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Age Differences in the Demand–Control Model of Work Stress:

An Examination of Data From 15 European Countries

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Abstract

There have been many tests of Karasek's demand–control model of work stress. However, no studies have examined how the model may differentially apply to older versus younger workers. Due to age changes in cognitive processing, the psychological demands of jobs may interact differently with controls for younger versus older workers. Therefore, the study uses data from the Eurobarometer to examine how the demand–control model of work stress may function differently for older versus younger workers. The results indicate that different controls may in fact buffer different types of job demands for younger versus older workers. The findings reveal that only the interaction between problem solving and time to complete tasks was significant for younger workers. For older workers, however, the interactions between time deadlines and having sufficient time to complete tasks, autonomy, and the interaction between problem solving and schedule flexibility are significant predictors of self-reported stress.

Keywords

work stress; demand–control model; older workers; age difference

Europe has the highest proportion of elderly residents in the developed world and is likely to remain that way for decades (Waite, 2004). In the United States, it is projected that by the year 2020, 16% of the population will be persons aged 65 or older (U.S. Census Bureau, 2004). Similarly, developing countries are aging and now host 59% of the world's elderly (Kinsella & Velkoff, 2001). Following this demographic transition is the rapid growth of the presence of older workers in the labor force. In fact, the National Research Council and the Institute of Medicine (Wegman & McGee, 2004) reported that in 2002, 44% of the U.S. civilian workforce was aged 45 or older. They also noted that this proportion is expected to grow to 53% by the year 2050. Given this changing trend toward an older workforce, it is important to provide older workers with opportunities to maintain healthy, productive, and less stressful work lives.

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This will be beneficial in terms of addressing the projected growing labor shortages due to the pending retirement of the baby boomers (AARP, 2005; Alley & Crimmins, 2007) and help to reduce barriers, and encourage work, at older ages (Shultz & Adams, 2007; Shultz, Sirotnik, & Bockman, 2000).

One of the theoretical models that is particularly relevant to the study of work-related stress for older workers is Karasek's (1979,1989;Karasek & Theorell, 1990) job demand–control model (Barnes-Farrell, 2005). It provides a useful framework to accommodate the changes in individual characteristics that occur with age (Jex, Wang, & Zarubin, 2007), thereby offering a theoretical approach to study and clarify the relationship between age and work-related stress.

To the current authors' knowledge, there have not been any studies that have examined age differences in the ability of the demand–control model to predict worker stress levels. Therefore, conducting such research will not only help us qualify the interactive mechanism between job demands and control in different age populations, but also help us reconcile previous inconsistent findings in the literature. For example, in a reanalysis of 63 demand–control-model–related studies reviewed by Van der Doef and Maes (1999), Taris (2006) found that only 10% of those studies showed support for the demand–control interaction effect. One of the explanations of this inconsistency points to potential moderators. A revisit of the studies reviewed by Van der Doef and Maes (1999) showed that the typical samples used to test the demand–control model are relatively young (most samples have average ages between 27 and 36). To these relatively younger workers, some job demands may not be perceived as stressful as they are to their older counterparts (e.g., workers who are older than 40; Jex et al., 2007). Therefore, the current study seeks to test age as a potential moderator of the demand–control model.

We first briefly review the demand–control model and age-related reduction in cognitive resources to set up the theoretical framework for the current study. Then, we draw on these theoretical perspectives to develop our current hypothesis. We test our hypothesis by using a large representative sample from 15 European countries.

The Demand–Control Model

According to Karasek (1979,1989;Karasek & Theorell, 1990), the demand–control model argues that any job environment can be characterized in terms of the combination of two dimensions: psychological work demands and the amount of control workers have to meet these demands. The prediction of the demand–control model can be summarized as high work demands tend to lead to high levels of workers' stress, but having high control with regard to one's job will help buffer the stress caused by high work demands and in turn lower the levels of work stress experienced by workers. Statistically, this prediction is operationalized by a significant demand–control interaction effect on work-related stress outcomes (Taris, 2006).

In the past two decades, research at the individual level of analysis, as well as large-scale epidemiological studies using medical records and occupational classification data, have provided some support for the demand–control model (e.g., Ganster & Murphy, 2000; Ganster, Fox, & Dwyer, 2001; Wegman & McGee, 2004). Nevertheless, as Taris (2006) recently pointed out, most studies support the main effects of demand and control, but not the interaction between demand and control on stress outcomes. As mentioned earlier, this may be due to the existence of potential moderators, such as individual characteristics (Meier, Semmer, Elfering, & Jacobshagen, 2008) and situational factors (Van der Doef & Maes, 1999).

It should also be noted that in Karasek's (1979; also see Karasek & Theorell, 1990) original conceptualization of job demands, he focused specifically on the psychological work demands or mental workload of the job, including time demands, problem-solving demands, and

monitoring demands. However, as Beehr, Glaser, Canali, and Wallwey (2001) noted, many of the studies testing Karasek's demand–control model have not adhered to his original conceptualization of job demands as mental workload, but more as physical demands and organizational constraints. In the present study, we adhered more strictly to Karasek's original conceptualization of the job demands as mental workload, and for this reason, we emphasize the potential role of cognitive rather than physical changes associated with age.

Control at work has been defined in two ways in the literature: (1) as "job decision latitude," which includes both personal discretion and job skill level, and (2) more narrowly, in terms of being able to influence the work environment in a way that one may be able to influence the outcomes (Ganster & Murphy, 2000). Karasek's (1979) original conceptualization of job control was more in line with this second definition. In the present study, we were able to tap into both definitions of job controls outlined above.

Age-Related Reduction in Cognitive Resources

When people grow older, even though their general knowledge remains stable or even increases, they may experience some reduction in several cognitive resources (Jex et al., 2007; Park, 2000). Specifically, on average, older adults experience declines in processing speed (Salthouse, 1991), working memory (Baddeley, 1992), and inhibition function (Hasher & Zacks, 1988). These declines are viewed as components of age-related differences in cognitive performance and can start as early as age 40 (Park, 2000). Overall, the cognitive aging literature suggests that age-related reduction in cognitive resources may lead to more difficulty for older adults than younger adults in dealing with high mental load tasks, which require retention of large amounts of information or rapid cognitive processing (Wang & Chen, 2004; 2006). It has been shown that to maintain the same level of task performance, older adults have to expend greater effort on these types of tasks than younger adults (Bunce & Sisa, 2002). In addition, Hansson, Robson, and Limas (2001) noted that, "with aging, experience, and maturity, then, cognitive abilities increasingly influence one's emotional response to distress" (p. 249). Hence, to the extent that overall cognitive resources and reserves may be declining with age, while they are becoming more critical to one's response to distress, it is important that we better understand the relationship between aging and the perception of work stressors.

Hypothesis Development

Based on the above evidence of age-related reductions in cognitive resources, it is reasonable to expect that in the work situation, job demands involving high mental workload will be appraised as more stressful and threatening by older workers than by younger workers. For example, in one of the few empirical studies that focused on age differences in cognitive appraisals regarding workplace stressors, Mayes, Barton, and Ganster (1991) found that older workers responded more negatively to role conflicts compared to younger workers. They pointed out that this result was possibly due to the fact that balancing these role conflicts may have required higher levels of cognitive resources than older employees possessed. Similarly, in another study, de Zwart, Frings-Dresen, and van Duivenbooden (1999) compared the prevalence of complaints about work and health conditions of 1,881 younger (aged 16 to 30 years) and 1,946 older (aged 45 to 64 years) Dutch construction workers. They found that older construction workers complained more about working under excessive time pressure than younger construction workers. In addition, older workers not only reported decreased physical demands but they also reported increased mental demands. Thus, this also supports the notion that high mental workload may be appraised as more threatening for older workers than for younger workers.

Furthermore, given age-related declines in cognitive resources, it may be more important and beneficial for older workers to possess high levels of control in their jobs than younger workers in terms of effectively dealing with the high stress caused by high job demands. For example, Barnes-Farrell (2005), Hansson et al. (2001), and Ilmarinen (1994), all argued that granting older workers more autonomy at work would help them overcome the high job demands that may exist in their work. In addition, previous literature has shown that when given enough decision-making freedom, older workers typically perform as well as younger workers on their job tasks (e.g., Park, 1994). This argument also helps account for the lack of support of the demand–control interaction (Taris, 2006) in studies that typically used samples of relatively younger workers. Specifically, for younger workers, given that they have more cognitive resources to cope with high mental workload, the extent to which they possess job control may not be essential in influencing their perceived work stress, partly because they may not perceive the situation as high demand. However, for older workers, possessing high job control will be more important in helping them reduce their perceived work stress, as they may appraise high mental workload as more stressful in that they may not have enough cognitive resources to cope with it.

Taken all together, considering the potential of age-related reduction in cognitive resources, we hypothesize that the demand–control model would apply differently to older and younger workers. Specifically, the interaction effects between demand and control variables hypothesized by the demand–control model on perceived work stress are expected to be more prevalent and numerous for older workers than for younger workers.

Method

Sample and Data

Data from the second European survey on working conditions (Eurobarometer 44.2) was examined in the present study. The Eurobarometer collected data from a representative sample that included 15,986 working adults in 15 Western European Countries, with roughly 1,000 participants coming from each country (see Reif & Malier, 1996, for more details). Participants in the study were in the age group of 15 to 83 (M = 38.9), with approximately 7,400 aged 40 and older. Men comprised 57% of the sample. The most prominent occupations reported included craft and related trade workers (17%), clerks (15%), service and sales workers (13%), and technicians (12%). Approximately 70% of workers were employed in the private sector.

Measures

Demographic variables—The demographic variables of gender, years on main job, hours worked per week, employment sector, job category, and supervisory responsibilities were entered first in the hierarchical logistic regression equations. Gender was coded 0 for women and 1 for men. Employment sector was coded 1 for public sector and 2 for private sector. Job category was coded 0 for white-collar workers (i.e., legislators and managers, professional, technicians, clerks, service and sales workers) and 1 for blue-collar workers (i.e., agricultural and fishery workers, craft and related trade workers, plant and machine operators, elementary occupations, and armed forces). Supervisory responsibility was coded 0 for no supervisory responsibilities and 1 for any supervisory responsibilities. Each of these variables has been shown to be related to work stress in past research (Beehr, 1985; Sulsky & Smith, 2005). Therefore, it was imperative to control for these demographic variables prior to testing the demand–control model and how it may differentially apply to older versus younger workers, to rule out alternative explanations for perceived job stress.

Job demands—Karasek and Theorell (1990) focused on mental demands of tasks when defining job demands in their demand–control theory. Thus, Beehr et al. (2001) suggested that

demands in demand–control theory would include three types of job demands: time demands, monitoring demands, and problem-solving demands. Both the former and the latter were assessed in the Eurobarometer data set. Tight deadlines (two items, $r = .67$) were measured with the items, "Does your main paid job involve …" (1) working at very high speed? and (2) working to tight deadlines? The response scale was 1 = *all the time*, 2 = *almost all the time*, 3 = *about three fourth of the time*, 4 = *around half the time*, 5 = *around one fourth of the time*, 6 = *almost never*, and 7 = *never*. The two items were averaged to obtain a score on this scale. This scale was reverse scored so that a higher score represents tighter time deadlines.

For problem solving (4 items, $\alpha = .61$) the item stem read, "Generally, does your main paid job involve, or not…" (1) solving unforeseen problems on your own? (2) complex tasks? (3) learning new things? (4) deciding, possibly with colleagues, on departmental issues such as the division of tasks, staff replacements, production objectives, timetables, etc? A "yes" (coded as 1), "no" (coded as 0), and "DK" (don't know, coded as missing) response format was used. The 4 items were summed to obtain a score on this scale so that a higher score represents more problem solving.

Job controls—The three variables of flexibility in scheduling (3 items, $\alpha = .69$), time to get the job done (1 item), and perceptions of autonomy (3 items, $\alpha = .78$), were also measured. The item stem for the three schedule flexibility items reads, "For each of the following statements, please answer yes or no": (1) You can take your break when you wish, (2) you are free to decide when to take holidays or days off, and (3) you have a fixed starting and finished time every day (reverse scored). Item responses were coded as 1 for "yes" and 0 for "no." Items were summed to obtain a score on this scale so that a higher score represents more schedule flexibility. The time to get the job done item used the same stem as the flexibility in scheduling items and asked, "You have enough time to get the job done" (yes/no). A higher score signifies more time to get the job done. The stem for the three perceptions of autonomy items read, "Are you able, or not, to choose or change… " (1) your order of tasks? (2) your methods of work? (3) your speed or rate of work? Again a yes/no response format was used and items were summed to obtain a score on this scale so that a higher score represents greater autonomy.

It should be noted that *tight deadlines* (job demands) are imposed by the organization and its agents and thus represent demands imposed by the work organization that the worker will rarely, if ever, have control of. Whereas, *time to get the job done* (control variable) is based on a wide variety of contextual factors that the workers themselves may or may not feel they control, but often have the potential to be within the control of the worker. Thus, though these two variables are somewhat related, they are also conceptually distinct.

Work stress—The question, "Does your work affect your health, or not? If yes, how does it affect your health?" was asked of participants. For the latter part of the question, 16 aspects of health were presented for participants to endorse. The two most frequently occurring health problems endorsed were backaches (30%) and stress (28%). All other aspects of health were reported by 20% or less of participants, with 10 aspects having an endorsement rate less than 10%. Although other items on the scale (e.g., backaches, anxiety, sleeping problems, and irritability) may be indicative of psychological distress, they were not directly assessments of stress. In addition, given that most of these additional items have a much lower base rate than the stress item, including them would have led to statistical difficulties in identifying moderation effects in the demand–control model. Therefore, only the responses to the stress item were used in the current study. For workers who endorsed *stress* as the response to the question, their responses were coded as 1. For workers who did not endorse *stress* as the response to the question, their responses were coded as 0.

Results

Table 1 provides the means, standard deviations, and intercorrelations among demographic variables, predictors, and the criterion variable for both the younger and older worker samples. As can be seen in Table 1, except for the average number of years on the job and probability of having supervisory responsibilities, most means are comparable across the two age groups. It should be noted that all of the control and demand variables were standardized (i.e., converted to deviation scores from their respective means) within age group prior to creating the interaction terms and entering the variables into the regression equations, to reduce nonessential multicollinearity and improve interpretability (Cohen, Cohen, West, & Aiken, 2003).

Table 2 reports the results of the hierarchical logistic regression for the perceived work stress criterion for the younger worker sample. This regression analysis for younger workers (younger than age 40) shows that in Step 1, five of the six demographic variables (gender, job category, years on main job, hours worked per week, and *employment sector*) significantly predicted perceived work stress: Step 1, $\chi^2(6, N = 6{,}643) = 168.55$, $p < .001$, Nagelkerke $R^2 = .04$. Note that Nagelkerke's pseudo R^2 ranges from 0 to 1 and summarizes the variance accounted for by the logistic regression model but is not interpreted the same as R^2 is in ordinary least square (OLS) regression (i.e., the percentage of variance accounted for in the criterion variable by the predictor variables). Nagelkerke's pseudo R^2, in this instance, revealed a modest improvement in fit when comparing the fitted model to the null model.

Specifically, in the younger worker sample, there was a significantly higher probability of perceiving work stress for women, those in white-collar jobs, those in the public sector, those with more years on the job, and those who worked more hours per week (see Table 2 for odds ratios). Supervisory responsibility was the only demographic variable that was not a significant predictor of work stress in the younger worker sample.

For Step 2, both job demands were significant for the younger worker sample, as was the control variable of time: Step 2, $\chi^2(5, N = 6{,}643) = 537.07$, $p < .001$, Nagelkerke $R^2 = .14$. Specifically, the more stringent the time deadlines and problem-solving requirements of the job, the higher the probability was for those respondents to perceive work stress. In addition, if respondents reported that they did not have enough time to get the job done, the probability of perceiving work stress was also higher (see Table 2 for odds ratio). In Step 3, including the interaction terms for demands and controls did represent a significant improvement in overall model fit: Step 3, $\chi^2(6, N = 6{,}643) = 13.35$, $p < .05$, Nagelkerke $R^2 = .15$; however, only one of the six interaction terms was statistically significant for the younger work group. This was the interaction between problem solving and time to complete tasks. Following Cohen et al.'s (2003) procedure, this interaction is plotted in Figure 1. Specifically, the positive relationship between problem-solving demands and the probability of perceiving work stress was less pronounced for younger workers who had enough time to complete their tasks than for those who did not have enough time to complete their tasks.

Table 3 reports the results of the hierarchical logistic regression for the perceived work stress criterion for the older worker sample. This regression for older workers (aged 40 and older) shows that in Step 1, three of the six demographic variables (*job category*, *hours worked per week*, and *employment sector*) significantly predicted perceived work stress: Step 1, $\chi^2(6, N = 6{,}619) = 133.89$, $p < .001$, Nagelkerke $R^2 = .03$. Specifically, for the older worker sample, there was a significantly higher probability of perceiving work stress for those in white-collar jobs, those in the public sector, and those who worked more hours per week (see Table 3). Supervisory responsibility, gender, and years on the job did not significantly predict the probability of perceiving work stress for older workers.

For Step 2, both job demands were significant predictors for the older worker sample; however, only one of the three controls (i.e., time to get the job done) was a significant individual predictor: Step 2, $\chi^2(5, N = 6{,}619) = 526.46$, $p < .001$, Nagelkerke $R^2 = .13$. Specifically, similar to the younger worker sample, the more stringent the time deadlines, problem-solving requirements of the job, and less perceived time to get the work done, the higher the probability the participants would perceive stress (see Table 3 for odds ratios). In the final step, as a group, the six interaction terms represented a significant improvement in overall model fit: Step 3, $\chi^2(6, N = 6{,}619) = 22.48$, $p < .01$, Nagelkerke $R^2 = .14$. Three of the six interaction terms were statistically significant. They were the interaction terms between time deadlines and time to complete tasks, time deadlines and autonomy, as well as problem solving and schedule flexibility. These interactions are plotted in Figures 2, 3, and 4, respectively.

Specifically, from Figure 2 it can be seen that there was a strong positive relationship between the deadline demands and the probability of perceiving work stress for older works who did not have enough time to complete their tasks, whereas this relationship was slightly negative for those who had enough time to complete their tasks. From Figure 3, it can be seen that the positive relationship between deadline demands and the probability of perceiving work stress was less pronounced for older workers who had high autonomy to complete their tasks than for those who had low autonomy to complete their tasks. Finally, from Figure 4, it can be seen that the positive relationship between problem-solving demands and the probability of perceiving work stress was less pronounced for older workers who had high schedule flexibility to complete their tasks than for those who had low schedule flexibility to complete their tasks.

To statistically test whether the demand–control interaction patterns were significantly different between younger and older workers, we combined the data of the two age groups to test the three-way interaction terms between worker age, stressors, and controls. Following Hardy's (1993) recommendation in testing moderation effects of grouping variables, the three-way interaction terms were created by multiplying the grouping variable (i.e., *age*) with each demand by control two-way interaction terms, resulting in 6 three-way interaction terms entered in the logistic regression model in addition to the control variables, main effects, and two-way interactions. The model comparison revealed that as a block of predictors, these 6 three-way interaction terms significantly improved the model fit: χ^2 (6, $N = 12{,}515$) = 15.40, $p < .05$; Nagelkerke R^2 improved from .14 to .15. Furthermore, the Wald tests revealed that 3 three-way interaction terms were significant. Specifically, the Time Deadlines × Time To Complete Tasks interaction was significantly different across age groups ($B = .09$, $p < .05$), the Time Deadlines × Autonomy interaction was significantly different across age groups ($B = -.15$, $p < .01$), and the Problem Solving × Schedule Flexibility interaction was significantly different across age groups ($B = -.17$, $p < .05$). These significant three-way interaction patterns directly support the findings we derived from testing two-way interactions in separate age groups.

Discussion

The aging of the baby-boom generation is resulting in the aging of most workforces in developed countries (OECD, 2006). However, in most cases, there are not enough younger workers to take the place of the aging workers as they approach retirement age (Alley & Crimmins, 2007). Hence, it is becoming more critical to recruit and retain older workers (Hedge, Borman, & Lammlein, 2006; Taylor, Shultz, & Doverspike, 2005). One important aspect to retaining older workers is to better understand possible differences in how older workers, when compared to younger workers, deal with work stressors (Barnes-Farrell, 2005; Hansson et al., 2001). Karasek's (1979) demand–control model has received some support in terms of how workers can use job controls to buffer the effects of excessive job demands that result in experienced psychological stress. However, previous research has not

examined possible age differences in how the demand–control model might apply to younger versus older workers. In fact, most research that has applied Karasek's model has used predominantly younger workers.

In the present research, we found that older and younger workers reported similar effects of demands and controls (i.e., main effects) from their respective jobs, even controlling for numerous demographic variables such as gender, job type, employment sector, hours worked per week, years on the job, and supervisory responsibilities. However, interaction effects between demands and controls were different for younger versus older workers. For younger workers only one job-control mechanism (having enough time to get the job done) buffered stressful experience associated with the problem-solving demand, whereas for older workers all job-control mechanisms examined in the current study demonstrated buffering effects against the work stress associated with different types of job demands. However, these significant interaction effects had relatively small effects.

Specifically, older workers who reported having enough time to complete their work were actually less likely to report stress even with high deadline demands (see Figure 2). In addition, high levels of autonomy helped buffer the stress associated with strong deadline demands (Figure 3), whereas schedule flexibility helped in reducing the likelihood of reporting stress associated with high problem-solving demands (Figure 4). Thus, older workers who may be experiencing more age-related reductions in both cognitive and physical resources (Jex et al., 2007;Park, 2000) than younger workers appear to be particularly in need of job controls to reduce the likelihood of experiencing stress resulting from job demands such as stringent deadlines and heavy problem-solving-focused work. Our findings of older workers' stronger need to buffer the job demands of deadlines is consistent with Osipow and Doty's (1985) finding that older workers experience more stress from high work loads and time demands than do younger workers.

Also, as noted earlier, older workers are likely to have more difficulty inhibiting their attention to irrelevant information and concentrating on relevant information (Hasher & Zacks, 1988). Thus, it makes sense that older workers who have more schedule flexibility would be able to benefit from a job-control mechanism to reduce the likelihood of experiencing stress associated with high problem-solving demands, by scheduling such cognitively demanding tasks at times where interruptions and distractions would be minimized, whereas younger workers, absent such deficits, would be less likely to be in need of such controls. Furthermore, older workers are more likely to have slower processing speed (Salthouse, 1991, 1996); therefore, it makes sense that having enough time and autonomy to do the job will help reduce the likelihood of experiencing stress associated with stringent deadlines.

In addition, older workers with more autonomy and flexibility in their jobs may be implementing Baltes and Baltes' (1990) concept of selective optimization with compensation (SOC); that is, older workers faced with age-related declines in physical and cognitive capacities or reserves are able to select or focus on tasks that they do well (i.e., specializing), thus optimizing their strengths. In addition, older workers may need to compensate for age-related declines (e.g., by using technology devices) to makeup for age-related declines. In fact, Abraham and Hansson (1995) found that older workers reporting higher levels of work stress were in fact more likely to be using SOC strategies than older workers not experiencing high levels of work stress or younger workers in general. Thus, another explanatory mechanism for the age differences between older and younger workers in the present study may be the use of SOC strategies on the part of older workers that include job controls such a flexible schedules, autonomy, and time management (Hansson et al., 2001).

The current findings also shed light in terms of reconciling previous inconsistent findings in the demand–control model literature. Specifically, we found that the stress-buffering effect of job-control variables were more prevalent for older workers (mean age = 49.50) than for younger workers (mean age = 29.74). Given that the typical samples used to test the demand–control model are relatively young (most samples have average ages between 27 and 36), the current findings in younger workers are consistent with Taris' (2006) notion that most previous studies support the main effects of demand and control but not the interaction between demand and control on stress outcomes. Overall, the present findings suggest that age may be one of the potential moderators for the demand–control model, because the basic premise of the demand–control model (i.e., the stress-buffering effect of job controls) is more likely to be observed in older workers than in younger workers. Our current explanation points to the differences in available cognitive resources between younger and older workers, which further indicates that it may be beneficial for researchers to consider combining a resource perspective (e.g., Jex et al., 2007) and the demand–control model in developing more comprehensive theoretical framework regarding the relationships between individual characteristics, work environment, and psychological and health outcomes.

Practical Implications

The present research findings of age differences in the demand–control model of stress indicate that different stress reduction intervention strategies may need to be applied for older versus younger workers. Barnes-Farrell (2005) recently noted, "There is evidence of age-related shifts in the kinds of coping strategies that adults use to manage stressful experiences, as well as skill in using such strategies" (p . 435). This shift in coping mechanisms and strategies as we age can have important practical implications for the work environment, job, and task design and redesign (i.e., ergonomic interventions), as well as differences in training interventions for older versus younger workers. However, Hansson et al. (2001) noted that we need to "expect increasingly diverse reactions with age to stress in the workplace, and to reflect this expectation in assessment and intervention planning" (p. 248).

Barnes-Farrell (2005) also noted, "Furthermore, older workers must contend with some kinds of psychosocial stressors (e.g., age discrimination, transition to retirement) that are unique to members of this group" (p. 451). For example, Elovainio et al. (2005) recently found that the interaction between job demands and control was correlated with early retirement thoughts in Finnish social and health care employees. Elovainio et al. (2005) noted, "Our results provide evidence that the stressfulness of the psychosocial work environment has a role in the prediction of early retirement" (p. 90). Specifically, though workers with low-demand jobs generally had a lower likelihood of thoughts of early retirement than those in high-demand jobs, there was a significant interaction effect where larger differences in odds ratios of thoughts of early retirement were found between workers in high- and low-demand job with low control compared to the smaller differences found for workers with high-control jobs. Thus, providing more control to workers in high-demand jobs appears to have the strongest effect on reducing thoughts of early retirement.

Given older workers' closer proximity to retirement, a better understanding of how job controls and demands interact differently for older versus younger workers appears to have implications not only for experienced work stress, as studied here, but also for early retirement decision-making and workforce participation decisions, which is critical, given the aging work-force trends discussed earlier (Alley & Crimmins, 2007). Thus, to the extent that organizations can make work life more attractive to older workers (e.g., via reduced perceived job stress), they may be able to reduce thoughts of what Elovainio et al. (2005) referred to as "unnecessary early retirement" in

> that making the work more controllable and reducing work overload would be one way of increasing the beliefs of employees in their ability to cope at work until retirement age. The findings showing that the relationship between job characteristics and retirement thoughts were even stronger among people over 45 years, suggest that this is even more important in workplaces having a large portion of ageing workers. (p. 90).

Limitations and Future Research

There are several important limitations to the current study. First, we only used self-report measures in the present research. Therefore, common method bias may influence our current results. Using a self-report measure to assess perceived work stress may also lead to a possible issue with drawing causal conclusions: Respondents may overestimate the impact of their work on their stress experience or report something as due to work that may be due to other factors. Nevertheless, based on Lazarus' (1966) well-cited work regarding the cognitive appraisal of stress and the notion that whether a particular stimulus is perceived as a stressor varies across individuals, as that perception is in the eye of the beholder, and it makes a lot of sense to ask individuals directly about their perceived level of work stress. However, future studies may want to include both self-report and biological measures (e.g., cortisol level) to achieve reliable assessment of perceived work stress.

A second limitation is related to the archival nature of the data used in the current study. Because we used measures that were devised for a different research purpose, some measures for the current variables may not seem ideal, especially the single-item measures used for time to get the job done and perceived work stress. In terms of the *stress* variable, it is not clear what specifically the respondents were designating as the sources of stress at work (i.e., work stressors). Thus, future researchers should delve more deeply into the various sources and types of stress experienced by respondents to better understand how older workers, compared to younger workers, may differentially experience and respond to such stressors. In addition, the reliability and variability of these constructs would have increased if multiple indicators or established scale measures were available from this archival data set. Thus, relationships related to these variables might well be underestimated in the current study due to measurement errors. Future studies may test these relationships via well-established scales instead of single-item measures to provide more accurate estimates.

Third, the archival data we used were collected more than 10 years ago, which casts the question regarding whether the present findings may still generalize to the current population. This is a particularly valid concern as during the past 10 years new technologies have been applied to the work-place to help older workers to perform their jobs (Charness, Czaja, & Sharit, 2007). Therefore, future research should try to replicate our findings in the current workforce. However, we believe that the present findings are still generalizable to a large extent because, with the new technology development, workers are experiencing more and more training demands from their jobs (Jex et al., 2007). Furthermore, to effectively use these new technologies requires high mental workload in many jobs (Barnes-Farrell, 2005). Therefore, the general level of perceived job demands may not have decreased compared to what prevailed 10 years ago.

Fourth, although we interpreted current findings by combining the demand–control model with the age-related reduction in cognitive resources, we were not able to directly test the cognitive mechanism underlying this explanation. This is mainly because there are no measures of cognitive resource variables in the archival data we used for the current study. Future research may directly test whether the moderation effect of age on demand–control model was mediated by cognitive resource variables, such as *processing speed* and *working memory*. It is also possible that the difference between younger and older workers is due to difference in their

experience: With more experience, one may be more likely to achieve autonomy and also more able to use the autonomy in beneficial ways.[1] Furthermore, both Barnes-Farrell (2005) and Hansson et al.'s (2001) recent reviews of the aging and stress literature suggested that the differences in how older and younger workers experience and deal with stress may be due to differences in job demands, personal resources, and organizational constraints, but not aging or developmental phenomenon. Although we were able to control for some alternative explanations such as employment sector, years on the job, hours worked per week, job category, and supervisory responsibilities in our analyses, future studies may use more fine-grained measures to explore their roles in accounting for age differences in stress appraisal and coping.

Finally, the Eurobarometer archival data set used a cross-sectional design. As a result, we cannot rule out that the observed differences between younger and older workers in the use of various job controls to buffer the stress associated with various job demands, are a result of cohort or period effect (Barnes-Farrell, 2005; Shultz & Adams, 2007). That is, older workers from the mid-1990s may have been using different coping strategies than younger workers to deal with work stress as a result of the period of time the data were collected or as a result of cohort differences in how younger works, when compared to older workers of that era, dealt with job stress. Specifically, the younger cohort may be somehow different from the older one in the way they feel about stress and work demands and what they need to overcome them. For example, the younger cohort may be more independent and rely on themselves more; perhaps this is why having the time to meet demands is the only control element that seemed to be important to younger workers. Future studies would also need to use a cross-sequential-type design and include measures that detect cohort differences in stress appraisal and coping strategies to definitively tease apart aging, cohort, and period effects. In addition, following a life-course perspective (e.g., Elder & Johnson, 2003; Wang, 2007) in forming a more comprehensive theoretical framework that integrates individual development trajectories and development contexts may particularly benefit the empirical examinations in future studies for this endeavor.

Because our results are cross-sectional, we compare older and younger persons who still work, but with the number of workers in the older cohort reduced through retirement and disability. Those who experience the most difficult working conditions may be the ones who have left the workforce. Only longitudinal data would provide the information to examine this link.

However, it should be noted that though the use of archival data does impose some clear limitations to the interpretations of our results, the extremely large and diverse sample used here is a clear advantage of this study overall. As was the ability to test multiple demands and controls, and their interactions, while controlling for numerous demographic variables, which would not be possible in most primary study data sets with much smaller samples. However, the large samples may have also been a contributing factor to the relatively small effects found, particularly for the significant interaction effects.

Conclusion

In summary, the current study suggested that age imposes an important boundary condition for applying the demand–control model. The buffering effect of job control on perceived work stress caused by job demands was found to be more salient for older workers than for younger workers, albeit with relatively small effects. This finding helps reconcile the previous inconsistent findings in the demand–control model literature by providing a plausible explanation of the lack of support to the demand–control interaction. Furthermore, this finding represents one of the initial steps toward understanding the relationship between aging and

[1]We thank one anonymous reviewer for directing our attention to these alternative explanations.

work-related well-being. It offers important practical implications for providing older workers with healthy, productive, and less stressful work lives.

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Biography

Kenneth S. Shultz, PhD, is a professor of in the psychology department at California State University, San Bernardino. He earned his PhD in industrial and organizational (I/O) psychology from Wayne State University and also completed a National Institute on Aging postdoctoral training fellowship in social gerontology at the Andrus Gerontology Center at the University of Southern California. His research and publications focus on the areas of retirement, bridge employment, the aging workforce, and applied psychological measurement issues. He recently coedited (with Gary A. Adams) the book *Aging and Work in the 21st Century* (Psychology Press, 2007).

Mo Wang, PhD, is an assistant professor in the Department of Psychology at the University of Maryland, College Park. He majored in both industrial and organizational (I/O) psychology and developmental psychology at Bowling Green State University. He also had a minor in quantitative methods. His research interests include four broad areas of investigation: (1) older worker employment and retirement, (2) expatriate management and global/cross-cultural HR practice, (3) application of advanced quantitative methodology, and (4) occupational health psychology. He has received the Academy of Management HR Division Scholarly Achievement Award (2008) and European Commission's Erasmus Mundus Scholarship Award for Work, Organizational, and Personnel Psychology (2009). He also serves on the editorial boards of Journal of Applied Psychology, Journal of Management, and *Journal of Business and Psychology*.

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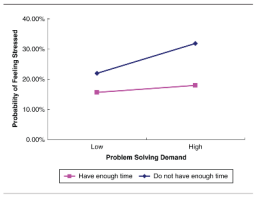

Figure 1.
Problem Solving (Demand) by Time (Control) Interaction on Work Stress in Younger Workers

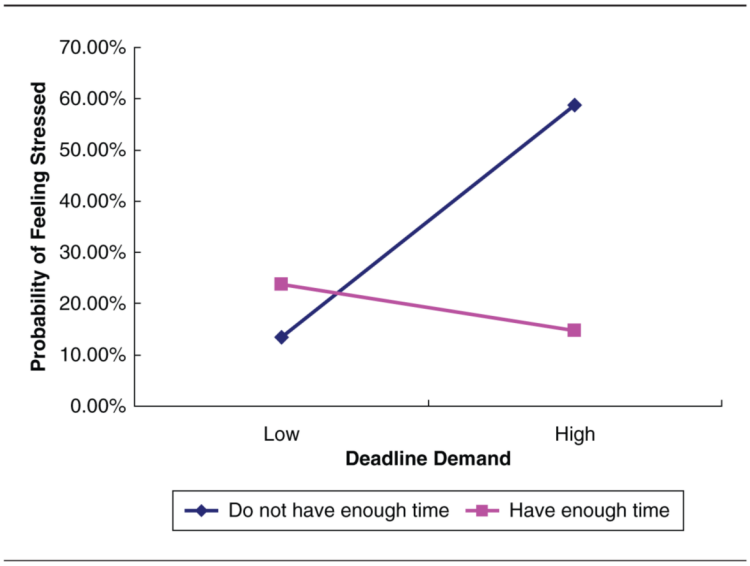

Figure 2.
Deadline (Demand) by Time (Control) Interaction on Work Stress in Older Workers

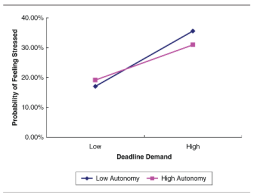

Figure 3.
Deadline (Demand) by Autonomy (Control) Interaction on Work Stress in Older Workers

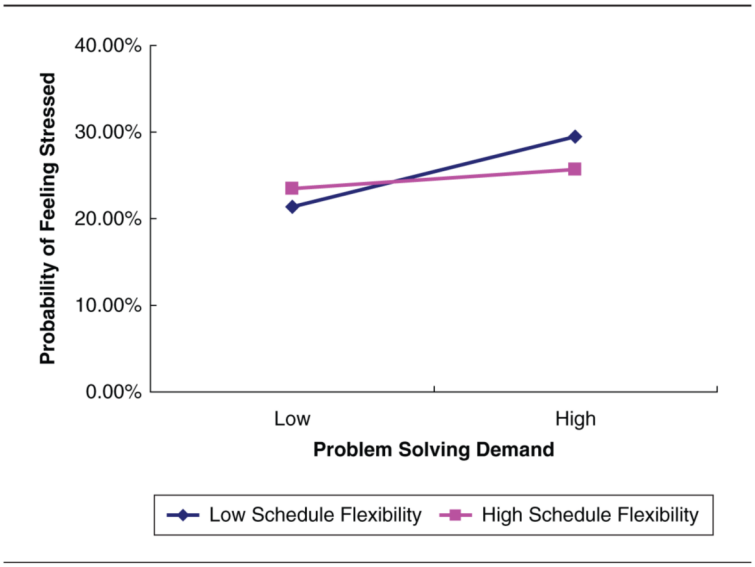

Figure 4.
Problem Solving (Demand) by Schedule Flexibility (Control) Interaction on Work Stress in Older Workers

Table 1

Means, Standard Deviations, Reliabilities, and Intercorrelations Among Predictor Variables for Both Younger and Older Samples

Variable	Younger Worker, *M*	Younger Worker, *SD*	Older Worker, *M*	Older Worker, *SD*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1. Gender[a]	0.56	0.50	0.59	0.49	–	0.25	0.11	0.07	0.27	0.14	0.08	0.09	0.01	−0.00	0.13	0.01	0.04	0.01	0.02	0.01	0.03	−0.02
2. Job category[b]	0.40	0.49	0.39	0.49	0.20	–	0.20	0.05	0.06	−0.12	0.04	−0.22	0.06	−0.19	−0.10	0.03	−0.05	−0.06	0.05	0.07	0.04	−0.09
3. Employment sector	1.73	0.44	1.67	0.47	0.14	0.23	–	−0.07	0.14	−0.01	0.09	−0.12	0.04	−0.05	−0.09	0.01	0.01	0.00	0.02	0.05	0.08	−0.05
4. Average years in job	6.81	5.18	17.95	11.15	0.17	0.09	0.02	–	0.08	0.10	0.01	0.06	−0.03	0.03	−0.01	0.01	0.01	−0.03	0.03	0.01	−0.01	0.04
5. Average hours per wk	39.63	12.00	40.53	13.22	0.30	0.06	0.21	0.17	–	0.17	0.12	0.09	−0.04	0.03	0.15	−0.03	0.05	0.01	−0.00	0.02	0.07	0.11
6. Supervisory[d]	0.23	0.42	0.32	0.46	0.19	−0.16	0.01	0.08	0.19	–	0.10	0.29	−0.09	0.18	0.17	−0.02	0.06	0.05	−0.04	−0.01	0.03	0.07
7. Deadlines	3.51	1.90	3.33	1.91	0.04	0.03	0.07	−0.10	0.10	0.11	0.67	0.18	−0.27	−0.08	−0.02	−0.09	−0.06	−0.04	−0.01	0.03	0.04	−0.23
8. Problem solving	2.63	1.23	2.66	1.24	0.11	−0.29	−0.11	0.01	0.07	0.34	0.19	0.61	−0.13	0.35	0.20	−0.01	0.03	0.04	0.00	−0.21	−0.10	0.15
9. Time	0.80	0.40	0.78	0.42	0.04	0.11	0.07	0.02	−0.06	−0.10	−0.29	−0.15	1.0	0.03	0.04	0.39	0.02	0.02	0.20	−0.03	−0.03	−0.23
10. Autonomy	0.69	0.38	0.74	0.37	0.04	−0.16	0.03	0.03	0.09	0.19	−0.13	0.28	0.03	0.78	0.37	0.03	0.04	0.05	−0.03	−0.28	−0.10	0.01
11. Schedule flex	0.49	0.32	0.53	0.33	0.14	−0.05	0.19	0.05	0.23	0.17	−0.04	0.15	0.03	0.37	0.69	0.02	0.05	0.04	−0.03	0.09	0.00	0.01
12. Interaction 7 × 9	−0.21	0.78	−0.23	0.84	0.04	0.05	0.01	0.03	0.00	−0.02	−0.15	−0.01	0.37	0.01	0.03	–	0.05	0.06	0.16	−0.01	−0.02	−0.11
13. Interaction 7 × 10	−0.06	0.75	−0.09	0.73	0.04	−0.05	−0.00	0.01	0.04	0.07	0.06	0.06	0.01	0.10	0.07	0.04	–	0.38	−0.11	0.15	0.07	−0.01
14. Interaction 7 × 11	−0.01	0.62	−0.04	0.64	0.02	−0.09	−0.02	−0.01	0.05	0.06	0.06	0.06	0.04	0.07	0.07	0.07	0.37	–	−0.07	0.06	0.18	−0.07
15. Interaction 8 × 9	−0.06	0.49	−0.08	0.50	0.02	0.04	0.04	0.02	−0.02	−0.04	0.04	0.03	0.21	−0.02	−0.02	0.16	−0.08	−0.03	–	0.04	0.04	−0.03
16. Interaction 8 × 10	0.16	0.50	0.13	0.50	0.04	0.06	0.02	−0.05	0.01	−0.00	−0.18	−0.18	−0.02	−0.30	−0.12	0.02	0.14	0.04	0.02	–	0.38	−0.02
17. Interaction 8 × 11	0.08	0.39	0.06	0.41	0.05	0.02	0.07	−0.06	0.03	0.03	−0.11	−0.11	−0.02	−0.13	−0.01	0.02	0.05	0.18	0.03	0.40	–	−0.12
18. Stress[e]	0.27	0.45	0.30	0.46	0.00	−0.08	−0.06	0.01	0.09	0.08	−0.24	0.14	−0.24	−0.01	−0.01	−0.08	−0.03	−0.07	0.02	−0.01	0.12	–

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Note: Entries above the diagonals are for younger (age less than 40) workers, N = 7,156 to 8,582. Entries below the diagonal are for older (age 40 and older) workers, N = 7,077 to 7,404. Diagonal entries in **bold** are alpha reliability values for the entire sample with—representing single indicator items. For $|r|s \geq .03$, $p < .05$; for $|r|s \geq .04$, $p < .01$.

[a] 0 = *women*, 1 = *men*.

[b] 0 = *white collar*, 1 = *blue collar*.

[c] 1 = *public sector*, 2 = *private sector*.

[d] 0 = *no supervisory responsibility*, 1 = *some supervisory responsibility*.

[e] 0 = *no stress*, 1 = *stress*.

Table 2

Estimated Coefficients, Odds Ratios, and 95% Confidence Intervals for Odds Ratios for Perceived Stress in Logistic Regression for Those Respondents Under Age 40

	Perceived Stress			
	Coefficient Estimates	***SE***	**Odds Ratio**	**95% Confidence Interval for Odds Ratio**
Demographic variables (Step 1)				
Gender[a]	−0.237**	0.064	0.789	0.697-0.894
Job category[b]	−0.271**	0.067	0.763	0.669-0.869
Employment sector[c]	−0.259**	0.067	0.772	0.677-0.880
Average years in job	0.018**	0.006	1.018	1.007-1.029
Average hours worked per week	0.021**	0.003	1.021	1.016-1.027
Supervisory duties[d]	0.018	0.069	1.018	.889-1.166
Demands (Step 2)				
Deadlines	0.222**	0.016	1.249	1.210-1.289
Problem solving	0.137**	0.028	1.147	1.085-1.212
Controls (Step 2)				
Time	−0.738**	0.078	0.478	0.410-0.557
Autonomy	−0.123	0.089	0.884	0.742-1.053
Schedule flexibility	−0.131	0.102	0.877	0.718-1.072
Interactions (Step 3)				
Deadline × Time	−0.023	0.038	0.977	0.908-1.052
Deadlines × Autonomy	−0.006	0.043	0.994	0.914-1.081
Deadlines × Schedule Flexibility	0.016	0.052	1.016	0.918-1.124
Problem solving × Time	−0.173**	0.059	0.841	0.749-.944
Problem solving × Autonomy	−0.046	0.068	0.955	0.835-1.092
Problem Solving × Schedule Flexibility	−0.112	0.084	0.894	0.758-1.055
Intercept (Step 3)	−1.306**	0.150	0.271	
N = 6,643	$\chi^2(df)$	−2 log likelihood		Nagelkerke R^2
Step 1: Block model	168.55 (6)**	7816.42		0.04
	168.55 (6)**			
Step 2: Block model	537.07 (5)**	7279.35		0.14
	705.62 (11)**			
Step 3: Block model	13.35 (6)*	7266.00		0.15
	718.96 (17)**			

[a] 0 = *women*, 1 = *men*.

[b] 0 = *white collar*, 1 = *blue collar*.

[c] 1 = *public sector*, 2 = *private sector*.

[d] 0 = *no supervisory responsibility*, 1 = *some supervisory responsibility*.

* $p < .05$.

** $p < .01$.

Table 3

Estimated Coefficients, Odds Ratios, and Confidence Intervals for Odds Ratios for Perceived Stress in Logistic Regression for Those Respondents Age 40 and Older

	Perceived Stress			
	Coefficient Estimates	***SE***	**Odds Ratio**	**95% CI for Odds Ratio**
Demographic variables (Step 1)				
Gender[a]	−0.080	0.064	0.923	0.814-1.046
Job category[b]	−0.185 **	0.066	0.831	0.730-.0947
Employment sector[c]	−0.212**	0.065	0.809	0.712-0.918
Average years in job	0.002	0.003	1.002	0.997-1.008
Average hours worked per week	0.014**	0.002	1.014	1.010-1.019
Supervisory duties[d]	0.070	0.066	1.073	0.943-1.220
Demands (Step 2)				
Deadlines	0.213**	0.016	1.238	1.200-1.277
Problem solving	0.112**	0.028	1.119	1.058-1.183
Controls (Step 2)				
Time	−0.845**	0.072	.430	0.373-0.495
Autonomy	−0.041	0.094	.960	0.799-1.153
Schedule flexibility	−.051	0.098	.951	0.784-1.153
Interactions (Step 3)				
Deadline by time	−.088**	0.034	.916	.846-.986
Deadlines by autonomy	−.127**	0.043	.881	.809-.959
Deadlines by schedule flexibility	.010	0.048	1.010	.920-1.110
Problem solving by time	−.079	0.056	.924	.828-1.031
Problem solving by autonomy	.113	0.069	1.120	.979-1.281
Problem solving by schedule flexibility	−.186*	0.081	.830	.708-.972
Intercept (Step 3)	−1.105**	0.136	.331	
N = 6,619	χ^2 (df)	−2 log likelihood		Nagelkerke R^2
Step 1: Block model	133.89 (6)**	7988.05		0.03
	133.89 (6)**			
Step 2: Block model	526.46 (5)**	7462.05		0.13
	660.35 (11)**			
Step 3: Block model	22.48 (6)**	7439.57		0.14
	682.82 (17)**			

[a] 0 = *women*, 1 = *men*.

[b] 0 = *white collar*, 1 = *blue collar*.

[c] 1 = *public sector*, 2 = *private sector*.

[d] 0 = *no supervisory responsibility*, 1 = *some supervisory responsibility*.

[*] $p < .05$.

[**] $p < .01$.