The Job Demands, Control, Support Model: Where Are We Now?

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ABSTRACT

The demands-control (support) (JDC[S]) model (Karasek, 1979; Karask & Theorell, 1990) continues to be highly influential in occupational stress and health literature, and has been the theoretical foundation of more empirical studies than any other work stress theory (Griffin & Clarke, 2011; Kain & Jex, 2010). The main ideas of the model are two-fold: that demanding work, control over working processes, and social support within the workplace all independently relate to well-being and strain; and control and support resources mitigate (of buffer) the effects of high demands on these outcomes. Despite its popularity and longevity, the model has been widely criticized for a predominance of self-report versus objective measurement, cross-sectional rather than longitudinal study design, variety and inconsistency in how the three main dimensions are measured, and a lack of consideration of individual difference variables. Kain and Jex (2010) reviewed the first 30 years of research on the model, and called for future research to address these issues. They also suggested that future research examine different conceptualizations of demands, and further individual difference variables. This paper serves to update the literature of the model, and reviews how calls for future research have been addressed since Kain and Jex’s (2010) review. Additionally, further recommendations for continued development of research are suggested, including updating the taxonomy of jobs frequently associated with different combinations of demands control and support, operationalizing these dimensions in several different ways in each study to increase findings of interactive effects, and designing industry- or role-specific measures of these dimensions to improve this consistency.

Keywords: Demands, Control, Support, Review, Theoretical, Methodological

I. A BRIEF BACKGROUND: THEORETICAL FOUNDATIONS OF WORK STRESS RESEARCH

Work stress is defined as a negative emotional state due to adverse experiences in the workplace (Beehr & Bhagat, 1985; Hart & Cooper, 2001). According to organizational stress theory (Kahn & Byosiere, 1992), stress is not a single event, but a process involving appraisal, response, and attempts to cope with and manage stressors in order to meet goals. Strains are adverse and potentially harmful reactions to stressful work from attempting to function effectively in the face of too many challenges. Furthermore, certain behavioral outcomes are thought to occur as a result of physiological or psychological strains (e.g., counterproductive work behavior, absenteeism, voluntary turnover, smoking, excessive eating and drinking) (Kahn & Byosiere, 1992).

Organizational stress theory has served as the foundation for over a hundred stress theories which frame relationships between various stressors, strains, and in some cases behavioral outcomes (see Griffin and Clarke, 2011; Sulsky & Smith, 2005). A central theme to many of these theories is the fit perspective of work stress, whereby an employee’s fit with their working environment (that is, their role or position and their workplace) is fundamental to minimizing stress at work (Edwards & Cooper, 1990; Eulberg, Weekley, & Bhagat, 1988;
French, Caplan, & Harrison, 1982). Perceptions of fit are largely driven by cognitive appraisal of correspondence between work demands and the availability of coping resources to meet these demands, with stress thought to be experienced if demands are appraised as exceeding resources (French et al., 1982; Lazarus, 1966). The term “resources” refers to many things, such as objects, energy, or work or personal characteristics or conditions that enable employees to facilitate problem solving in order to meet demands by accomplishing goals (Campbell, Perry, Maertz, Allen, & Griffeth, 2013). However, the central focus appears to be on cognitive and emotional resources needed for work and daily transactions with others (Jex & Yankelevich, 2008), with control over work, and support from within the workplace having been given the most attention (Griffin & Clarke, 2011).

II. THE JOB DEMANDS-CONTROL (SUPPORT) MODEL

In 1979, Robert Karasek introduced the job demand-control (JDC) model, which outlines the impact of work characteristics on stress, health, and occupational wellbeing (Karasek, 1979). Karasek envisioned how demanding jobs are, and how much control individual workers are afforded as essential to well-being, motivation, and productivity, as well as the minimization of psychological and physiological strains. The central tenet of the JDC model is that highly demanding jobs that afford little control over work are most likely to lead to decrements in well-being, and to induce strain. Specifically, in line with research on the classical stress process (e.g., Selye, 1956, 1976; Wundt, 1922) Karasek believed that such conditions would lead to individuals continually devoting high amounts of cognitive resources to meeting demands, which would result in an elevated level of physiological arousal and increased cardiovascular and nervous system attention. Moreover, if sustained, this condition would result in the individual’s body beginning to run out of resources, followed by impairment of physical functioning and psychological well-being (Karasek, 1979). Karasek termed positions characterized by high demand low control as high strain jobs (Häusser, Mojzisch, Niesel, & Schulz-Hardt, 2010; Karasek, 1979). In a study on psychosocial work design that used data from quality of employment surveys in 1972 and 1977 to categorize a range of occupations based on perceived demands and control, Karasek (1989) found that among others junior nurses and assembly line workers typically characterized their work as high strain.

Although high strain jobs paint a negative picture of demanding work, Karasek (1979) also believed that demanding work can engender positive outcomes when accompanied by high levels of control. He stated that “some of the most challenging situations, typically of professional work, call for the highest levels of performance, but without negative psychological strain” (Karasek & Theorell, 1990, p. 35). He termed such jobs as active jobs. The theory behind active jobs is grounded in classical literature on competence (White, 1959), activation (Scott, 1966), and stimulation (Schwab & Cummings, 1976). Specifically, performance and learning are hypothesized to be maximal in high demand high control circumstances because workers can actively use the control they have been afforded to meet demands. This is thought to engender greater levels of productivity and goal achievement than when control is low (e.g., high strain jobs), or if the work is not demanding. Thus, when considering high strain and active jobs together, Karasek (1979) did not view positive and negative outcomes of demand and control conditions as simply lying at opposite ends of a continuum, but as two separable mechanisms surrounding the amount of control an employee has over his/her work when faced with high demands. According to Karasek (1989) examples of active jobs include electrical engineers, and physicians.

With regards to other combinations of demands and control, Karasek (1979) termed jobs characterized by low demands and low control as passive jobs, because workers tend to experience a degree of strain due to boredom from combined with an inability to control their work. Moreover, in line with classical stress theory (e.g., Selye, 1956) he contended that workers in these types of jobs experience a gradual atrophying of skills due to underutilization. Karasek (1989) has exampled
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public sector clerical work as adhering to the description of passive jobs. Finally, Karasek (1979) termed jobs characterized by low demands but high levels of control as low strain jobs, because workers would benefit from high levels of skill decision and autonomy without the pressure of high demands. Results of Karasek’s (1989) study suggest that natural scientists often consider their work to be characterized as low strain.

Ten years later, following increased attention to the role of workplace support in the stressor-strain process (e.g., Ganster, 1989); the JDC model was extended to account for workplace social support as a third predictor of well-being and strain. This extended model became known as the job demand-control-support (JDCS) model (Karasek & Theorell, 1990). Karasek believed that effects of high strain (i.e., high demands, low control) jobs would be exaggerated if workplace support was also perceived to be low (Johnson & Hall, 1988; Karasek & Theorell, 1990). He termed such conditions as iso-strain jobs, whereby workers experience even greater strain through social isolation, or a lack of support at work. Conversely, he contended that positive outcomes in active jobs would increase still further for individuals experiencing high levels of support from within their workplace.

In summary, Karasek’s model is underpinned by the fit perspective of stress (e.g., Edwards & Cooper, 1990; French et al., 1982), because fit with work is based on perceiving demands to be manageable in conjunction with resources of control over work, and support from within the workplace (Kain & Jex, 2010). In line with other discussions of the model, the acronym “JDC(S)” (Karasek & Theorell, 1990) is used in the remainder of this chapter as an all-encompassing term to reference both the original and extended versions of the model. The following section outlines these dimensions of the model in greater detail.

III. JOB DEMANDS, CONTROL, AND SUPPORT

Job Demands: Job demands constitute physical, social, or organizational aspects of the job that require physical or mental effort. These include work pacing/time pressure, exacting task requirements, and overall workload demands (De Jonge&Dormann, 2006). According to classical theories on optimal activity level (Selye, 1956, 1976), and performance (Wundt, 1922), a certain level of demand placed upon the worker is beneficial to their psychological well-being, learning, motivation, performance, and job satisfaction. However, too low or high a level of demands can have the inverse affect, causing negative physiological and/or psychological outcomes. As such, most conceptualizations of role-related demand stressors conceive of stress based on how much of a stressor (e.g. time pressure or general workload) one experiences, or how frequently something considered to be stressful (e.g. interruptions or excessive noise) occurs (Sonnentag & Frese, 2003). Numerous studies in work stress literature found relationships between high levels of demands and a variety of strains, as well as negative relationships with psychological well-being (Griffin & Clarke, 2011).

Job Control: Control constitutes an individual’s belief in his/her ability to affect a desired change on their work environment (Greenberger & Strasser, 1986). Karasek (1979) envisioned control as one’s degree of autonomy or decision authority over tasks, including ordering of task completion, discretion in how tasks are completed, or a degree of autonomy over the nature of the tasks themselves (Ganster & Fusilier, 1989). The notion that human beings seek control over their environment is regarded as one of the most important elements of the stress process, and is central to many theories of work stress (for reviews, see Ganster, 1989; Spector, 2002). Specifically, the ability to intervene and changework processes may reduce inherently stressful cognitions of having insufficient resources to complete tasks (Hobfoll, 2001). Moreover, even illusions of being in control appear to promote well-being (Friedland, Keinan, & Regev, 1992). This is corroborated by numerous studies that have found strong negative associations between perceived control and psychological strains (Eatough & Spector, 2014). Conversely, perceiving a lack of control can induce strain by frustrating the intrinsic need to feel competent (Frese, 1989; Spector, 1986; White, 1959).
**Workplace Social Support:** Workplace support refers to helpful relationships at work regarding job-related matters, generally with supervisors and coworkers (Karasek & Theorell, 1990; Maertz, Griffeth, Campbell, & Allen, 2007; Price, 1997). Social support at work is an aspect of employee social capital, which is the extent to which relationships at work are valuable to the employee in terms of acquiring task information or assistance, or social companionship (Nahapiet & Ghoshal, 1998). Unlike job control, social capital does not afford employees the ability to directly intervene in alteration of work tasks, or aspects of the work environment; however, social capital can benefit employees by reducing the burden on their other personal resources (Lin, 1999). The organizational literature is now replete with evidence that high levels of support are associated with increased well-being; whereas, a perceived lack of support can be a catalyst for strain (Häusser et al., 2010; Luchman & González-Morales, 2013; van der Doef & Maes, 1999).

**IV. HYPOTHESES OF THE JDC(S) MODEL**

The vast majority of research on the JDC(S) model has focused on high strain jobs, with comparatively little attention to active jobs, and almost no attention to passive or low strain jobs (Kain & Jex, 2010). Both the original JDC and extended JDCS versions of the model examine strain using two contrasting, but not mutually exclusive hypotheses each for high strain, and active jobs.

**High Strain Jobs:** The strain hypothesis pertains to an increased likelihood of strain when demands are additively increased, and control and/or support are decreased. It is exclusively concerned with main effects of these dimensions on strain. For example, Karasek & Theorell (1990) regard factory line workers as typically being subject to high demands, but also have low control due to the routinized nature of their work and the relatively low levels of support within the workplace. Thus, according to the strain hypothesis a job design intervention to reduce strain in factory workers could be effective by additively changing the balance between perceived demands, control, and/or support, such that (i) demands are reduced (ii) control and/or support are increased or (iii), a combination of both, such that demands are decreased and control and/or support are increased.

In contrast, the buffer hypothesis is concerned exclusively with the moderating effects of control and/or support on the relationship between demands and strain. According to the buffer hypothesis, resources of control and support serve to mitigate the effects of high demands on strain. The practical implication of the buffer hypothesis is that it is sometimes unrealistic to recommend lowering work demands (Griffin & Clarke, 2011); such as for military personnel on operations, or for organizations that are short-staffed, or in a peak season of work (e.g., tax specialists). Thus, workplace interventions to reduce stress should focus exclusively on affording individuals greater control over their work, and/or support greater control over their work, and/or support from within the organization, in lieu of reducing demands.

An important distinction between the strain and buffer hypotheses lies in the importance placed on supposed moderating effects of control and/or support on relationship between demands and strains. Whereas main effects of demands and control and/or support on strain are sufficient to support the strain hypothesis by showing that demands are positively related to strain, and control and/or support are negatively related to strain; the buffer hypothesis can only be supported if a moderating effect of control and/or support is found. That is, the form of control and/or support measured in the study must specifically moderate, or buffer, the form of demand measured, such that negative effects of demands are less when control and/or support are high, versus when they are low. The purpose for this requirement is to show that affording employees’ greater control and/or support resources mitigates the negative effects of demands on strain. In contrast, the strain hypothesis simply shows that demands, control, and support reduce strain independently.

From a practical perspective, the distinction between the strain and buffer hypotheses is tied to differing implications surrounding the need to reduce demands in order to minimize strain. Specifically, according to the strain hypothesis, it is necessary to reduce demands in order to reduce employee stress levels, unless control
and/or support can be additively raised. Conversely, the buffer hypothesis implies that reducing demands is unnecessary to lowering stress, because control and/or support resources will directly counteract the effects of demands stressors on strain. Thus, the strain hypothesis focuses on counterbalancing demand levels with control and/or support resources levels to reduce strain, whereas the buffer hypothesis focusing on the counteracting effects of these resources on strain (Karasek & Theorell, 1990).

**Active Jobs:** As previously mentioned, the vast majority of research on the model has examined the strain and buffer hypotheses in relation to high strain jobs, with far less attention having been given to active jobs (Kain & Jex, 2010). However, the activation hypothesis is the term used for tests of high demands and high control and/or high support with positive outcomes such as performance, learning, or motivation (Karasek, 1979, Karasek & Theorell, 1990). The activation hypothesis is concerned exclusively with *interactive* effects of these dimensions, such that positive relationships between control and/or support and these outcomes are thought to be accentuated by high demands. Moreover, the greatest relationships with these outcomes are expected when both control and support interact with demands, such that all three dimensions are perceived as “high” (Karasek & Theorell, 1990). For example, a lawyer who is performing high demanding work well given high control over work, is thought to perform to even higher standards when well supported by constituents within his/her organization, than when an absence of support is perceived.

**V. Research on the JDC(S) Model to Date**

The JDC(S) model has been highly influential in occupational stress and health literature for over 37 years. It has been the theoretical foundation of more published empirical studies (over 300 to date) than any other work stress model (Griffin & Clarke, 2011; Kain & Jex, 2010). Most studies of the model have examined the strain and/or buffer hypotheses in a single sample of employees operating within a single organization or occupation, within a specific country. However, there has been little to connect the vast number of studies published other than their theoretical underpinnings. As such, several reviews of research on the model have been published in order to collate findings (e.g., De Lange, Taris, Kompier, Houtman, & Bongers, 2003; Häusser et al., 2010; van der Doef & Maes, 1999). These reviews have adopted a vote counting (e.g., non-meta-analytic) method, whereby conclusions are drawn by tallying significant versus non-significant results. According to the vote counting method if the majority of studies show a non-significant finding it is generally concluded that no relationship exists, and vice-versa (Light & Smith, 1971). Findings and conclusions from each review are outlined in the following sub-sections.

**Review 1:** Van der Doef and Maes (1999): Van der Doef & Maes (1999) reviewed 63 studies published between the model’s 1979 inception, and 1997. Studies were categorized based on examination of (i) job-related and (ii) general psychological well-being outcomes. Job-related well-being outcomes included job satisfaction, work satisfaction, burnout, negative job feelings, occupational stress, job-related worries, and exhaustion. General psychological well-being outcomes included life satisfaction, depression, psychological distress, psychiatric distress, psychological strain, general strain, affective disorder symptomatology, psychotic affective disorder, mild psychiatric morbidity, social dysfunction, tension, anxiety, daily life stress, well-being, irritability, state anger, trait anger, happiness, schizophrenia/delusion/hallucinations, need to recover after work, lack of identification, hostility, and frustration. Results revealed a moderate level of support for additive effects of demand, control, and support, in accordance with the strain hypothesis; but only weak support for interactive effects as predicted by the buffer hypotheses. Degree of support for the hypotheses was independent of sample characteristics (e.g., sample size, occupation, gender, nationality, and outcome variable). However, greater support was found in studies which employed narrower (rather than broader) measures of demands, control, and support. Fifty-four of 63 studies reviewed were cross-sectional, and nine were longitudinal. Stronger support was found for both strain and buffer hypotheses in cross-sectional studies than...
in the nine longitudinal studies (van der Doef & Maes, 1999).

Overall, van der Doef & Maes (1999) concluded that support for the strain hypothesis is fairly consistent in both JDC and JDC(S) models, but limited in the few buffering hypothesis studies. They speculated this as partly due to poor matches between demand, control, and support constructs in most studies, with poor fitting measures of control and support less likely to buffer the negative effects of demands on strain. In this regard, the authors called for future research to improve the measurement of work characteristics, and to undertake more longitudinal studies of the model, given their methodological advantages over cross-sectional studies (which are addressed later in this review).

Review 2: De Lange et al., (2003): Given the relative lack of support for interactive effects in the first review, De Lange et al. (2003) conducted a second review of the JDC(S) model with the goal of increasing support for the buffer hypotheses by reviewing only “high quality” studies. Specifically, where van der Doef & Maes had reviewed all studies published to 1997, De Lange and colleagues evaluated the methodological quality of each study based on five criteria, and included only those studies that reached a certain level of quality based on their specifications. The first of these criteria related to study design. The authors evaluated whether each study had used a complete panel design for two variables, X and Y, in order to examine cross-lagged effects (i.e., effects of variable X as measured on Time 1 on variable Y as measured on Time 2, and effects of variable Y at time 1 on variable X at time 2). Complete panel designs afford the ability to examine possible reverse- or reciprocal causal effects, in addition to the relationships of interest (e.g., variable X at time 1 on variable Y at time 2) (Zapf, Dormann, & Frese, 1996).

The second stipulation related to time-lags between data points for longitudinal studies. De Lange et al., (2003) noted an absence of commonly accepted guidelines regarding the most appropriate time lag for predictor variables (X) to influence criterion variables (Y) (Taris & Kompier, 2003). However, they contended that researchers should evaluate what time lag is appropriate by considering how the effect of X on Y develops over time (Frese & Zapf, 1988). Moreover, the authors posited that although time lags between data points in studies are often motivated by practical considerations (e.g., availability research facilities, and time availability of both researchers and participants), these considerations should be accompanied by plausible theoretical and methodological reasoning for the length of time lag between data points.

Their third criterion related to measurement. De Lange et al., (2003) acknowledged that the vast majority of studies of the JDC(S) model utilize survey design methods that come with inherent risks of self-reporting bias (e.g., Schnall, Landsbergis, & Baker, 1994). Thus, they stipulated that internal reliability of survey instruments (i.e., their respective Cronbach alphas) should be acceptably high (e.g., around .70, or higher, Stangor, 1998), in order to minimize possible conceptual overlap between variables. Moreover, they gave preference to studies that combined subjective self-report survey variables with objective (e.g., psychophysiological) measures, in order to reduce possible conceptual overlaps and self-report bias; provided that such measures accurately reflected the individuals’ experience of the job.

Fourth, with regard to method of analysis, De Lange and colleagues (2003) gave preference to studies employing multiple regression analysis, or structural equation modeling, over those that compared cross-lagged correlations. They reasoned that cross-lagged correlations are more likely to yield erroneous causal conclusions (Taris, 2000) because they depend on the variances of the variables measured (Zapf et al., 1996) as well as across-time stability of variables (Kessler & Greenberg, 1981).

Finally, the authors contended that studies of the model should include a non-response examination. That is, researchers should examine possible selectivity of responses (e.g., in terms of gender and age) both for baseline (e.g., time 1) measurement, and for subsequent follow-up measurements. Furthermore, they gave preference to studies that examined whether baseline associations between demand-
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control-support dimensions and study outcome variables differed for responders and non-responders (i.e., those who did not respond to subsequent measures following their baseline response). They achieved this by comparing associations between work characteristics (e.g., demands, control, and support) and study outcomes at time 1 for the response group, versus those who opted not to respond following time 1 (e.g., Etter & Perneger, 1997).

Based on these stipulations, De Lange et al. (2003) selected studies from those published since the model’s 1979 inception to 2000, thus chronologically overlapping with van der Doef & Maes’ (1999) original review. They developed a point scoring system to rate the methodological quality of each study (see Table 1 in De Lange et al., 2003, p. 286). Studies were rated from 1-4 stars, with one star deemed insufficient for inclusion in their review. However, only 19 studies adhered to their stipulations for two or more stars. Their results showed that, only eight of the 19 studies demonstrated support for the strain hypothesis of the model, and only one study found interactive effects in accordance with the buffer hypothesis (Karasek, 1979; Karasek & Theorell, 1990). Thus despite their considerable stipulations for inclusion to their review, De Lange et al. (2003) were unable to demonstrate that “high quality” studies provided stronger support for the JDC(S) hypotheses (and in particular, the buffer hypothesis) than those included in van der Doef & Maes’ (1999) original review. Instead, their review provided further evidence that moderating effects of control and/or support on demand-strain relationships are rare in JDC(S) studies (Kasl, 1996; Kristensen 1995; Theorell & Karasek, 1996; van der Doef & Maes, 1999). However, the authors conceded that a sample of 19 studies was insufficient to credibly test their hypotheses. Moreover, they acknowledged failing to account for how well measures of demands control and support were matched in each study may have limited their findings regarding buffering effects. This echoed De Jonge, Dollard, Dormann, Le Blanc, & Houtmann (2000), as well as contentions made by van der Doef & Maes (1999) in the first review that conceptual congruence in operationalizations of demand, control, and support measures would yield greater evidence of moderating effects.

**Review 3:** Häusser et al. (2010): In the most recent vote counting review, Häusser et al. (2010) returned to van der Doef and Maes’ (1999) original approach of including all published studies of the model, irrespective of methodological characteristics. In doing so, they reviewed 87 studies published between 2000 and 2007, thus chronologically continuing from van der Doef and Maes’ end point. Studies examined similar psychological well-being and strain outcomes to the two previous reviews, and results of their review revealed four major findings.

First, Häusser et al., (2010) found that sufficient sample size appears to almost guarantee support for additive effects of demands, control, and social support, as per the strain hypothesis (Karasek, 1979; Karasek & Theorell, 1990). They concluded that studies showing support generally employed larger samples than unsupported studies. Moreover, all studies with \( n \geq 1000 \) found at least partial support for additive effects (i.e., whereby relationships were in the direction hypothesized, but not necessarily significant), and full support for main effects was found in all studies employing samples of \( n > 3,000 \). Based on these findings, Häusser et al. (2010) concluded that additive effects of the model have been proven beyond empirical doubt. Second, as with previous reviews Häusser et al. (2010) found support for additive effects to be consistently lower in longitudinal studies than cross-sectional studies, arguably because of reciprocal/reversed effects in cross-sectional studies (Taris & Kompier, 2003). Third, as with previous reviews, evidence for interactive effects was again sparse. Only 29 of 97 tests (30%) provide partial support for the demands-control interaction, with full support in just 14 tests (13%). Moreover, only seven of 52 tests (13%) provide partial support for the interaction of demands, control, and support, with full support found in only three studies (6%). Finally, Häusser et al., (2010) found studies of the extended JDCS model to be less strongly supported than studies of the original JDC model. However, they did not argue for a problem with the social support dimension due to finding approximately equal support for main.
effects of demand, control, and support dimensions. Instead, they attributed lower levels of support for the extended model to stochastic effects of including an additional criterion, which would be expected to reduce multiplicative effects (Häusser et al., 2010).

Based on their findings, Häusser et al. (2010) called for more experimental rather than survey-based studies of the model to provide causal examinations of its major hypotheses. They also repeated van der Doef & Maes’ (1999) call for more longitudinal studies to dangers of reduce reversed or reciprocal causation. The authors also contended that there should be more studies of objective (rather than subjective) measures -- or at least studies with a mix of objective and subjective measures -- in order to reduce self-report bias in surveys, and because the model purports to make conclusions about the objective environment. Finally, Häusser and colleagues (2010) called for a transition from vote counting reviews to systematic meta-analyses of the model in order to measure population level effect sizes, and to examine possible moderating variables.

The following section briefly reviews the case for meta-analytic investigation as an improvement over the vote counting method, and outlines two meta-analytic studies to date of the model.

VI. THE NEXT STEP: META-ANALYTIC RESEARCH

Improvements on Vote Counting Reviews: Although the three vote counting reviews (De Lange et al., 2003; Häusser et al., 2010; van der Doef & Maes, 1999) have progressed research on the model by collating results of individual studies to form broader conclusions, there are several limitations of the vote counting method of summarization which limit what inferences can be made about the model. First, conclusions are formed by tallying of significant against non-significant results (Light & Smith, 1971). Thus, if the majority of studies show a non-significant finding it is generally concluded that no relationship exists. However, what are not taken into account are the near significant results that may have resulted from underpowered studies which are a critical component of understanding true construct-level relationships (Hunter & Schmidt, 2004).

Second, due to the common issue of lack of power, the larger the number of studies analyzed in a vote counting review, the greater the certainty of concluding that no relationship exists (i.e., that $\rho = 0$) (Hunter & Schmidt, 2004). Third, significance is influenced by sample size (Bentler & Bonnett, 1980). Thus, readers may be misled as to the true nature of relationships simply due to the size of $n$ across different studies. For example, relatively small sample studies (as often found in psychological research) produce seemingly contradictory results (Hunter & Schmidt, 2004). Conversely, in their respective reviews both Van der Doef & Maes (1999) and Häusser et al. (2010) concede that all studies above a certain sample size found significant additive effects. This makes for a muddy picture where holding other methodological characteristics constant, overall conclusions are strongly influenced by the number of participants in given studies.

A fourth limitation of the vote counting method is that in most cases (including both Hausser et al., 2010 and Van der Doef & Maes, 1999) effect sizes are not recorded, which leaves readers in the dark as to the true strength of relationships (Hunter & Schmidt, 2004). Conversely, Hunter and Schmidt (2004) argue that “these (population correlations) are the relationships of scientific interest” (p. 31, italics added), because they give the most accurate depiction of the population construct-level relationships. Finally, vote counting reviews fail to take into account study artifacts, such as sampling error, measurement error, and other artifacts that produce conflicting results. In contrast, one of the greatest contributions of meta-analysis is the ability to correct for these distorting effects (Hunter & Schmidt, 1990). Therefore, conducting a meta-analysis is the most accurate way to estimate what the findings would have been had every study been conducted perfectly (i.e., with no methodological limitations). The following subsections outline two such recently published studies.

Meta-Analysis 1: Luchman & González-Morales (2013). The first meta-analytic steps were taken by Luchman & González-Morales
Job Demands, Control, Support Model (2013), who examined cumulative interrelationships between the model’s core demand-control-support dimensions, across 106 studies of the model. This represented a new approach to research on the model, and was based on the premise that understanding the nature of interrelationships between workplace characteristics would facilitate better understanding of employees’ work experience. Moreover, they posited that this knowledge would facilitate more relevant and accurate job design, and occupational stress interventions.

Luchman & González-Morales (2013) hypothesized that demands would be negatively related to job control, because workers who perceived a high degree of control over work would likely restructure their tasks in order to reduce the effects of high demands on lost personal resources (Hobfoll, 2001, Spector, 2002). They also hypothesized a negative relationship between demands and supervisor support and coworker support, respectively, because of the instrumental and task-related assistance from supportive supervisors, and (Hobfoll, 2001; Lin, 1999); and because greater task assistance among coworkers allows the ability to call upon the resources of others if demands are high (Hobfoll, 2001; Settoon & Mossholder, 2002). Finally, Luchman & González-Morales (2013) hypothesized a positive relationship between control and both supervisor and coworker support resources, because according to COR theory gaining personal resources requires using personal resources; thus the more resources an individual perceives themselves as having, the more they will perceive they are able to acquire (Hobfoll, 2001).

Four out of these five hypotheses were supported. Specifically, demands were negatively related to supervisor support ($\bar{r}_{\text{C}} = -.16$, 95% CI -.19 to -.12) and to coworker support ($\bar{r}_{\text{C}} = -.11$, 95% CI -.15 to -.08); and control was positively related to support from supervisors ($\bar{r}_{\text{C}} = .30$, 95% CI .19 to .41), and from coworkers ($\bar{r}_{\text{C}} = .23$, 95% CI .14 to .31). However, their hypothesis that demands and control would be negatively related was not supported, because the meta-analytic correlation between these two workplace characteristics was practically zero ($\bar{r}_{\text{C}} = -.02$, 95% CI -.07 to .04). Another characteristic of their findings was that effects sizes for all hypothesized relationships showed evidence of heterogeneity (as indicated by the significant Q statistics on Table 1 in their study, p. 43). This indicated the possibility of moderating factors in all demand-control-support interrelationships (Hunter & Schmidt, 2004). Luchman & González-Morales (2013) addressed this by conducting an exploratory moderator analysis. They found that gender moderated the demand-control relationship, such that samples of mainly female participants tended towards a negative demand-control correlation, whereas more male-dominated samples showed, on average, a positive relationship. However, the authors did not report any other moderating effects.

Meta-Analysis 2: Fila, Purl, & Griffeth (In Press). The second meta-analysis of the model built directly off of the first, making several further contributions to knowledge of work stress and occupational health. In an analysis of 141 studies of the model, Fila, Purl, and Griffeth (in press) extended examination of interrelationships between the model’s three dimensions to include estimation of relationships between each of these and job satisfaction and emotional exhaustion, which are the two most examined psychological outcomes in studies of the model (Häusser et al., 2010). Job satisfaction is a positive and pleasurable psychological state that results from positive appraisal of one’s job (Cranny, Smith, & Stone, 1992; Locke, 1976). Moreover, it can affect organizational-level functioning through changes in performance, and employees’ desire to remain with the organization (Hom, 2011). Emotional exhaustion is a form of psychological overextension that refers to feelings of being “…drained or used up, unable to face a day’s work, totally unenthusiastic” (Sulsky & Smith, 2005 p.45). Emotional exhaustion is more likely to be experienced when emotional resources are depleted such that the employee feels as if he/she can no longer meet the demands of work-related stressors (Lee & Ashforth, 1996).

Fila et al. (in press) also extended Luchman & González-Morales’ (2013) exploratory moderator analysis of gender by making a more explicit case as to why gender may moderate
DCS interrelationships (e.g., that different bio-behavioral mechanisms in men and women are thought to underpin interpretation of stressors, and coping with stress, Roxburgh, 1996; Taylor et al., 2000) as well as extending gender moderator analysis to other DCS interrelationships besides demands and control, and relationships with job satisfaction and emotional exhaustion. Furthermore, the authors examined two further potential moderators of DCS interrelationships, and relationships with job satisfaction and emotional exhaustion that have received significant recent attention: nationality and occupation. For example, according to the theory of culture’s consequences, nationality influences perceptions of work stress based on how individuals from different countries appraise and respond to working conditions (Hofstede, 2001). Similarly, according to the job characteristics model (Oldham & Hackman, 2005) perceptions of work stress differ between occupations. This is thought to be based on social and structural differences in how jobs are designed which are thought to manifest in the stress process (Grant, Fried, & Juillerat, 2011; Sulsky & Smith, 2005). The author’s analyses for these two moderators were conducted by sub-grouping samples from primary studies into categories (or clusters) based on nationality and occupation, respectively. In total, 27 moderating relationships were examined (e.g., nine DCS interrelationships and relationships with job satisfaction and emotional exhaustion, for each of the three moderators).

The author’s primary meta-analytic results were similar to those of Luchman & González-Morales (2013). Additionally, they found job satisfaction to be negatively related to demands ($r_c = -.27$, 95% CI - .30 to -.23), but positively related to both control ($r_c = .46$, 95% CI .44 to .48), and to workplace support ($r_c = .49$, 95% CI .44 to .53). Furthermore, emotional exhaustion was positively related to demands ($r_e = .51$, 95% CI .48 to .54), and negatively related to control ($r_c = -.20$, 95% CI -.24 to -.16), and to workplace support ($r_c = -.30$, 95% CI -.32 to -.27). With regards to gender, the demands-control relationship was moderated similarly to that of Luchman and González-Morales’ (2013) exploratory review. However, they also found that gender moderated the relationship between demands and job satisfaction $[(r_c = -.32, 95% CI -.35 to -.28) for females and (r_c = -.22, 95% CI -.28 to -.16) for males]$, such that males had a smaller negative demands-job satisfaction relationship than females. Finally, almost all DCS interrelationships and relationships with job satisfaction and emotional exhaustion were moderated somehow by nationality and by occupation. Space restrictions here prevent full coverage of these results. However, hypotheses regarding moderating effects were strongly supported, with widespread implications for job design and work stress interventions for organizations throughout the world.

In summary, the JDC(S) model remains the most examined theory in work stress literature (Griffin & Clarke, 2011; Kain & Jex, 2010, Luchman & González-Morales, 2013; Sulsky & Smith, 2005). However, despite fairly consistent support for the strain hypothesis since its 1979 inception, support for the buffer hypothesis has been sporadic throughout. As such, the JDC(S) model has been widely criticized for several theoretical and methodological limitations that are apparent both in many of the individual studies of the model, and collective research on the model (e.g., De Jonge & Dorman, 2006; Kristensen 1995; Taris & Kompier, 2003). These issues, and attempts to address them, are outlined in greater detail in the following section. Further suggestions for future research are then made.

VII. MAJOR CRITICISMS OF THE MODEL

The most enduring criticism of the JDC(S) model is the inconsistency to which buffering effects of control and/or support are found (e.g., De Jonge & Dorman, 2006; Kristensen 1995; Taris & Kompier, 2003). Additionally, the model has been criticized for a predominance of self-report measurement studies, mainly cross-sectional rather than longitudinal research designs, and failing to account for individual difference variables that may moderate relationships underpinning its major hypotheses. These criticisms were echoed most recently by Kain & Jex (2010) in their review of the model. As such, each of these criticisms is expounded upon below. Additionally, the present review serves to update Kain & Jex (2010) by
reviewing studies published in the ensuring six years that have adhered to suggestions born out of these criticisms.

VIII. INCONSISTENT MULTIPLICATIVE SUPPORT

As highlighted in the three aforementioned vote counting reviews, and several other theoretical reviews of the model (e.g., De Jonge & Dorman, 2006; Kristensen 1995; Taris & Kompier, 2003), inconsistent buffering effects is by far the greatest criticism the JDC(S) model (Kain & Jex, 2010). From a theoretical perspective, this inconsistency has led to some scholars doubting the model’s predictive value (e.g., Beehr, Glaser, Canali, & Wallwey, 2001). However, Karasek (1979; in De Lange et al., 2003) argued that interactive effects are unnecessary to support the validity of the model because; (1) its basic premise is supported if demands, control, (and support) separately exert main effects on strain; (2) reducing job demands and increasing control and/or support would additively reduce strain even if no interaction is present; and (3) implications for job redesign are the same with or without multiplicative effects. Additionally, in a recent review of the work stress literature Griffin & Clarke (2011) acknowledged difficulty in assessing the unique importance of interactions in the stress process independently of main effects, because “interactions are often reported in relation to multiple main effects…and the proportion of variance is often small” (p. 370). However, from a theoretical standpoint it could be argued that an interaction between demands and control (and support) is necessary to validate the model. For example, as Beehr et al. (2001) contended that: “…if main effects are all that constitute the theory, then demands and lack of control are simply a set of independent stressors with no necessary relationship to each other” (p. 117). Thus, the model’s strength -- that is, the presupposed interactive effect of control and/or support on demand characteristics -- is at the same time also its weakness (De Jonge & Kompier, 1997).

Aside to debate regarding the model’s validitiyas an effective predictor of well-being and strain, it is important to address theoretical and methodological reasons why multiplicative effects have been so inconsistent. The following criticisms of the model are theoretical and methodological issues that have arguably contributed to this inconsistency, with Kain & Jex (2010) calling for further studies to address them.

IX. VARIED AND NON-MATCHING MEASUREMENT DCS CONSTRUCTS

Several researchers (e.g., Dea Jonge & Kompier, 1997; Kasl, 1996; Viswesvaran, Sanchez, & Fisher, 1999; Wall, Jackson, Mullarkey, & Parker, 1996) have contended that the probability of finding significant JDC(S) interaction effects is affected by how the model’s key dimensions are conceptualized and operationalized. Specifically, inconsistent effects are thought to be attributable to both the number of different ways that demands control (and support) have been measured across studies, and by most instruments being too global -- that is, lacking in occupational specificity, and lacking in context when related to the other dimensions -- to reveal consistent interactive effects (e.g., Terry & Jimmieson, 1999; Wall et al., 1996). For example, in their recent review of the model Kain & Jex (2010) included a table of different conceptualizations of demand and control. According to this, job demands have been measured as self-reported workload, role conflict (i.e., stress attributed to incompatibility between multiple sets of work demands; Beehr & Newman, 1978) (Karasek, 1979), physical exertion, hazardous exposure (both in Landsbergis, 1988), and patientload (Fox, Dwyer, & Ganster, 1993). This is by no means an exhaustive list (see Häusser et al., 2010; van der Doef & Maes, 1999).

Additionally, control has been measured as autonomy, and decision making latitude (Karasek, 1979), as well as task control, scheduling control, and control over procedure and policies (Fox et al., 1993). Finally, although not included in this table, workplace support has been measured as an all-encompassing construct, as well as supervisory support, and coworker support (Luchman & González-Morales, 2013). Given this variability, even if it is theoretically plausible that control and/or support could moderate the effects of high demands on strain these effects have probably not been found in studies where the type of
control or support measured is incongruent with the type of demands they are hypothesized to buffer (e.g., De Jonge & Kompier, 1997; Kasl, 1996; Viswesvaran et al., 1999; Wall et al., 1996). These concerns were also raised by the authors of aforementioned vote counting reviews (e.g., Häusser et al., 2010; van der Doef & Maes, 1999).

In response to this concern, Häusser et al. (2010) conducted an exploratory analysis to examine whether degree of match between demand and control measures used in studies was associated with a higher likelihood of finding significant interactive effects. Measures of support were not included in this analysis. They divided reviewed studies into categories of “good” and “poor” match. Good match studies as those in which demand and control measures referred to the same level of functioning at the task level. For example, these studies typically operationalized demands as work load or time pressure, and control as control over the timing, scheduling, or pacing of tasks. Studies that utilized occupation-specific rather than global/generic measures were also included in this category. In all, twenty studies were classified as having a good match. Conversely, 76 studies were classified as having a poor match based on relatively unmatched or incongruent measures of demands and control (for example, emotional demands and timing control). Häusser et al. (2010) found that 50% of studies in the good fit category evidenced interactive effects of demands and control, whereas only 25% of studies in the poor fit category found interactive effects. This significant difference, $\chi^2 (1, N = 96) = 4.69, p<.05$ indicates the benefit of congruency between key dimensions.

Unfortunately, despite this evidence many researchers have continued to measure demands, control, and support in numerous different ways, with varying degrees of match between measures. For example, Fransson et al., (2012) compared alternative demand-control-support scales in 17 European cohort studies. Their findings highlighted that not only had different measures been used across studies, but that variation exists between studies regarding which items were used to construct scales. Thus, even ostensibly matching scales are likely to vary in the degree of actual match to others in the same study. Additionally, the variability in measurement extends to outcome variables with several different survey instruments having been used to measure frequently examined outcome variables such as job satisfaction, emotional exhaustion, and anxiety (Fransson et al., 2012). Thus, degree of match between demand, control (and support) measures may also be confounded by differences in how outcomes are measured because a well- or poorly matched set of measures may interact in their relationship with one measure of, say, job satisfaction, but not another. Furthermore, most studies of the model continue to use broad rather than occupation specific measures of demands, control, and support dimensions. This is understandable because most of the validated measures available are not specific to one particular job or industry (Kain & Jex, 2010). However, as previously mentioned the principle of matching measures of key constructs to achieve greater consistency of multiplicative effects is arguably harder to achieve if context is too broad (Beehr et al., 2001). With most empirical studies of the JDC(S) model designed as individual studies in their own right, and with seemingly little to tie them together, it appears that issues of varied and often poorly matched measures is likely to continue.

X. PREDOMINANCE OF SELF-REPORT MEASUREMENT

In empirical studies of the JDC(S) model, dimensions can be measured by imputation of job characteristics, or self-report questionnaires (van Veghel, De Jonge, & Landsbergis, 2005). In the imputation method, scores for job demands, control, and workplace support are assigned to employees on the basis of their job title, as derived from large national studies (Karasek & Theorell, 1990). This method is recommended for large multi-occupational studies where information about an individual’s occupation is available (Landsbergis & Theorell, 2000). The most prominent example of this is the Occupational Information Network (O*Net; Peterson, Mumford, Borman, Jeanneret, & Fleishman, 1999) where myriad jobs are compared on demands and resources, as well as attributes and work styles required to be
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successful, based on previous research. However, viewing stress objectively as a condition or an event in a given situation has been criticized for overlooking individual differences in cognitive appraisal of stress (Cooper & Marshall, 1976; Matteson & Ivancevich, 1979). Thus, most researchers of the JDC(S) model have been interested in stressor-strain relationships based on how job characteristics are perceived by workers (Kain & Jex, 2010) in accordance with the fit perspective of work stress (e.g., Edwards & Cooper, 1990; French et al., 1982). As such, self-report questionnaires have been used in the vast majority of studies of the model (Luchman & González-Morales, 2013; van Vegchel et al., 2005).

Self-report measures require people to report on their experiences, feelings, or attitudes (van Vegchel et al., 2005). In stress research such measures assess usually the affective, somatic, and cognitive aspects of perceived stress (Sulskey & Smith, 2005). Self-report measures have several benefits to researchers: They are relatively inexpensive, easy to administer to large groups of people, and easily quantifiable. Moreover, from a validity perspective individual perceptions are a critical component of the stress process because a large body of research suggests that the actual existence or degree of stress may be less important than how the individual appraises and copes with perceived stress (Aldwin & Revenson, 1987; Lazarus, 1966). Furthermore, validated self-report measures offer a high degree of face validity because arguably the best way to find out if someone is stressed is to ask (Sulskey & Smith, 2005).

Despite the obvious benefits of self-report methods they have received repeated criticism for being poor indicators of the objective work environment (van Vegchel et al., 2005). That is, the degree to which different employees find the same set of working conditions to be stressful is likely to vary (French et al., 1982; Lazarus, 1966). As such, there may be a danger in generalizing perceptions of demands, control, and support at the individual level to objective dimensions of an organization. Self-report measures are also prone to response bias, and a host of cognitive biases including reliance on past experiences or schemas (Sulskey & Smith, 1995). Furthermore, psychological perception of stress may occur earlier or later than objectively measurable symptoms in the context of a stressful experience. Moreover, unreliability (e.g., a low Cronbach alpha) in any of the self-report measures used will attenuate relationships among them (Sulskey & Smith, 2005). Thus, there are inherent dangers in making too strong a conclusion about organizational phenomena using self-reports measures (Sulskey & Smith, 1995; van Vegchel et al., 2005). This is especially the case where self-reports are used to measure both independent and dependent variables of interest because of the risk of inflated relationships due to common method variance (Spector, 2006). However, transactional stress theory proposes that only the individual can appraise the challenging or threatening nature of the stressor (Lazarus & Folkman, 1984). Thus, despite poignant arguments against the use of self-report measures their popularity in work stress research -- including studies of the JDC(S) model -- continues to be unabating (Griffin & Clarke, 2011; Kain & Jex, 2010).

Different Types of Measures in a Single Study: Given the aforementioned potential problems with self-reports measures, Kain & Jex (2010) recommended that researchers either use different types of measures (e.g., subjective and objective) to avoid common method bias, or adopt experimental (or quasi-experimental) methods. Several studies have since followed their advice, with more consistent evidence of buffering effects. First, Pekkarinen & colleagues (2013) examined whether perceived control, workplace support, and distributive justice moderated associations between high physical and mental workload and musculoskeletal symptoms, among 975 females nurses working in 152 geriatric units in Finland. Objective workload measures were also taken. These consisted of unit-level incidents or occasions of work, including residents’ dependency on physical functions (e.g., bed mobility, toileting, eating, and hygiene), residents’ cognitive impairments (i.e., coma, short-term memory decision making, communication, and dependence in eating), and daily behavioral problems (i.e., wandering, verbal and physical abusiveness, resistance to care, and social
disruptiveness). However, rather than examining possible interactive effects between perceived control and support resources, respectively, and these measures, objective workloads measures were accounted for (e.g., held) in their regression analysis of subjective demand, control, and support measures. Their multilevel logistic regression analyses showed that self-reported physical workload was associated with higher risk of musculoskeletal symptoms among nurses with low social support. Additional examples of studies of the JDC(S) model that have used objective measures are outlined as follows.

Studies with an Experimental Design: First, Häusser, Mojzisch, & Schulz-Hardt (2011) examined the buffer hypothesis with respect to both psychological (e.g., subjective) well-being, and salivary cortisol as a physiological indicator of strain. Seventy-seven participants worked in a computer simulated workspace for approximately two hours, during which job demands (overall workload) and job control (self-paced vs. machine-paced work) were manipulated in a 2x2x7 study design of high versus low demands and control, and seven time measurements of both subjective well-being and salivary cortisol. Häusser and colleagues (2011) found that in line with the buffer hypothesis, high control (e.g., self-paced rather than machine-paced work) eliminated the impact of high demands on salivary cortisol responses. Their hypothesis of multiplicative effects of demands, control, and time of measurement on salivary cortisol was supported by a three-way interaction \( p < .001 \). Given lagged cortisol reactions, no effects were found in times 1 and 2. However, high demands led to increased cortisol reactions only in the low control condition in each of the remaining five time measurements. Conversely, the authors found no main or multiplicative effects of demands and control on subjective well-being. They contended that their findings provided both clear-cut experimental evidence that the negative impact of high demands on endocrinological responses can be buffered by high levels of control, and that the lack of effects on subjective well-being can be attributed to an inherent lack of specificity in subjective well-being measures.

More recently still, Subhani, Malik, Kamel, Saad, & Nandagopal (2015) investigated the impact of demands and control on cognitive arousal. Their experiment involved manipulating task demand and control over method and order of task completion for four demand-control conditions (e.g., high-high, high-low, etc.), and recording electroencephalogram (EEG) to extract levels of cognitive arousal. Both the strain and buffer hypotheses were supported by cognitive arousal levels in association with task performance and subjective well-being feedback. That is, their results showed that the maximum arousal and the worst performance occurred under the high demands low control condition. Moreover, high control under conditions of high demands proved to significantly lower arousal and improve task performance when compared to the high demands low control condition. Subhani et al.’s (2015) results not only validate the strain and buffer hypotheses for high strain (e.g., high demands, low control) conditions in an experimental setting, but present a rare experimental examination of the activation hypothesis (high demands and high control; Karasek & Theorell, 1990).

Finally, O’Donnell, Landolt, Hazi, Dragano, & Wright (2015) assessed the possible buffering effects of control in an experimental design of the strain hypothesis. In a within-subject design, 60 female participants were randomly assigned to one of two control (autonomy) conditions whereby when completing a word processing task in a simulated office environment, they were either given the autonomy to choose their break times, or were assigned them. O’Donnell et al. (2015) measured adaptive physiology using heart rate variability (HRV) and salivary alpha amylase (sAA) as objective physiological markers of stress. To the authors’ surprise, although participants reported increased perceptions of control in the task in the break-time autonomy versus the standard condition they reported no difference in demands, and performed worse than those who had been assigned break times. Thus, their results revealed support for the manipulation of autonomy, but in the opposite direction than hypothesized in the buffer hypothesis. Moreover, increased autonomy was related to dysregulated physiological reactivity, which is
synonymous with typical increases in the stress responses (Schneider, 2004). Thus, their findings suggest that autonomy can become an additional stressor when it adds additional complexity to work (e.g., Karasek & Theorell, 1990).

XI. PREDOMINANCE OF CROSS-SECTIONAL RESEARCH DESIGNS

The majority of JDC(S) studies have adopted cross-sectional rather than longitudinal research designs (De Lange et al., 2003; Häusser et al., 2010; van der Doef & Maes, 1999). Cross-sectional designs allow for all data to be collected at a single time point. However, they have been widely criticized for potential reverse- or reciprocal-causation (Spector, 2006). Reverse/reciprocal causality is cause and effect in reverse, such that the effect precedes the cause (Tharenou, 1993). For example, where findings of a cross-sectional JDC(S) study show a positive relationship between perceived demands and emotional exhaustion, it is possible that being emotionally exhausted may evoke perceptions of job demands being high. Similarly, if results show a negative relationship between perceived control and emotional exhaustion, an employee who feels able to cope with the pressures of work (i.e., who is not emotionally exhausted) may be likely to perceive a greater degree of control (cf. Dalgard et al., 2009).

A weight of predictive evidence from longitudinal JDC(S) studies suggests that demands, control, and support respectively do in fact predict well-being and strain (Häu ss er et al., 2010; van der Doef & Maes, 1999). Thus, support of the model’s hypotheses in cross-sectional studies may not be due to reverse- or reciprocal-causation. However, it may be a factor in more consistent support being found overall for both the strain and buffer hypotheses in cross-sectional versus in longitudinal studies (Taris & Kompier, 2003) (see Häusser et al., 2010; van der Doef & Maes, 1999). As such, Kain & Jex (2010) as well as the authors of JDC(S) reviews (e.g., Häusser et al., 2010; van der Doef & Maes, 1999) recommended that more researchers adopt longitudinal research designs. Longitudinal designs do not allow researchers to infer causality in non-experimental survey research (Kasl, 1996; Zapf et al., 1996). However, they reduce the risk of reverse- or reciprocal-causation, particularly when cross-lagged correlations can be obtained that support directionality of effect (De Lange et al., 2003). Since Kain & Jex’s (2010) review several further studies have been published that adhere to their call for more longitudinal research.

XII. STUDIES WITH LONGITUDINAL DESIGNS

First, De Jonge, van Vegchel, Shimazu, Schaufeli, & Dormann (2010) performed a two-wave longitudinal test of the demand–control model in a sample of 267 health care employees from a Dutch panel survey, with a 2-year time lag between waves. They examined the strain hypothesis using specific types of job demands, and both objective and subjective well-being. The specific types of demands were mental demands, measured with an eight-item scale that measured demanding aspects of the job, such as working under time pressure, strenuous work, and job complexity; emotional demands, which were assessed using a 12-item scale regarding aspects of work such as being confronted with emotionally demanding behavioral characteristics of clients (e.g., awkward or aggressive behaviors) and traumatic events such as human suffering; and physical demands, as measured by a seven-item scale that contained items about carrying heavy loads, severe bending, restricted standing, and carrying at shoulder height. Control was measured as perceived decision authority on the job. Finally, they measured job satisfaction, and subjective well-being in the form of psychosomatic health complaints, as well as objective well-being based on incidents of sickness absence, as recorded by the organization. De Jonge et al. (2010) found significant interactions between demands and control for mental and emotional demands, but not for physical demands. Specifically, they found a positive relationship between demands and job satisfaction for those who reported high levels of control, and a negative relationship for those reporting low control. Conversely, the relationship between demands and both psychosomatic health symptoms and incidents of sickness absence
were negative for those with high levels of control, but positive for those reporting low control.

In another study, Butterworth et al. (2011) used longitudinal data to investigate whether the benefits of having a job depended on its psychosocial qualities (e.g., levels of demands and control, as well as complexity, security, and fair pay), and whether poorer quality jobs were associated with better mental health than unemployment. The authors analyzed seven waves of data from 7,155 respondents of working age for a total of 44,019 observations taken from a national household panel survey. Longitudinal regression models evaluated the concurrent and prospective association between employment circumstances (e.g., unemployment versus employment in jobs varying in psychosocial job quality) and participants’ reported mental health. Although as expected the authors found unemployed respondents to have poorer mental health than those who were employed, the mental health of the unemployed was slightly superior to those who were employed in jobs of the poorest psychosocial quality (e.g., high demands, low control, and also routinized work that lacked job security and was poorly paid). Although not a test of the buffer hypothesis, this examination of the strain hypothesis (e.g., main effects of demands and control) across time was revealing given that those who were unemployed experienced better mental health than those employed in psychosocially poor jobs.

Finally, Boyd et al. (2011) used structural equation modeling to conduct a longitudinal test of the model in a sample of 296 Australian university academics in order to determine how job demands (work pressure, academic workload) and job resources (procedural fairness, job autonomy) would predict psychological strain and organizational commitment over a three-year period. The authors also conducted longitudinal tests of reversed causation to support the validity of their longitudinal design. Their results of SEM analyses showed that resources at time 1 directly predicted strain and organizational commitment three years later, but that demands in the first time wave only predicted strain three years later via job resources. That is, perceived control and procedural fairness at time 1 mediated the relationship. Their results suggest that workers future levels of strain are affected by present levels of resources. Moreover, Boyd et al. (2011) did not find evidence for reversed causation.

Taken together, the results of this study show that although longitudinal studies of the model remain relatively rare, some support does exist for buffering effects on demand-strain relationships. Moreover, these more recent studies have adopted longer gaps between time waves than some of those reviewed by Kain & Jex (2010). Although justification for the length of gap between waves appears to be still lacking, adopting a longer-time lag between waves decreases the chance of finding significant effects. Thus, these studies go some way to validating that hypotheses of the JDC(S) model are valid over time.

XIII. FAILING TO ACCOUNT FOR INDIVIDUAL DIFFERENCE VARIABLES

In line with Karasek (1979), Kain & Jex (2010) contended that main and multiplicative effects of demand, control, and support on well-being and strain might vary based on individual differences; something that the model has been criticized for overlooking (Kristensen, 1995). In their review, Kain & Jex (2010) noted that although Karasek had outlined several possible individual differences (e.g., age, education, income, urban versus rural living), he had not hypothesized what these effects might be. Moreover, in the thirty years leading up to their review relatively little research had been conducted on possible moderating effects of these (or other) individual difference variables. This may have contributed to criticism regarding the model’s simplicity, and relative lack of multiplicative effects in primary studies. Kain & Jex (2010) noted, however, that more recent studies of the model had included various measures of individual differences, such as proactive personality (defined as the propensity to show initiative, take action, and persevere until the problems one faces are overcome; Parker & Sprigg, 1999), active coping (e.g., a wide range of purposeful strategies which are directed towards altering or avoiding job-related stressors; Parkes, 1994), self-efficacy (an
individual’s judgments of their own capabilities to organize and execute courses of action in order to attain designated goals; Bandura, 1977), and external locus of control (e.g., the degree to which one attributes or concedes control to forces outside of oneself; Spector, 1982). They reviewed findings of the effects of these individual difference variables on main and multiplicative effects of demand, control, and support dimensions, and reached several initial conclusions.

First, individuals with a proactive personality tend to use autonomy at work to cope with demands more effectively than those with a less proactive personality. However, strain levels tend to be higher for those with a proactive personality when perceived control/autonomy is low (Parker & Sprigg, 1999). Second, Kain & Jex (2010) acknowledged that one’s choice of coping methods can depend on the situation (e.g., what resources are at hand). Specifically, they reported that job control mitigated the relationship between demands and physical forms of strain for those who adopted active coping methods, but not for those who didn’t. This was attributed to the ability of those adopting active coping methods to use control in order to meet demands (Ippolito, Adler, Thomas, Litz, & Holzl, 2005). Conversely, as with proactive personality, employees reported higher levels of strain when control was perceived to be low (Parker & Sprigg, 1999).

Similarly, Kain & Jex (2010) reported that according to Salanova, Peiro, & Schaufeli (2002), employees reporting high levels of self-efficacy were more likely to experience a buffering effect of control on the relationship between high demands and strain because they believed in their ability to utilize control afforded to them in order to meet demands. However, those with lower levels of self-efficacy did not experience this interaction, even if they reported perceiving high levels of control, because they were unable to utilize it. Finally, with regards to locus of control, Kain & Jex reported that studies had shown control not to buffer relationships between demands and anxiety, and demands and musculoskeletal pain for those perceiving an external locus of control (Meier, Semmer, Elfering, & Jacobshagen, 2008). However, buffering effects were strongest for those with an internal locus of control, particularly when workplace support was also perceived to be high (Rodriguez, Bravo, & Peiro, 2001).

XIV. INDIVIDUAL DIFFERENCE RESEARCH SINCE KAIN AND JEX’S REVIEW

In the ensuing years since Kain and Jex’s (2010) review, further research on the JDC(S) model has taken individual differences into account. For example, there has been further evidence for the effects of active coping (van den Tooren, de Jonge, Vlerick, Daniels, & Van de Ven, 2011), self-efficacy (Panatik, O'Driscoll, & Anderson, 2011), and external locus of control (Parker, Jimmieson, & Amiot, 2010), which largely corroborate the aforementioned studies reviewed by Kain & Jex (2010). However, researchers have also examined several other individual differences variables.

First, it appears that hardiness is an important individual resource in relation to health at work by protecting against stress to enable healthy functioning. Hardiness is defined as a generalized style of functioning that is characterized by a strong sense of commitment to goals, control over circumstances, and willingness to undertake challenge (Bartone, 2000). The quality of hardiness is believed to influence how people interact with their environment by encouraging effective coping with stressful circumstances (Maddi & Kobasa, 1984). Specifically, Hystad, Eid, & Brevik (2011) investigated the role of hardiness in sickness absences from work in a sample of Norwegian Armed Forces employees. They found that hardiness predicted both the likelihood of having sickness absences and the number of absence spells over the following 12 months. Moreover, individuals who reported high demands and high control (in line with the activation hypothesis; Karasek, 1979) were absent more often if they reported a low versus high levels of hardiness. This suggests that hardiness comes into play when individuals are actively challenged by demanding work over which they perceive a strong measure of control (Hystad et al., 2011).
Another individual difference variable that has recently received investigative attention in a study of the JDC(S) model is emotional stability. Emotional stability is defined as the ability to remain calm when faced with stressful circumstances or environments, and to perform effectively under such conditions (Leone, Van der Zee, van Oudenhoven, Perugini, & Ercolani, 2005). It is associated with low levels of negative affect, as well as higher levels of self-confidence, productive coping strategies, such as problem-focused and emotion-approach coping, and a calm demeanor. Conversely, when faced with challenges, individuals with low levels of emotional stability are more likely to focus on their own inner turmoil, and to direct available resources (e.g., control or support) toward reducing negative emotions rather than to addressing situational demands (Baker & Berenbaum, 2007; Connor-Smith & Flachsbart, 2007). Moreover, individuals who are low in emotional stability are likely to inadvertently invite more stress and strain by dwelling on negative emotions, and to experience anxiety, hostility, and self-doubt (Costa & McCrae, 1987), despite a range of emotion-avoidance coping strategies (Baker & Berenbaum, 2007).

Rubino, Perry, Milam, Spitzmueller, & Zapf (2012) integrated study of the JDC(S) model (Karasek & Theorell, 1990) with the conservation of resources theory, which views stress as triggered by failure to acquire sufficient resources, or by threat or actual loss of them (Hobfoll, 2001), by positing that emotional stability can act as a personal resource by aiding in the management of job demands. The authors tested the moderating effect of emotional stability on job demands of uncertainty and time pressure, and control (i.e., decision latitude) in predicting job dissatisfaction and disengagement. For both uncertainty and time pressure they found that a significant three-way interaction emerged, such that the traditional demand–control interaction was found only in those with high emotional stability, and that those with low-emotional stability did not benefit as readily from decision latitude. Moreover, those with low emotional stability were more susceptible to job demands when they experienced high levels of control. This suggests that highly emotionally stable individuals are best able to capitalize on being afforded significant control over their work to manage demands; whereas in uncertain situations, emotionally unstable individuals may view decision latitude as added responsibility that may further contribute to strain (Rubino et al., 2012).

Finally, Daniels, Wimalasiri, Cheyne, & Story (2011), examined whether personal initiative moderated demand-control-support relationships with outcomes of idea generation and idea implementation. Personal initiative is defined as a set of co-occurring behaviors consisting of being self-starting, persistent in implementing goals, and having a long-term orientation (Frese & Fay, 2001). Moreover, according to Seibert, Kraimer, & Crant (2001), individuals with high levels of personal initiative are future oriented, and thus may be more predisposed to resolve ambiguous problem situations through the development and implementation of new ideas. Such people also tend to be more creative than those with lower levels of personal initiative (Binnewies, Ohly & Sonnentag, 2007).

Daniels et al. (2011) used an experience sampling methodology whereby participants provided data up to four times per day for up to five working days ($n = 89$). They expected that workers with higher levels of personal initiative would be more likely to use job control to solve problems (e.g., demands) as a way to generate new and useful ideas (c.f., Searle, 2008). They operationalized job control as “changing aspects of work activities to solve problems” (p. 11), and found that the degree to which people reported doing so was associated with higher levels of idea generation for people with high personal initiative.

Additionally, Daniels et al. (2011) operationalized social support in the context of problem solving as “discussing problems to solve problems” (p. 13). They did not expect workers with high levels of personal initiative to use support in the idea generation process, because according to Paulus, Larey, & Dzindolet (2001) cognitive processes relating to idea generation can be hindered by the presence of others. However, people with high levels of initiative tend to be more persistent in implementing ideas (Frese & Fay, 2001), and idea implementation is thought to include a social element (whereby ideas can be both
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supported and transformed based on feedback; e.g., De Dreu, 2006). Thus, Daniels et al. (2011) expected such people to discuss problems with others in order to refine and implement new ideas for solving problems (Frese & Fay, 2001). They found that the extent to which workers discussed problems to solve problems (e.g., support) was associated with higher levels of idea implementation for those with higher levels of personal initiative. Thus, Daniels et al.’s (2011) findings suggest that individuals with a high degree of personal initiative are more likely to make optimal use of control and support resources, in order to solve problems in the shape of work demands.

Taken together, these results further suggest that such differences are at play when examining the major hypotheses of the JDC(S) model. Furthermore, it appears that multiple individual difference characteristics share similar relationships, when accounted for in studies of the model. That is, the negative effects of strain tend to be less for those who are high in these characteristics, in conjunction with high levels of perceived control and in some cases support. Moreover, positive effects of high demands and high control (and in some cases, high support) appear to have the strongest affect on active learning and performance-related outcomes (as per the activation hypothesis; Karasek, 1979; Karasek & Theorell, 1990) in people who are strong in these individual difference characteristics.

XV. FURTHER ISSUES TO BE ADDRESSED: NEW CONCEPTUALIZATIONS OF DEMANDS

In addition to the theoretical and methodological concerns above, Kain & Jex (2010) followed up Karasek & Theorell’s (1990) original call for tests of other demands using the model. That is, although studies have examined a number of different operationalizations of demands (e.g., workload, role overload, psychological demands), the authors called for examinations to test the strain and buffering hypotheses on alternative conceptualizations of the term “demands.” Beyond these different operationalizations, and what has already been reviewed and discussed regarding objective versus subjective demands, arguably the most progressive change in relatively recent years is a reconceptualization of demands as being both “bad” and “good” not only in their quantity (e.g., eustress, due to a moderate versus high or low amount of demands, Selye, 1956; or the different role of demands in the activation versus strain hypothesis, Karasek & Theorell, 1990), but also in terms of the nature and characteristic of the demands themselves. Thus, there is now greater consideration than before that the type of demand stressor may be important in predicting job satisfaction, and strain.

Challenge-Hindrance Stressors: For example, in their meta-analysis of work stress and employee turnover, Podsakoff, LePine, & LePine (2007) argued for two conceptually separate domains of stressor in their examinations, which they purport may somewhat explain inconsistencies in previously reported relationships where demands have operated within a singular domain space (e.g., Selye, 1956; Wundt, 1922). Specifically, Podsakoff et al. (2007) categorized job demands as either hindrance or challenge stressors. The authors defined hindrance stressors as demands that workers tend to appraise as potentially constraining to their personal development and work-related accomplishment. Examples included role ambiguity (i.e., the degree to which work is demanding because of uncertainty regarding expectations; Kahn, Wolfe, Quinn, & Snoek, 1964), organizational politics, and concerns about job security. In contrast, they defined challenge stressors as those that promote personal growth and achievement (Podsakoff et al., 2007). Examples include high levels of workload, time pressure, job scope, and responsibility. Thus, challenging demands require some energy, but are stimulating. Although the term “job demands” has come to encompass a variety of stressor variables, delineation of demands into negative and positive categories stands in contrast to previous stress research in which the term stressor was inherently thought to be negative to employee well-being. Interestingly, this conceptualization has stood in contrast to classical stress theory on there being an optimal level of stress for well-being, not a linear negative relationship (e.g., Selye, 1956, 1976).
In their recent meta-analysis, Podsakoff et al. (2007) collated primary studies based on whether stressor variables could be considered to be challenges or hindrances. Their findings revealed that hindrance stressors were more strongly related to strain ($r_c = .56$, 95% CI .50 to .62) than were challenge stressors ($r_c = .40$, 95% CI .34 to .47). However, although hindrance stressors were strongly negatively related to job satisfaction ($r_c = -.57$, 95% CI -.61 to -.52), challenge stressors had a near-zero relationship with job satisfaction ($r_c = -.02$, 95% CI -.10 to .05). Although challenge stressors are thus painted in a more positive conceptual light than hindrance stressors, Podsakoff et al.’s (2007) findings suggest that high levels of challenge stressors increase the occurrence of strain. Moreover, when seeking to enhance employee satisfaction through job redesign, interventions targeting job demands are unlikely to produce meaningful effects.

Despite the relative prominence of the challenge-hindrance stressor framework in recent years, and widespread acceptance that demand stressors can be delineated based on these characteristics, almost no research to date has investigated whether the moderating role of resources (e.g., control and support) differs in relationships between challenge and hindrance stressors, respectively, and job satisfaction and strain. This may be due to questions being raised regarding the accuracy of these concepts as standalone variables. For example, Schieman (2013) contended that “the conceptual fuzziness of demands and resources in the challenge-hindrance model is problematic on many levels” (p. 9). First, the challenge stressor and hindrance stressor conceptualizations blur the lines between the job attribute and the consequences that flow from it by blending the independent and dependent variables. Specifically, a job characteristic is labeled as a “hindrance stressor” if it is associated with decreased functioning or poor health; but as a “challenge stressor” if it is deemed to be stimulating. Moreover, Schieman (2013) argued that the challenge-hindrance framework obscures key distinctions between demands and resources, and, instead characterizes them all as different kinds of demands. That is, challenging demands may encompass positive assessment of resource availability for task completion, whereas hindrance demands may simply be demands that the individual appraises as being imbalanced with resource availability. In addition to these contentions, as previously mentioned transactional stress theory (Lazarus & Folkman, 1984) proposes that only the individual can appraise the challenging or threatening nature of the stressor. Thus, what may be challenging for one individual may be a hindrance to another. Furthermore, a recent study by Webster, Beehr and Love (2011) showed that some employees simultaneously appraised stressors such as role ambiguity, workload and responsibility both as challenges and threats.

Despite these arguments, one recent study investigated whether the role of resources differed for challenge and hindrance stressor relationships with strain. Tadic, Bakker, and Oerlemans (2015) conducted a quantitative daily diary study to investigate whether primary school teachers experienced the most positive affect and work engagement on days when they were confronted with highly challenging (vs. low challenge) job demands and high resources of control and work support; and the lowest levels of positive affect and engagement on the days they were confronted with high (vs. low) levels of hindrance demands combined with low job resources. They found that hindrance demands had a negative relationship with daily positive affect and work engagement, but that control and support buffered this relationship. In contrast, daily challenge demands had a positive relationship with the two outcomes, and this was made stronger by the presence of resources. Tadic et al. (2015) have taken the first step to showing that resources may in fact have differing effects between challenge and hindrance stressors, but clearly, more research is required to draw firmer conclusions.

Illegitimate Tasks: Another relatively new conceptualization of job demands is that of illegitimate tasks (Semmer et al., 2005, 2015). The concept of illegitimate tasks, as well as an examination of their effects in a test of the JDC(S) model is covered in article 3 of this dissertation.
XVI. Where Now? Future Research on the Model

In addition to addressing Kain & Jex’s (2010) calls for future research on the JDC(S) model, there are other concerns that arguably deserve more investigative attention. First, given significant changes in the design of many established types of jobs, as well as the advent of many new types of occupation since Karasek’s (1989) original research (see O*Net; Peterson et al., 1999), categorizations of jobs based on demand, control, and support characteristics should be reevaluated. It would also be interesting to ascertain whether certain occupations have changed position in the ensuing period (e.g., from being active jobs, to high strain jobs), and to understand why. Aligned to this, further research could establish whether demographic trends exist in these different categorizations of jobs. For example, given the gradual shift towards greater levels of gender equality in the workplace, have there been changes in the work characteristic profile of jobs they frequently occupy (e.g., from an arguable tendency towards passive jobs such as clerical work, to more low strain, active, and high strain positions, such as scientists, management consultants, and attorneys?).

Additionally, future studies of the model could address concerns regarding interactive effects by examining a broader array of operationalizations of job demands, control, and support, within a single study (for example, physical demands, emotional demands, task demands; skill discretion, autonomy, and decision making authority; as well as coworker and supervisor support, and perhaps other sources of workplace support, such as from internal counselors). A more comprehensive approach to measuring demands, control, and support makes both theoretical and practical sense, and is necessary both to validating the buffer hypothesis on a more consistent basis, and moving the theory away from criticism due to frequently unjustified reasons for selecting a single measure only of the main constructs (e.g., Kristensen, 1995). Furthermore, future cumulative reviews of JDC(S) research could compare findings across different occupations to better determine what control and support resources are more or less likely to buffer effects of demands on well-being and strain in different jobs. Doing so would increase the likelihood of finding interactive effects because of the greater number of tests that could be performed in a single study (e.g., two types of demands and two types of control would yield four tests of multiplicative effects). However, perhaps more importantly from both a theoretical and practical perspective, such an approach would allow for more specific matching between types of demands and control, which would aid efforts to redesign jobs for maximal positive outcomes such as learning, motivation, and performance, and minimization of strain. For non-experimental survey-based studies of the model, as adopted by the vast majority of studies of the model to date (De Lange et al., 2003; Häusser et al., 2010; van der Doef & Maes, 1999), adding further measures of the three main dimensions of the model would simply be a question of adding more survey instruments to the investigation.

A third recommendation for future research, in line with the second recommendations, is that researchers make a greater effort to focus on forms demand, control, and support that are relevant to the type of work or organization participants work in, rather than relying on global measures. For example, a brick layer performs routinized physical and monotonous tasks (Karasek & Theorell, 1990). The three classical forms of control measured in studies of the JDC(S) model are skill discretion, participation in decision making, and autonomy. However, it is hard to argue that the average brick layer would have, or indeed benefit from either of the first two, much less that either or both would buffer the effects of their specific job demands on strain. Moreover, autonomy may be interpreted contextually. That is, a brick layer may perceive a degree of autonomy when, having been given instructions for the day’s tasks, he or she is left to work with little supervision. However, if autonomy is contextualized as having the freedom to make larger scale decisions, such as what shift hours to work, when to take breaks, what products and tools to use, or what freedom to assess the quality of one’s own work, then a typical brick layer (that is, an employee of an organization, not an independent contractor) may perceive having little autonomy in their work.
Furthermore, even for jobs with seemingly clear task demands, such as a brick layer, psychological demands of the work may be contextualized differently. For example, a laborer who is passionate about brick laying may interpret the nature of his/her work as low in psychological demands: the job is set, the tools are ready, and success is a question of applying oneself to a relatively set formula. Conversely, as aspiring laborer who wishes to become a manager may find the psychological demands of brick laying higher, because of having to suppress their as yet unfulfilled ambitions.

The validity of a more occupation-specific approach to measurement could also be examined. For example, until now most studies of the JDC(S) model have operationalized demands control and support with broad measures (De Jonge & Dorman, 2006; Kristensen 1995; Taris & Kompier, 2003). Thus, it appears that researchers have either hoped or expected that participants would interpret these constructs in the context of their own job specific relevancies. However, this could be ascertained this by assessing perceptions of both broad and job-specific constructs, and comparing respective results.

Finally, given the vast amount of research published on the model, as well as three vote counting reviews (De Lange et al., 2003; Häusser et al., 2010; van der Doef & Maes, 1999), and numerous theoretical articles (e.g., De Jonge & Dorman, 2006; Kristensen 1995; Taris & Kompier, 2003), cumulative research should now adopt a meta-analytic approach. The transition to meta-analytic research is covered in article 2 of this dissertation.

XVII. CONCLUSION

Although the JDC(S) model has been highly influential in occupational stress literature for over 37 years, it has been widely criticized for inconsistent multiplicative effects of control and/or support with demands on strain and well-being outcomes. Research as a whole on the model has also been criticized for a predominance of self-report versus objective measurement, cross-sectional rather than longitudinal design, variety and inconsistency in how the three main dimensions are measured, and a lack of consideration of individual difference variables. Other considerations include a progression in our understanding, conceptualization, and operationalization of job demands in recent years, and the need for meta-analytic research. However, the model remains a bedrock of work stress literature, and is popular not only because of its simplicity and the ease in which it can be tested given the numerous ways that demands, control, support, and strain can be measured; but because of the practical implications that can be gleaned from it, and the enduring (and arguably ubiquitous) concern regarding job demands, control, and support within the wider work stress and job design literature (Griffin & Clarke, 2011). Thus, its proponent’s goals must surely be to increase its reputation for consistent multiplicative effects and rigorous research designs by ensuring that the model remains at the forefront of continually progressing theoretical and methodological developments in scientific research.

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