNEMAN, 1973) and/or cognitive reserve (STERN, 2009) when executive functions are required, such that performance is not significantly compromised. However, we can only make this assertion on the basis of cross-sectional and 12-month assessments, and findings may differ with chronic burnout and depressive symptoms sustained over longer time periods.

Overall, we believe existing literature support the idea that cognitive deficits associated with the effects of psychosocial strains in the workplace are likely a more distal and often indirect later-life outcome of work-related stress, emerging most likely from chronic medical conditions, which may themselves be related to chronic physical and mental strain in the workplace. Chronic diseases such as heart disease, stroke, and diabetes, are major sources of disability and are each associated with a greater risk of cognitive decline and dementia (Gottesman et al., 2014; Norton, Matthews, Barnes, Yaffe, & Brayne, 2014; Yaffe et al., 2014). Chronic medical conditions are also associated with chronic job strain (KIVIMAKI et al., 2012; NYBERG et al., 2014). This suggests that effects of job strain may exacerbate the association between chronic medical conditions and cognitive decline later in life. This may be a greater concern among older workers, who have been shown greater physiological stress in response to high job demands and take longer to recover from work stress (RITVANEN et al., 2006; KISS et al., 2008). In our opinion, the work by ANDEL and colleagues (ANDEL et al., 2011; ANDEL et al., 2012) provides the most compelling support to date for this perspective. Based on this literature, we would argue that preventing burnout and depressive symptoms is still relevant to preserving cognitive function, but is best served by a focus on reducing the prevalence and severity of chronic medical conditions that are exacerbated by work-related stress (e.g., cardiovascular disease, diabetes), in order to maximize cognitive reserve for later life. This of course includes interventions to reduce the effects of burnout on physical health.

There are caveats to the interpretation of our cognitive results. One caveat is the idea of ecological validity, which reflects the predictive relationship between an individual's performance on a cognitive test and his or her performance in real-world contexts, in this case the context of work performance (SPOONER & PACHANA, 2006). Research on ecological validity suggests that while many cognitive and neuropsychological tests have moderate ecological validity when predicting everyday functions, the strongest correlations occur with better matches between the task and the outcome measure (CHAYTOR & SCHMITTER-EDGECOMBE, 2003). This reflects a distinction, and potential limitation, between laboratory tests of cognitive functions as used in the current study and various approaches to assessing job task performance in the workplace. The advantage of laboratory tests of cognitive function is that they are designed with high levels of control to minimize extraneous confounds to the specific cognitive processes of interest. As such, they are administered according to standardized procedures, often using computers for reliable stimulus presentation and response timing, and in quiet, closed settings that minimize external distractions such as noise. In this sense, laboratory testing is an artificial context compared to a work environment filled with uncontrolled distractions, but ecologically valid tests have also proven difficult to administer with measures that are standardized, unconfounded, and well-validated. Bringing participants into a laboratory setting is designed to elicit the individual's optimal cognitive performance. It is possible that testing participants outside of their immediate work setting elicits better performance because it removes them from the context that contributes to their stress, burnout, and depressive symptoms. This is consistent with the idea of burnout being dependent on work context, and suggests that testing individuals with work-related burnout and depressive symptoms in a new and optimal setting may be sufficient normalize their performance. This would be a positive outcome for individuals, in that it suggests resilience of cognitive function with a change of context. What the current study was unable to determine was whether cognitive deficits are present in the context of the workplace, or possibly with tasks that are designed with more ecological validity to specifically resemble workplace function. Future research could compare laboratory measures with ecologically designed assessments to determine whether the latter approach produces different relationships to PWC, burnout, and depressive symptoms.

Another caveat to our interpretation is that levels of cognitive reserve may differ across occupations. Nursing is a cognitively complex occupation, and it has been shown that occupational complexity has a protective effect on late-life cognitive function that many interpret as reflecting cognitive reserve (BOOTS et al., 2015). Many nursing certifications require a college degree or higher, which means that the educational level in our studied occupation of nursing is higher than in occupations more related to unskilled or semi-skilled labor. Given that education is often a proxy for cognitive reserve (STERN, 2002), it is possible that stressors related to PWC, burnout, or depressive symptoms may have a greater effect on cognitive performance in less cognitively complex work, or in occupations characterized by lower levels of education.

5.3 Work Ability

We conducted structural equation models that revealed insights about the relationships among demands, resources, and work ability. We found that job demands and job resources both had significant indirect effects on the psychological dimension of work ability, with indications of mediation by both burnout and depressive symptoms. In contrast, there was only one significant path to physical work ability, which suggests that job demands are indirectly associated with physical work ability via mediation by burnout, but not via mediation by depression. Moreover, greater age showed interesting interactions with burnout in predicting psychological work ability. We found that both low and high levels of burnout exacerbated the negative association between age and physical work ability. For psychological work ability, in contrast, older workers deviated by level of burnout: they had better psychological work ability than younger workers at lower levels of burnout, and worse psychological work ability at higher levels of burnout.

Although the WAI has been previously examined with respect to its bi-dimensional structure, previous studies have not examined whether burnout and depressive symptoms differentially affect these dimensions of work ability. The current findings are novel in this regard, and provide further evidence that work ability is not a unitary construct. In addition, we replicated the bi-dimensional model proposed by MARTUS et al. (MARTUS et al., 2010) in a North American sample. We argue that work ability should be assessed with respect to individual psychological and physical dimensions, particularly among older workers. In addition, our findings highlight the potency of COPSOQ Quantitative Demands as a job stressor, as it was a contributor to lower longitudinal scores in both psychological and physical work ability. This was also true of (exhaustion-related) burnout, which had direct negative effects on both psychological and physical work ability, whereas depressive symptoms were only related to psychological work ability. This suggests that exhaustion-related burnout may have more adverse consequences for physical health than depressive symptoms, at least in relation to the ability to work. This supports the conceptualization of burnout as not only part of a health impairment process (BAKKER & DEMEROUTI, 2007), but as a major driver of potential impairment.

5.4 Work and aging

Addressing Research Question 4, our analyses showed some protective benefits of age in the workplace, in that greater age was associated with lower levels of burnout and depressive symptoms. This was consistent across both cross-sectional and longitudinal models, though this potential benefit did not appear to extend to work ability. One explanation for these findings may lie in research showing better emotional regulation and emotional selectivity with age (CARSTENSEN et al., 2003; URRY & GROSS, 2010). Socioemotional selectivity theory suggests that there is a bias toward emotionally meaningful activities with age. It is possible, for instance, that older workers are more likely to focus on meaningful and supportive social relationships in the workplace, which the current project found is associated with

lower levels of burnout and depressive symptoms. Another reason may be a form of survivor bias, in that older workers have remained in their jobs because they have been less susceptible to burnout and depressive symptoms over the years, whereas some of the younger workers may be expected to leave nursing in the future due to a lesser capacity to tolerate the stress of this occupation. Unfortunately, we do not have the data in the current study to explore these explanations further.

With respect to cognitive findings, we found that most cognitive performances were worse with increasing age, which fits the patterns of a large and well-established literature on cognitive aging, particularly with respect to executive functions, information processing speed, and memory (SALTHOUSE, 2004; INSTITUTE OF MEDICINE, 2015). Despite this fact of aging, we did not find enough consistent evidence to suggest that cognitive aging presents a vulnerability to burnout, depressive symptoms, or work ability. This may be particularly important on the question of work ability, which suggests that despite a normal decline of cognitive performance with age, most individuals perceive themselves to have sufficient cognitive capacity to perform their job tasks. These can be considered positive findings for older workers who may either want or need to work into older ages. It may also be evidence to combat stereotypes of lesser cognitive aptitude among older workers, which can be a source of discrimination in hiring older workers (ABRAMS et al., 2016).

Finally, our study provided interesting results regarding aging and work ability. Psychological aspects of work ability were comparable for younger and older workers overall, but we also found that the psychological dimension of work ability is more vulnerable among older workers at higher levels of burnout-related stress. In addition, physical work ability is made worse at even low levels of burnout. In this case, it appears the accumulation of physical health problems with age can be a source of work disability that is worsened by exhaustion-related burnout. Maintaining stable work ability in older workers appears to be strongly related to managing burnout and the PWC that may engender it.

5.5 Limitations

There are some limitations to our project. We used a convenience sample of nursing workers in one health system, which may introduce unintended bias and reduce generalizability. There is potential for selection bias if mostly healthy, nursing workers with low burnout symptoms were more likely to participate. However, our baseline burnout scores were comparable to those reported in a study of European nurses (INNSTRAND et al., 2011). Our sample was also demographically similar to the overall nursing workforce in the health system we studied, which argues against systematic selection bias related to disparities in participation due to racial or ethnic differences. There are also disadvantages to studying a single occupation, as it may not generalize to other occupations. Despite this, we note that nursing is frequently studied with respect to burnout across multiple countries (AIKEN et al., 2013). We believe that the current results are relevant to other human service professions and perhaps more broadly to other occupations, but this should be tested in future

research. Finally, with a mean age of 42 years, many of the older workers in our sample are closer to midlife than later life; however, this is consistent with evidence indicating individuals with reduced work ability and burnout in mid-career are at higher risk for early retirement (CAMERINO et al., 2006), and with approaches emphasizing interventions in midlife to maintain health and ability in late life (DANAEI et al., 2013; SZOEKE et al., 2016).

The strengths of the current study include longitudinal modeling of multiple PWC, burnout, depressive symptoms, and work ability in an occupational group at high risk for burnout. We also excluded individuals with elevated burnout and depressive symptoms at baseline in longitudinal models predicting these outcomes; this is a strong control for symptom confounding, the lack of which was a weakness in several prior studies. Our study also included sensitive and well-validated paradigms for assessing executive function performance at study baseline.

6 Outlook

6.1 Outlook for job insecurity and job demands

The outlook for reducing mental strain in the workplace is challenging based on current social and economic trends. The global economic crisis that started in 2008 has resulted in changes to work and employment models that have broadly increased job insecurity. A major change, for instance, comes in the form of non-permanent work contracts (HEYES, 2011). In addition, due to increased economic pressures in many sectors, such as nursing, a push toward smaller workforces or lower staff-to-patient ratios have increased overall job demands and stress. This is consistent with the finding in our study that the two main drivers of burnout and depressive symptoms were high job insecurity and high quantitative demands. Job insecurity is driven in part by macroeconomic factors that may be challenging to overcome at the organizational level, and which may be practically and politically difficult to successfully resolve through social policy (HEYES, 2011). Increased job demands may be a consequence of organization and leadership practices, but macroeconomic pressures drive decisions about staffing, wages, and benefits as well. A combination of findings from the current study as well as related literatures suggest there are no single approaches, but rather a constellation of approaches across policy, organizational, and individual levels. Policy recommendations are beyond the scope of this study, but there are organizational and personal approaches to both job security and job demands that are common across the research literature. Several of these recommendations apply to issues of both job insecurity and quantitative demands. These recommendations are adapted from work by PROBST and colleagues (PROBST et al., 2015)

Organizational:

1. Provide opportunities for job control and decision-making autonomy
2. Prioritize open, two-way communication between employees and supervisors, particularly during organizational changes
3. Promote a climate that values justice, trust, and safety
4. Provide opportunities for skill development.

Individual:

1. Seek out and request training opportunities that will maintain employability
2. Develop social support networks within the work context
3. Develop professional networks that can provide new job opportunities if needed.

With respect to stress-related to job insecurity, countries differ on their policies regarding permanent vs. temporary work contracts, resources for skills training, and levels of assistance or protection for unemployed and part-time workers. In economies where such protections are low, it may be important for individuals to shift

their personal perspective from a “job security mindset” to an “employability mindset” (HEYES, 2011)
With respect to stress related to high job demands, our data indicated that three COPSOQ scales in the domain of interpersonal relationships were most strongly associated with perceived stress due to Quantitative Demands at work: Role Clarity, Social Support, and Quality of Leadership. This strongly suggests many types of workload can be less stressful under conditions of team work, clear objectives, and clear delineation of areas of responsibility among individuals and teams. In most cases, cultures of effective work communication are set by managers and supervisors, who need to be trained to provide the work objectives, resolve role-based misunderstandings, and promote job satisfaction. We would recommend more research and training on how to establish a positive “organizational climate” to promote workplace mental health, and how it might be defined in different work contexts. A few research reviews offer general suggestions on how to best design and implement occupational mental interventions, including organizational climate and culture, but acknowledge that more research is needed (NIELSEN et al., 2010; LINZER et al., 2015). It has also been argued that ongoing psychosocial risk assessment is an important part of the intervention process (NIELSEN et al., 2010; SHANAFELT & NOSEWORTHY, 2017). We argue that the COPSOQ has both the validity and flexibility to be a useful tool for this type of research.

6.2 Outlook for burnout and depressive symptoms in the workplace

Despite our initial emphasis on depression as an occupational health risk, our results indicate that risk for depression in a work context is strongly influenced by psychosocial work characteristics, but even more so by burnout. An important finding from our study was that burnout fully mediated the association between psychosocial work stress and chronic depressive symptoms, while depressive symptoms were an inconsistent and partial mediator of chronic burnout. This indicates that lowering the prevalence of workplace depression should be led by interventions to lower levels of burnout. That is, by addressing the fundamental issue of burnout as a driver of health impairment, both burnout and depressive symptoms may be reduced, and with the prospect of improving psychological and physical work ability.

At the current time, the outlook for interventions to improve workplace burnout is mixed. A recent systematic review and meta-analysis (AHOLA et al., 2017) concluded that it is “impossible to draw guidelines regarding how to treat burnout (pg. 9).” The review noted there is a need to expand on the few studies focused on treating acute burnout, and suggest a future focus on interventions aimed at treating acute stress and burnout, with the goal of preventing chronic symptoms. Our research supports this approach. In the AHOLA et al. review, evidence for the efficacy of individual approaches was deemed unreliable at the current time, and it was argued that future interventions should focus on both individual and organizational elements. A relatively recent Cochrane review found modest support for flexibility of work hours in reducing stress, but also argued that more focus is needed on reducing specific work stressors (RUOTSALAINEN et al., 2015). Both

studies call for more randomized controlled trials comparing target interventions to a relevant alternative or “placebo” intervention.

In order to support this goal, we recommend regular monitoring of workplace stress, burnout, and depressive symptoms, in order to identify individuals at risk for chronic issues. The OLBI, PHQ-9, and COPSOQ all showed promise as measures for these monitoring purposes. Our study also demonstrated that such monitoring can be done cost effectively with electronic surveys, though we strongly recommend from our experience that human engagement and rapport between surveyors and participants is needed to reach high completion rates.

6.3 Outlook for older workers

The outlook for older workers predicts a need for individuals to work longer in many developed countries to offset lower birthrates and higher age-dependency ratios. Our data indicate many positive factors for older workers with particular respect to mental health. Our data find that greater age in the nursing workforce is associated with lower levels of burnout and depressive symptoms, but we also found that burnout needs to be managed to low levels in older workers to avoid deficits in work ability. In addition, while older participants performed worse than younger participants on cognitive tasks, these differences did not appear to substantially affect mental health or work ability. This suggests that in most occupations, cognitively and physically healthy older workers can be expected to maintain the capacity to engage in productive work. The challenge that does exist for older workers is in the physical aspect of work ability, which is lower among older workers, and worsened with higher levels of burnout. This appears to be largely driven by the accumulation of chronic medical conditions, which may be caused by chronic stress or injury. This suggests that injury prevention and physical wellness programs may be important in helping individuals maintain the longevity of their work ability. This, along with mental wellness programs, can also promote long-term cognitive health. Interventions should also include age-friendly workplace designs and ergonomic considerations (KNAUTH et al., 2005). Current and previous research (MARTUS et al., 2010) finding differential outcomes for psychological and physical work ability suggest that a measure accounting for both dimensions of work ability may be more useful for assessing older workers than one that does not make this distinction. New measures of work ability may need to be developed to more extensively consider psychological versus physical dimensions.

The caveat to these recommendations is data showing that individuals with higher levels of education and training remain in the labor force longer than individuals with lower levels (VENTI & WISE, 2015), and our sample was generally well educated. The implication of this is that additional attention may need to be paid to how educational and other social disparities impact long-term work ability.

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Annex

Annex 1 Additional scales administered in study

Scale	Reference	Participants completed (n)
Effort-Reward Imbalance	(SIEGRIST, 1996)	400
Job Content Questionnaire	(KARASEK et al., 1998)	402
Inventory of Depressive Symptoms-SR	(RUSH et al., 1996)	402
Health and Work Performance Questionnaire	(KESSLER et al., 2004)	400
Stanford Presenteeism Scale	(KOOPMAN et al., 2002)	401
Probabalistic Reward Task	(PIZZAGALLI et al., 2005)	257
Lexical Fluency	(LEZAK et al., 2012)	402
American National Adult Reading Test	(SPREEN & STRAUSS, 1998)	402
Symbol-Digit Modalities Test	(SMITH, 1982)	383
Paced Serial Attention Test	(GRONWALL, 1977)	162
Rey Auditory Verbal Memory Test	(SCHMIDT, 1996)	241
Scale of Positive and Negative Experience	(DIENER et al., 2010)	402
Psychological Well Being Scale	(DIENER, 2009)	401
Brief COPE	(CARVER, 1997)	400
DS-14	(DENOLLET, 2005)	400
Nursing Stress Scale	(GRAYTOFT & ANDERSON, 1981)	302

Note: Some numbers vary because measures were not administered during entire period of recruitment and testing.

Annex 2 Copenhagen Psychosocial Questionnaire (COPSOQ) scales and items used in project

Quantitative Demands

a. Do you have to work very fast?
(Always, Often, Sometimes, Seldom, Never/hardly ever)

b. Is your workload unevenly distributed so it piles up?
(Always, Often, Sometimes, Seldom, Never/hardly ever)

c. How often do you not have time to complete all your work tasks?
(Always, Often, Sometimes, Seldom, Never/hardly ever)

d. Do you get behind with your work?
(Always, Often, Sometimes, Seldom, Never/hardly ever)

f. Do you have enough time for your worktasks?
(Always, Often, Sometimes, Seldom, Never/hardly ever)

g. Do you have to do overtime?
(Always, Often, Sometimes, Seldom, Never/hardly ever)

Cognitive Demands

a. Do you have to keep your eyes on lots of things while you work?
(Always, Often, Sometimes, Seldom, Never/hardly ever)

Influence at Work

a. Do you have a large degree of influence concerning your work?
(Always, Often, Sometimes, Seldom, Never/hardly ever)

b. Do you have a say in choosing who you work with?
(Always, Often, Sometimes, Seldom, Never/hardly ever)

c. Can you influence the amount of work assigned to you?
(Always, Often, Sometimes, Seldom, Never/hardly ever)

d. Do you have any influence on WHAT you do at work?
(Always, Often, Sometimes, Seldom, Never/hardly ever)

Degree of Freedom at Work

a. Can you decide when to take a break?
(Always, Often, Sometimes, Seldom, Never/hardly ever)

b. Can you take holidays more or less when you wish?
(Always, Often, Sometimes, Seldom, Never/hardly ever)

c. Can you leave your work to have a chat with a colleague?
(Always, Often, Sometimes, Seldom, Never/hardly ever)

d. If you have some private business, is it possible for you to leave your place of work for half an hour without special permission?
(Always, Often, Sometimes, Seldom, Never/hardly ever)

Possibilities for Development

a. Is your work varied?
(Always, Often, Sometimes, Seldom, Never/hardly ever)

b. Does your work require you to take the initiative?
(To a very large extent, To a large extent, Somewhat, To a small extent, To a very small extent)

c. Do you have the possibility of learning new things through your work?
(To a very large extent, To a large extent, Somewhat, To a small extent, To a very small extent)

d. Can you use your skills or expertise in your work?
(To a very large extent, To a large extent, Somewhat, To a small extent, To a very small extent)

Role Clarity

a. Do you know exactly how much say you have at work?
(To a very large extent, To a large extent, Somewhat, To a small extent, To a very small extent)

b. Does your work have clear objectives?
(To a very large extent, To a large extent, Somewhat, To a small extent, To a very small extent)

c. Do you know exactly which areas are your responsibility?
(To a very large extent, To a large extent, Somewhat, To a small extent, To a very small extent)

Social Support

a. How often do you get help and support from your colleagues?
(Always, Often, Sometimes, Seldom, Never/hardly ever)

b. How often are your colleagues willing to listen to your work related problems?
(Always, Often, Sometimes, Seldom, Never/hardly ever)

Quality of Leadership

To what extent would you say that your immediate superior…

a. …makes sure that the individual member of staff has good development opportunties?
(To a very large extent, To a large extent, Somewhat, To a small extent, To a very small extent)

b. …gives high priority to job satisfaction?
(To a very large extent, To a large extent, Somewhat, To a small extent, To a very small extent)

c. …is good at work planning?
(To a very large extent, To a large extent, Somewhat, To a small extent, To a very small extent)

d. …is good at solving conflicts?
(To a very large extent, To a large extent, Somewhat, To a small extent, To a very small extent)

Insecurity at work

Are you worried about,,,

a. …becoming unemployed?
(yes, no)

b. …it being difficult for you to find another job if you became unemployed?
(yes, no)