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It is also in our nature: Genetic influences on work characteristics and in explaining their relationships with well-being

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Summary Work design research typically views employee work characteristics as being primarily determined by the work environment and has thus paid less attention to the possibility that the person may also influence employee work characteristics and in turn accounts for the work characteristics–well-being relationships through selection. Challenging this conventional view, we investigated the role of a fundamental individual difference variable—people's genetic makeup—in affecting work characteristics (i.e., job demands, job control, social support at work, and job complexity) and in explaining why work characteristics relate to subjective and physical well-being. Our findings based on a national US twin sample show sizable genetic influences on job demands, job control, and job complexity, but not on social support at work. Such genetic influences were partly attributed to genetic factors associated with core self-evaluations. Both genetic and environmental influences accounted for the relationships between work characteristics and well-being, but to varying degrees. The results underscore the importance of the *person*, in addition to the work environment, in influencing employee work characteristics and explaining the underlying nature of the relationships between employee work characteristics and their well-being. Copyright © 2016 John Wiley & Sons, Ltd.

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"[I]n an important sense human nature (i.e., what it means to be human), as well as any accurate description of the kind of species we are, is all about work and working."
— *Howard Weiss, Working as Human Nature*, p. 37, 2013

Work design research has played an essential role in organizational psychology (Hackman & Oldham, 1975; Morgeson, Garza, & Campion, 2012; Parker, 2014). Theories of work design have been rated as among the few theories with both scientific validity and practical significance (Miner, 2003). Meta-analytic evidence has documented that work characteristics, a core concept of work design research pertaining to various attributes of work including tasks and social relationships, profoundly influence employee job performance and well-being (Humphrey, Nahrgang, & Morgeson, 2007).

Work design research has traditionally deemed that the *work environment*, such as managers and organizations, predominantly determines employee work characteristics (Oldham & Hackman, 2010). This is understandable given the top-down approaches adopted by most researchers in examining management practices that can fuel employee performance and well-being. Nevertheless, treating work environments as primary antecedents of work characteristics has left important questions largely unaddressed. First, it is less well understood to what extent the *person* can affect employee work characteristics (Grant & Parker, 2009; Oldham & Hackman, 2010; Parker, Wall, & Cordery, 2001). This is unfortunate, because various streams of research on person–environment fit have underscored the

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indispensable role of the person in influencing individuals' work characteristics (e.g., Holland, 1996; Ilgen & Hollenbeck, 1991; Schneider, 1987) to gain optimal levels of fit (Kristof-Brown & Guay, 2010). Work design research has just recently embraced the importance of the person in proactively affecting work characteristics (e.g., Frese, Garst, & Fay, 2007; Tims & Bakker, 2010; Tims, Bakker, & Derks, 2013; Wrzesniewski & Dutton, 2001). Therefore, Parker et al. (2001) suggested "a final point about antecedents [of work characteristics] is that consideration should also be given to individual factors" (p. 421). Likewise, Oldham and Hackman (2010) urged future research to study "what are the characteristics of those people who are most likely to spontaneously customize their jobs" (p. 471).

Second and more important, the traditional emphasis on environmental effects on work characteristics has led to a presumption that the relations between work characteristics and outcomes (e.g., well-being) are predominantly caused by the environment. As such, individual characteristics have primarily been treated as moderators in the work characteristic–outcome relations (Morgeson et al., 2012). Managers and organizations affect work characteristics. Yet, research on person–environment fit (Kristof-Brown & Guay, 2010) has shown that the person can also influence employee work via various processes of selection, that is, occupational/job selection (Holland, 1996; McCormick, Jeanneret, & Mecham, 1972) and organizational selection (Schneider, 1987). During such processes, individuals select work environments that are congruent with their individual characteristics. Hence, the work characteristic–well-being relations may also be attributed to influences from the person through selection (Oldham & Hackman, 2010). Therefore, it is informative to examine the *relative potency* of influences from the person and from the environment in explaining those relations. Such an investigation provides a finer-grained understanding of *why* work characteristics are related to well-being, that is, because of "selection" or "environmental causation" (Johnson, Turkheimer, Gottesman, & Bouchard, 2009, p. 218).

The current study represents an initial endeavor to address these two issues by examining genetic influences—reflecting influences from the person as a whole versus influences from the environment—as well as environmental influences on work characteristics and in explaining the relationships between work characteristics and well-being. Genetic influences serve as an appropriate vehicle to study influences from the person versus those from the environment (Johnson et al., 2009). One important reason is that work characteristics may be affected by a number of individual characteristics such as various personalities (e.g., Fried, Hollenbeck, Slowik, Tiegs, & Ben-David, 1999; Spector, Jex, & Chen, 1995). Hence, it seems impractical to include all possible individual characteristics simultaneously in one study in order to capture the "whole" influence from the person. Genetic factors modulate virtually all individual characteristics (Turkheimer, 2000), so estimated genetic influences on work characteristics are able to reflect aggregated contributions of all hard-wired influences from the person (Johnson et al., 2009). For the same reason, genetic effects involved in the relations between work characteristics and well-being indicate influences from all possible person-related factors operative in the relations channeled through selection. Recognizing the importance of examining the relative potency of the person (i.e., genetic influences) and the environment in explaining important phenomena in organizational research, Judge, Ilies, and Zhang (2012) pointed out that relationships "can only be properly understood once we consider the degree to which these relationships are due to genetic effects, environment effects, or both" (p. 209).

We adopt a behavioral genetic approach based on a national US twin sample. This approach takes advantages of the quasi-natural experiments by comparing co-twin similarities between identical and fraternal twins (who share 100% and 50% of genes on average, respectively) to model relative genetic and environmental influences (Plomin, Owen, & McGuffin, 1994). We draw on the widely adopted job demand–control–support model (Karasek, 1979; Karasek & Theorell, 1990) to examine genetic influences on three perceived work characteristics: job demands, job control, and social support at work. We also include objectively measured job complexity as an omnibus work characteristic (Morgeson et al., 2012). To further explore some of the pathways of genetic influences on work characteristics, we examine the role of core self-evaluations (CSE, Judge, Locke, & Durham, 1997). CSE is a broad-band personality construct composed of four lower-order personality traits, thus it tends to capture related genetic influences through various mechanisms of selection on work characteristics (Judge et al., 1997).

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We further examine genetic and environmental influences in explaining the work characteristics–well-being relations. We expect that genetic factors play an indispensable role in explaining these relations. Interestingly, genetic research provides the "best available evidence" for environmental effects, because such approaches can *control for* genetic effects and thus help determine the relative importance of environments (Plomin et al., 1994, p. 1735). In this vein, our study provides a more stringent examination of the interpretation of environmental causation for the links between work characteristics and well-being.

This study makes three important contributions to the work design literature. First, by answering the call to examine person-related antecedents of work characteristics (Oldham & Hackman, 2010), it provides unique insight into *why* employees have different work characteristics by examining contributions from their genetic endowment (i.e., the person versus the environment). This study also extends work design research that has mainly treated individual characteristics as moderators in the work characteristic–outcome relations (Morgeson et al., 2012). Showing significant genetic influences on work characteristics indicates some limitations of previous approaches in studying person–environment interactions and thus the necessity of developing new theories in work design research (Barrick, Mount, & Li, 2013). Second, by examining genetic and environmental factors associated with CSE in affecting work characteristics, we extend previous research (e.g., Judge, Bono, & Locke, 2000) by providing an in-depth understanding of *why* CSE is related to work characteristics, that is, to what extent are the relations due to the person and the environment. Third, in decomposing the work characteristics–well-being relations into genetic and environmental components, we highlight the effects of the person as complementary to environmental effects. It challenges the presumption that work characteristic–outcome relations are mostly environmental (Oldham & Hackman, 2010).

Theoretical Development and Hypotheses

Behavioral genetic approach to organizational research

Behavioral genetic research has documented that genetic factors have appreciable influences not only on abilities, personalities (Turkheimer, 2000), and well-being (Plomin et al., 1994), but also on measured environmental factors (Plomin, DeFries, Knopic, & Neiderhiser, 2013). This scholarship has further underscored that the *person* plays an indispensable role in explaining relations between individuals' life environments and outcome variables through various processes of selection. It challenges and also compliments the often-assumed *environmental* causes from family and/or organization influences (Johnson et al., 2009). For instance, Kendler, Karkowski, and Prescott (1999) reported that approximately one third of the relations between stressful life events and depression was attributable to genetic influences (i.e., the person). Because of the advantages of distinguishing the relative importance of the person and the environment, other social sciences have increasingly embraced behavioral genetic approaches such as in studying social network (Fowler, Dawes, & Christakis, 2009).

Organizational research has yet to fully capitalize on the advantages of genetic approaches in investigating measured work environments. We are aware of two exceptions. Arvey, Zhang, Avolio, and Krueger (2007) found that invividuals' developmental work experience (e.g., mentoring and training) was under significant genetic influences. Judge et al. (2012) reported significant genetic influences on perceived work stress. However, given organizations have been conceived as strong situations in which employees are predominantly affected by managers (Davis-Blake & Pfeffer, 1989), it is uncertain whether employee work characteristics can be influenced by their genetic endowments. Indeed, in their review article, Kendler and Baker (2007) found that whether measured environmental variables were under genetic influences largely depended on the extent to which individuals could affect the environmental factors through their own behavior; for environmental variables that were relatively independent of individuals' own behavior, genetic factors had less influences (see Table 1 on p. 618). As discussed previously,

DOI: 10.1002/job

Table 1. Within-twin-pair correlations for the study variables.

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Core self-evaluations, twin 1 (t1)	—	−.23**	.28**	.32**	.09	.56**	.39**	.49**	−.11	.17*	.05	.15*	.25**	.24**
2. Job demands, t1	−.11	—	.01	−.19**	.18**	−.21**	−.15**	−.14*	.33**	.10	−.06	.02	−.16**	−.06
3. Job control, t1	.25**	.20**	—	.23**	.24**	.18**	.01	.14*	.14*	.32**	.04	.04	.13*	.03
4. Work social support, t1	.13	−.11	.25**	—	.10	.29**	.11	.26**	−.07	.00	.11	.04	.12	.03
5. Objective job complexity, t1	.08	.33**	.24**	−.11	—	.01	.07	.11	.12	.22**	.05	.32**	.11	.17**
6. Subjective well-being, t1	.35**	−.15*	.22**	.26**	−.03	—	.22**	.33**	−.18	.04	−.02	.01	.38**	.16**
7. Physical well-being, t1	.41**	−.14*	.09	.07	−.02	.31**	—	.26**	.00	.14*	.03	.13*	.23**	.36**
8. Core self-evaluations, twin 2 (t2)	.28**	−.15*	.09	.09	.05	.19**	.10	—	−.10	.18**	.16*	.17**	.49**	.38**
9. Job demands, t2	.03	.07	.12	.07	.14	−.07	.05	−.02	—	.20**	.−.22**	.20**	−.11	−.04
10. Job control, t2	.22**	−.02	.20*	.10	.15*	.10	.04	.35**	.12	—	.08	.20**	.18*	.11
11. Work social support, t2	.18*	−.07	.14	.12	.10	.07	−.06	.22**	−.07	.30**	—	.09	.07	.06
12. Objective job complexity, t2	.21**	.18*	.19*	−.02	.23**	.07	.23**	.29**	.13	.34**	.04	—	.06	.03
13. Subjective well-being, t2	.02	−.08	.00	.12	.00	.13*	.03	.36**	.09	.14*	.09	.03	—	.13**
14. Physical well-being, t2	.11	−.15*	.15*	.25**	.01	.12*	.28**	.32**	−.07	.13	.21**	.20**	.31**	—
Mean	.03	2.91	3.80	3.75	7.93	3.65	5.08	−.02	2.98	3.67	3.69	7.61	3.65	4.92
SD	.56	.69	.72	.76	2.86	.48	.73	.62	.60	.85	.73	2.96	.45	.83

N = 364 and 348 for identical and fraternal twin pairs, respectively. At the individual level, N = 952-1382 individuals $^*p < .05$; $^{**}p < .01$. t1 and t2 refers to twin 1 and twin 2 within the same twin pair. Values in the upper diagonal are within-pair correlations of study variables for identical twins and values in the lower diagonal are within-pair correlations for fraternal twins.

DOI: 10.1002/job

behavioral genetic approaches are particularly suitable for the current study to examine the relative contributions of the person (and the environment) in affecting work characteristics and their relations with well-being.

Genetic influences on work characteristics

We draw on the job demand–control–support model (Karasek, 1979; Karasek & Theorell, 1990) because it is one of the few work design models that explicitly incorporate two work characteristics with best predictive validity: job control and work social support (Humphrey et al., 2007). The model also explicitly emphasizes physiological consequences of work characteristics and has widely been adopted in the work stress research (Parker, 2014). *Job demands* were originally conceptualized as psychological demands such as workload and time pressure. *Job control*, or job autonomy, pertains to decision-making latitude at work. *Work social support* encompasses helpful assistance from supervisors and coworkers. A basic premise is that high job demands hinder well-being, while job control and work social support enhance well-being (Karasek & Theorell, 1990). While the model predicts that job demands interact with job control and social support, researchers have found mixed support for such interactions (Häusser, Mojzisch, Niesel, & Schulz-Hardt, 2010). We thus focus on their main effects. We also include *job complexity*, the extent to which a job is mentally demanding and difficult to perform (Hackman & Oldham, 1980). It has been conceptualized and used as an omnibus characteristic of job including aspects such as information processing, decision making, and social interactions (Morgeson et al., 2012).

Genetic influences on employee work characteristics may be carried through various psychological characteristics (e.g., personalities) via multiple processes of selection (Arvey, Li, & Wang, in press). We adopt a broad term of selection to refer to the multiple important mechanisms that may be operative (Bolger & Zuckerman, 1995; Judge et al., 1997). In keeping with previous research on person–environment fit (Kristof-Brown & Guay, 2010) and the behavioral genetics literature (Arvey et al., 2007; Johnson et al., 2009; Judge et al., 2012), *selection* refers to multiple processes through which individuals actively seek out compatible work environments associated with their occupations/jobs, organizations, and the like, which in turn renders certain levels of fit between the person and the job, as well as the organization. Various of streams of research on person–environment fit have suggested and documented the importance of selection. For instance, research on occupation/job choice shows that people actively select their occupations/jobs based on their interests (Holland, 1996), and personality traits (Judge, Higgins, Thoresen, & Barrick, 1999). Research on person–job fit also suggests that over time, individuals are gravitated to jobs with complexity levels commensurate with their abilities (McCormick et al., 1972; Wilk, Desmarais, & Sackett, 1995). Last but not least, the literature on person–organization fit documents that people seek organizations with characteristics compatible with their personality traits (Schneider, 1987). Those various selection processes result in certain levels of fit between individual characteristics and work characteristics (Kristof-Brown & Guay, 2010). Taken together, multiple processes of selection and various psychological characteristics may drive individuals to take actions in seeking compatible work characteristics. The mechanism of selection provides a theoretical rationale regarding why employees' genetic endowments may affect their work characteristics. Thus we propose that

Hypothesis 1: Genetic factors influence work characteristics including job demands (H1a), job control (H1b), social support at work (H1c), and job complexity (H1d).

The role of core self-evaluations

Genetic influences on work outcomes are often manifested through personality traits (Arvey et al., in press). To examine some potential pathway for genetic influences on work characteristics, we focus on CSE, individuals' fundamental, bottom-line appraisals of their self-worth and competence in attaining mastery and success (Judge et al., 1997). We focus on CSE for two reasons. First, CSE is a compound personality construct composed of four personality traits: self-esteem, generalized self-efficacy, locus of control, and neuroticism. Hence, CSE is able to capture multiple mechanisms through which genetics affect work characteristics, that is, the various selection processes attributable to all the four lower level personality traits. Second, as a personality construct under genetic influence (Judge et al., 2012), CSE is the individual characteristic that has received most research attention as being related to work characteristics (e.g., Judge et al., 2000).

Theoretical and empirical research suggests that CSE affects work characteristics through multiple processes of selection. In the seminal work, Judge et al. (1997) posited that high CSE causes individuals to seek congruent work situations (e.g., with less demands and more control and support), such as through job and organization selection. Ensuing research has provided more evidence for the relations between CSE and work characteristics through selection. High-CSE individuals set challenging and self-concordant goals to fit with their high aspirations (Judge, Bono, Erez, & Locke, 2005). Thus, they tend to have more complex jobs. Striving for self-concordant goals necessitates high levels of discretion at work and support from coworkers and supervisors (e.g., Judge et al., 2000). It may also lead to less demanding jobs for high-CSE individuals. Supporting these arguments, meta-analytic research has shown that CSE is positively related to job complexity, job control, work social support, and less job demands (Chang, Ferris, Johnson, Rosen, & Tan, 2012).

Thus far, we have argued for significant genetic influences on work characteristics. We have also established the relationships between CSE and such work characteristics. Moreover, previous research has reported that genetic factors explain approximately 40% of the variance in CSE (Judge et al., 2012). Thus, genetic factors associated with CSE may contribute to the genetic effects on work characteristics. A theoretical explanation is that genetic influences affect CSE, which in turn affects job attributes through selection (Arvey & Bouchard, 1994; Judge et al., 2012; Plomin et al., 2013). Indeed, using behavioral genetic approaches, Judge et al. (2012) found that genetic factors associated with CSE also significantly influenced job satisfaction. In sum, we hypothesize

Hypothesis 2: Genetic factors associated with CSE influence work characteristics including job demands (H2a), job control (H2b), social support at work (H2c), and job complexity (H2d).

Genetic influences in explaining the work characteristics–well-being relationships

In this study we focus on two important outcomes of work characteristics mostly studied in research on the job demand–control–support model: subjective and physical well-being (Karasek & Theorell, 1990). *Subjective well-being* is defined as individuals' cognitive and affective assessments of their lives, such as overall life satisfaction (Diener, 2000; Ryan & Deci, 2001). Self-reported physical health is used to indicate *physical well-being*, because others cannot directly observe all health problems. In fact, a review of longitudinal studies showed that perceived physical health independently predicted mortality (Idler & Benyamini, 1997). Because the concept of well-being is rather complex (Ryan & Deci, 2001), both subjective and physical well-being should be incorporated (Diener, 2000).

Excessive job demands may damage well-being (Karasek & Theorell, 1990; Schaufeli & Bakker, 2004). In contrast, individuals may harness job control and work social support resources, which in turn promote well-being (Karasek & Theorell, 1990). In addition, occupying jobs with high levels of complexity, control, and supportive social relationships may satisfy basic needs for competence, autonomy, relatedness, and promote intrinsic motivation, which are likely to boost subjective and physical well-being (Ryan & Deci, 2001).

Given that genetic variation is likely to partially affect work characteristics and well-being, it seems logical to expect that genetic influences may also account for the relationships between work characteristics and well-being. Put differently, observed relations between work characteristics and well-being may reflect the fact that individuals with certain characteristics select commensurate work environments through multiple processes of occupational selection and organizational selection, which in turn affects their well-being. Therefore, such relations are not merely caused

DOI: 10.1002/job

by environmental factors, a traditional assumption in work design research (Oldham & Hackman, 2010). Other areas of psychology have increasingly recognized that the person plays an indispensable role in affecting relationships between measured environmental variables and outcomes (e.g., Kendler et al., 1999). In organizational research, Arvey et al. (2007) showed that the relations of leadership emergence with work experiences were mostly genetic. Likewise, Judge et al. (2012) observed that genetic effects mostly explained the relation between work stress and health. All the research shows the influences of the person through selection. We thus propose

Hypothesis 3: Genetic influences partially explain the relationships of work characteristics including job demands (H3a), job control (H3b), social support at work (H3c), and job complexity (H3d), with subjective well-being.

Hypothesis 4: Genetic influences partially explain the relationships of work characteristics including job demands (H4a), job control (H4b), social support at work (H4c), and job complexity (H4d), with physical well-being.

Our expectation that genetic influences may partially account for the observed relationships between work characteristics and well-being does not mean that environmental factors have no effect. On the contrary, previous work design research has established that work redesign practices can influence work characteristics and the relationships between work characteristics and outcomes (Hackman & Oldham, 1980). We maintain that, in addition to organizational practices, the person is also an important stakeholder in influencing work characteristics and their relationships with well-being as argued previously. As such, we are also interested in investigating the *relative* contributions of genetic and environmental influences in the work characteristic–well-being relationships.

Method

Participants and procedures

Data were obtained from the Survey of Midlife Development in the United States (MIDUS, Kessler, Oilman, Thornton, & Kendler, 2004), a study to investigate successful midlife development. Although the dataset is in the public domain, with the exception of subjective well-being, none of our focal variables has been used in previous research.

The MIDUS national twin sample were 25 to 74 years old during the data collection from 1996 to 1997. We included only working participants with demographic information and study variables available. The final sample included 712 same-sex twin pairs (1424 individuals) reared together: 170 male monozygotic (MZ, or identical), 135 male dizygotic (DZ, or fraternal), 194 female MZ, and 213 female DZ twin pairs. Among these participants, 42.8% were men, 83.7% white, and 4.6% African American; their average age was 44.65 ($SD = 12.15$); 57.1% had college education or more. Their average work hours per week was 41.46 ($SD = 13.66$). The participants held jobs from 248 occupations (e.g., managerial and professional, technical, sales, and administrative, service, craft and repair, machine operators, and vehicle drivers), 178 industries (e.g., agriculture production, printing and publishing, service, education, finance, electrical machinery, motor vehicle, transportation, and retailing).

Measures

Core self-evaluations

The MIDUS study was initiated in 1990, before the new measure of CSE was devised. As such, Judge, Hurst, and Simon (2009) developed a 15-item measure ($\alpha = .86$) to gauge CSE by selecting items from MIDUS questionnaires according to core characteristics of CSE: fundamentality, evaluation focus, and broad scope. Judge et al. (2009) further conducted a validity study and showed satisfactory reliability and convergent validity of this scale with the 12-

DOI: 10.1002/job

item CSE instrument. It has also been used in other research (e.g., Zyphur, Li, Zhang, Arvey, & Barsky, 2015). Sample items are "Other people determine most of what I can do" (reverse coded, locus of control), "When I look at the story of my life, I am pleased with how things have turned out so far" (emotional stability), and "I often feel worthless" (reverse coded, self-esteem). All items were standardized and then used to generate a composite score with higher scores indicating higher levels of CSE.

Perceived work characteristics

The three perceived work characteristics were assessed by the Job Content Questionnaire (Karasek, 1979) on a five-point Likert-type scale (1 = *all the time*, 5 = *never*) administered through questionnaires. Job demands, job control, and social support were measured by five ($\alpha = .75$), six ($\alpha = .87$), and five ($\alpha = .85$) items, respectively. Sample items are "How often do you have too many demands made on you?" (job demands); "How often do you have a choice in deciding how you do your tasks at work?" (job control); and "How often do you get help and support from your immediate supervisor?" (social support). All items were coded so that higher scores represented higher levels of the respective construct (the same for all the other study variables).

Job complexity

Midlife Development in the United States (MIDUS) researchers captured job complexity by linking participants' occupation codes to the *Dictionary of Occupational Titles* (DOT) database, which contains information for thousands of occupations regarding complexity levels in terms of data, people, and things (England & Kilbourne, 1988). It was the US national occupational system during the MIDUS data collection. Participants were assigned DOT job complexity scores based on their job titles and most important work activities. Previous research has widely used objectively measured job complexity from the DOT database (e.g., Judge et al., 1999; Wilk & Sackett, 1996). It ranged from 4.17 to 18.47 (Mean = 7.82). Examples of jobs for most common scores included first line managers and administers, sales supervisors, elementary and primary school teachers, administrative assistance, office workers, janitors and cleaners, child care service workers, and clerks.

Subjective well-being

Subjective well-being was measured with a three-item scale ($\alpha = .73$) developed and used by Weiss, Bates, and Luciano (2008). Participants were phone interviewed to answer three questions on a four-point scale (1 = *a lot*, 4 = *not at all*) about the following three questions: how satisfied they were with life overall, how satisfied they were with life at the present, and how much control they felt they had over their lives.

Physical well-being

Physical well-being was assessed by a scale ($\alpha = .72$) developed by Lachman and Weaver (1998) with appreciable reliability and validity. Participants were asked in the same self-report questionnaire as work characteristics to indicate how frequently during the past 30 days they had experienced each of the nine acute symptoms (headaches, lower backaches, sweating, irritability, hot flushes, aches or stiffness in joints, trouble sleeping or staying asleep, leaking urine, and pain during intercourse) on a six-point scale (1 = *almost every day*, 6 = *not at all*). Previous research has widely used measures of similar health symptoms as indicators of self-perceived health (e.g., Emmons & McCullough, 2003).

Control variables

Behavioral genetics studies have found that age and gender tend to affect genetic effect estimations (McGue & Bouchard, 1984). Thus following previous research (McGue & Bouchard, 1984), we adjusted study variables by regressing them on age, age-squared, gender, age × gender, and the age-squared × gender to remove age and gender effects, and used standardized residuals in subsequent analyses. We also controlled for education level in analyzing the relationships of work characteristics with well-being and CSE, because education is related to both work characteristics and well-being.

DOI: 10.1002/job

Analytical approach

Univariate genetic analyses

We followed standard behavioral genetics methodology using multigroup structural equation modeling (Plomin et al., 2013) to test our hypotheses. First, we conducted univariate genetics analyses to identify the effects from three latent factors: an additive genetic factor (A), a shared environmental factor (C) representing the effects of shared family environments that make people similar, and a unique environmental factor (E) indicating the influence of idiosyncratic environmental (e.g., unique socialization and organizational) experiences for each twin and potential measurement error. An observed variable P is algebraically modeled as the following:

$$P = u + a^{*}\mathrm{A} + c^{*}\mathrm{C} + e^{*}\mathrm{E} \quad (1)$$

where u denotes the intercept term; A, C, and E are standardized latent genetic and environmental factors with means and variance specified at 0 and 1, respectively; and a, c, and e are their corresponding coefficients.

Variance in P is decomposed into three components: additive genetic effects (a^2), shared environmental effects (c^2), and non-shared environmental effect and/or error (e^2). Genetic influences are thus calculated ($=a^2/(a^2+c^2+e^2)$). Univariate analyses were used to test Hypothesis 1, genetic effects on work characteristics. Figure 1a illustrates the multi-group model using job control as an example. To determine the best-fitting model, we compared the fitness (chi-square, CFI, TLI, RMSEA, SRMR, and AIC of the ACE model, with all the three factors, A, C, and E) with alternative models: AE (with only A and E factors), CE (with only C and E factors), and E (with only E factor) models (Arvey et al., 2007; Judge et al., 2012). We also examined the significance of A, C, and E influences.

Bivariate genetic analyses

Univariate genetics analyses are useful in selecting best-fitting models for bivariate analyses. We employed the Cholesky decomposition approach (Plomin et al., 2013) to test Hypotheses 2 to 4. Figure 1b presents a simplified version of a bivariate model with genetic factors (A_1 and A_2) and unique environmental factors (E_1 and E_2; effects of the shared environmental factors C_1 and C_2 were not significant and thus were not modeled) for one twin for simplification.

As shown in Figure 1b, we decomposed the relationship between work characteristics (e.g. job control) and well-being into two components: one associated with the same genetic factor (A_1) and the other with the same environmental factor (E_1). If the effects of A_1 on job control and well-being are both significant, we can conclude that genetic factors are responsible for the job control–well-being relationship (H3b and H4b). This logic was used to test whether genetic factors partially account for the work characteristics–well-being relationships (Hypotheses 3 and 4). In addition, we sought to identify the relative contributions of genetic and environmental influences in the observed relationships between work characteristics and well-being. The relationships are driven by the same genetic factor A_1 and the same environmental factor E_1, which means that the relationships can be decomposed into two corresponding components: one genetic ($=a_{21} \times a_{22}$) and one environmental ($=e_{21} \times e_{22}$). As such, genetic and environmental contributions in the relationships can be computed (Li, Arvey, Zhang, & Song, 2012; Shane, Nicolaou, Cherkas, & Spector, 2010), which are $|a_{21} \times a_{22}|/(|a_{21} \times a_{22}|+|e_{21} \times e_{22}|)$ and $|e_{21} \times e_{22}|/(|a_{21} \times a_{22}|+|e_{21} \times e_{22}|)$, respectively.

If in Figure 1b we replace job control with CSE and well-being with one of the work characteristics, bivariate analyses can also be used in testing Hypothesis 2 on whether the same genetic factors related to CSE also affect work characteristics. We also performed multivariate genetic analyses using Cholesky decomposition with CSE and all the work characteristics in one model to test Hypothesis 2, and all the work characteristics and well-being variables in one model to test Hypotheses 3 and 4. We obtained similar results that did not change our conclusion. Thus for simplification, we present only bivariate analyses results.

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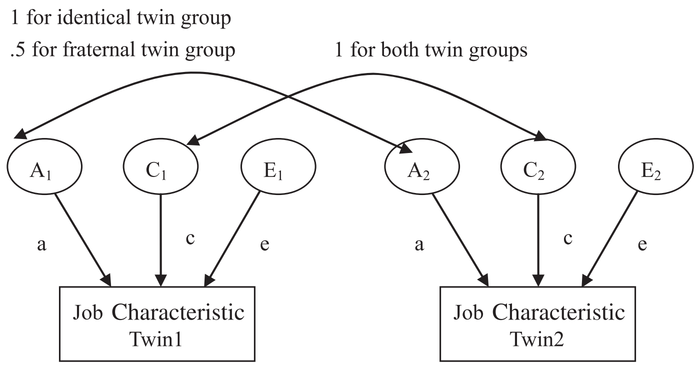
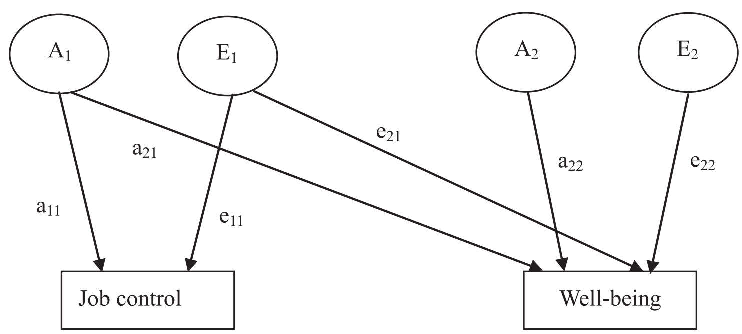


a. Univariate Multi-Group Confirmatory Structural Model

Note. A = additive genetic factor, C = shared environmental factor, E = unique environmental factor and/or measurement error.



b. Multi-Group Confirmatory Structural Model (Bivariate Cholesky Decomposition) for Job Control and Well-Being.

Note. This is a partial diagram with additive genetic factors (A1 and A2) and unique environmental factors (E1 and E2) for only one twin for simplicity. The influence of shared environmental factors (C1and C2) were not modeled because their influences were not significant. For models with work social support, since genetic and shared environmental influences were not significant, only unique environmental effects were modeled.

Figure 1. Univariate and bivariate multi-group confirmatory structural models in behavioral genetics analyses

Results

Scale validation

We performed confirmatory factor analyses to further demonstrate the scales used in this study were distinct from each other. We estimated the fit indices for a hypothesized six-factor model (job demands, job control, work social support, subjective well-being, physical well-being, and CSE with three indicators of the three lower-level traits in

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this study: self esteem, locus of control, and emotional stability). To determine the best-fitting models, we compare chi-square values and the four criteria: CFI, TLI, RMSEA, and SRMR. The results indicate that this model fits the data well ($\chi^2 = 1551.13$, $df = 419$, $p < .001$, CFI = .89, TLI = .88, RMSEA = .044, and SRMR = .053). This model was also significantly better than a five-factor model combining items of psychological and physical well-being ($\chi^2 = 2160.86$, $df = 424$, $p < .001$, CFI = .83, TLI = .82, RMSEA = .054, and SRMR = .063), a four-factor model combining items of the three work characteristics ($\chi^2 = 4168.24$, $df = 428$, $p < .001$, CFI = .64, TLI = .61, RMSEA = .080, and SRMR = .104), and a one-factor model ($\chi^2 = 6853.51$, $df = 434$, $p < .001$, CFI = .38, TLI = .33, RMSEA = .103, and SRMR = .136). The evidence further suggests that the variables used in this study were sufficiently independent.

Tests of hypotheses

The means, SDs, and within-twin pair correlations among study variables are displayed in Table 1. Table 1 shows greater similarities for identical twins (values in upper diagonal) than for fraternal twins (values in lower diagonal) on all study variables except for work social support. The results suggest likely genetic effects on these variables.

Genetic influences on work characteristics

Hypothesis 1 predicted significant genetic influences on work characteristics. Univariate genetic analyses (Table 2) revealed that genetic factors significantly affected two perceived work characteristics—job demands and job control—but not work social support. For job demands and job control, the AE model fit the data best. Genetic factors explained 28.6% (95% confidence interval, CI = [.171, .405]) and 34.2% (95% CI = [.201, .465]) of individual differences in job demands and job control, respectively (a^2 of the best fitting models, Table 2). Similar results were obtained for job complexity with 33.1% (95% CI = [.214, .447]) of variance associated with genetic variation (a^2 of the best-fitting model for job complexity, Table 2). For work social support, results of the ACE model (Model 1 for work social support) showed that genetic effects were not significant (95% CI = [0, .277]), neither the effects of shared environmental factors C. Thus E model was selected as the best-fitting model. Nonsignificant effects were fixed to zero in subsequent analyses (Arvey et al., 2007; Judge et al., 2012). These results support H1a, H1b, and H1d, but not H1c. Similarly, results showed that 51.1% (95% CI = [.433, .590]), 33.0% (95% CI = [.229, .438]) and 39.5% (95% CI = [.300, .488]) of the variance in CSE, subjective well-being, and physical well-being were associated with genetic variation.

Effects of genetic factors associated with core self-evaluations on work characteristics

Hypothesis 2 focused on whether the same genetic factors associated with CSE also affect work characteristics. We performed analyses for four bivariate models as shown in Figure 1b but with job control replaced by CSE and well-being by one of the four work characteristics. Results (Models 1 to 4 in Table 3) show that genetic factors related to CSE (as indicated by the path a_{11}) also significantly affected job demands ($a_{21} = -.20$, $p < .001$, Model 1), job control ($a_{21} = .26$, $p < .01$, Model 2), and job complexity ($a_{21} = .14$, $p < .01$, Model 4), respectively. The results provide support for H2a, H2b, and H2d, not for H2c.

Genetic influences in explaining the relationships between work characteristics and well-being

Hypothesis 3 dealt with genetic effects contributing to the work characteristic–subjective well-being relationship. We conducted analyses for four bivariate models as shown in Figure 1b. Results (Models 5 to 8 in Table 3) indicate that the same genetic factors associated with job demands also significantly affected subjective well-being ($a_{21} = -.23$, $p < .001$, Model 5). Similar results were obtained for both job control ($a_{21} = .14$, $p < .05$, Model 6) and job complexity ($a_{21} = .12$, $p < .05$, Model 8). Again, genetic influences on work social support were not significant. H4a, H4b and H4d received support; H4c did not.

Hypothesis 5 focused on genetic effects responsible for explaining the relationships between work characteristics and physical well-being. Results show that genetic factors associated with job demands ($a_{21} = -.13$, $p < .05$, Model 9

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Table 2. Results of univariate behavioral genetics model fitting for core self-evaluations, work characteristics, and well-being.

			Model fit indices					Model estimate (% variance explained)		
Models	χ^2 (*df*)	$\Delta\chi^2$	CFI	TLI	AIC	RMSEA	SRMR	a^2	c^2	e^2
Core self-evaluations										
Model 1: A, C, E	5.52 (6)	—	1.00	1.00	3529.46	.000	.055	46.4***	4.3	49.3***
Model 2: A, E@	5.66 (7)	0.14	1.00	1.00	3527.59	.000	.055	51.1***	—	48.9***
Model 3: C, E	17.94* (7)	12.42***	.90	.97	3539.87	.067	.073	—	40.2***	59.8***
Model 4: E	116.04*** (8)	110.52***	.00	.75	3635.97	.198	.190	—	—	100 ***
Job demands										
Model 1: A, C, E	7.85 (6)	—	.91	.97	2678.50	.032	.072	28.6**	0	71.4***
Model 2: A, E@	7.85 (7)	0	.96	.99	2676.50	.020	.072	28.6***	—	71.4***
Model 3: C, E	11.94 (7)	4.09*	.77	.93	2680.59	.049	.088	—	21.9***	78.1***
Model 4: E	29.79*** (8)	21.94***	.00	.75	2696.43	.096	.127	—	—	100***
Job control										
Model 1: A, C, E	11.85 (6)	—	.87	.92	2673.47	.058	.097	33.4**	0.7	65.9***
Model 2: A, E@	11.85 (7)	0	.90	.95	2671.48	.049	.097	34.2***	—	65.8***
Model 3: C, E	14.97* (7)	3.12	.79	.91	2674.59	.062	.010	—	25.3***	74.7***
Model 4: E	38.72*** (8)	26.87***	.00	.70	2696.34	.114	.152	—	—	100***
Work social support										
Model 1: A, C, E	2.54 (6)	—	1.00	1.00	2486.12	.000	.041	0	12.1	87.9***
Model 2: A, E	3.15 (7)	0.61	1.00	1.00	2484.73.53	.000	.047	13.4	—	86.6***
Model 3: C, E	2.54 (7)	0	1.00	1.00	2484.11	.000	.041	—	12.1	87.9***
Model 4: E@	6.74 (8)	4.2	1.00	1.00	2486.32	.000	.069	—	—	100***
Job complexity										
Model 1: A, C, E	1.30 (6)	—	1.00	1.01	3016.29	.000	.022	25.1*	7.0	67.9***
Model 2: A, E@	1.54 (7)	0.24	1.00	1.01	3014.53	.000	.024	33.1***	—	66.9***
Model 3: C, E	3.44 (7)	2.14	1.00	.99	3016.44	.000	.035	—	26.0***	74.0***
Model 4: E	34.40*** (8)	33.10***	.16	.79	3045.39	.102	.122	—	—	100 ***
Subjective well-being										
Model 1: A, C, E	5.66 (6)	—	1.00	1.00	3852.26	.000	.053	33.0***	0	67.0***
Model 2: A, E@	5.66 (7)	0	1.00	1.01	3850.26	.000	.053	33.0***	—	67.0***
Model 3: C, E	14.31* (7)	8.65***	.85	.96	3858.91	.054	.074	—	25.0***	75.0***
Model 4: E	57.09*** (8)	51.43***	.02	.76	3899.69	.131	.131	—	—	100 ***
Physical well—being										
Model 1: A, C, E	11.73 (6)	—	.90	.97	3569.85.47	.053	.082	24.4*	13.0	62.6***
Model 2: A, E@	12.93 (7)	1.20	.90	.97	3569.05	.050	.086	39.5***	—	60.9***
Model 3: C, E	14.53* (7)	2.80	.86	.96	3570.65	.056	.082	—	31.0***	69.0***
Model 4: E	70.49*** (8)	58.76***	.00	.72	3624.60	.150	.160	—	—	100 ***

Sample sizes were 364 and 348 for monozygotic and dizygotic twin pairs, respectively. RMSEA, root mean square error of approximation, AIC, Akaike's Information Criterion, TLI, Tucker–Lewis index, CFI, comparative fit index. SRMR, standardized root mean square residual. A, C, and E denotes additive genetic factors, shared environmental factors, and unique environmental factors, respectively. @Indicates the best-fit model. *$p < .05$; **$p < .01$; ***$p < .001$.

Table 3. Fitness and path coefficient estimates for models of bivariate behavioral genetic analyses for relationships among core self-evaluations, work characteristics, and well-being.

Bivariate genetic models:	Model fit indices						Path coefficients estimates							
	χ^2 (*df*)	CFI	TLI	AIC	RMSEA	SRMR	a_{11}	a_{21}	a_{22}	e_{11}	e_{21}	e_{22}	$a_{11} \times a_{21}$	$e_{11} \times e_{21}$
Core self evaluations with														
Job demands, model 1 (M1)	46.05 (34)	.94	.95	5933.48	.033	.059	.66	−.20	.47	.71	−.01	.85	−.13	−.01
Job control, M 2	40.64 (34)	.97	.98	5883.21	.025	.067	.66	.26	.52	.70	.13	.80	.17	.09
Work social support, M 3	66.18* (36)	.87	.90	5730.62	.051	.079	.63	—	—	.73	.25	.96	—	.18
Job complexity, M 4	40.35 (34)	.98	.98	6162.60	.024	.054	.67	.14	.46	.70	.02	.81	.09	.02
Subjective well-being with														
Job demands, M 5	39.39 (34)	.94	.95	7937.92	.022	.058	.52	−.23	.52	.84	.04	.81	−.12	.04
Job control, M 6	34.10 (34)	1.00	1.00	7911.62	.003	.059	.57	.14	.55	.81	.12	.80	.08	.10
Work social support, M 7	43.67 (36)	.91	.93	7734.50	.025	.065	—	—	.56	.99	.16	.80	—	.16
Job complexity, M 8	26.84 (34)	1.00	1.01	8169.52	.000	.041	.49	.12	.56	.81	−.06	.81	.06	−.05
Physical well-being with														
Job demands, M 9	47.38 (34)	.88	.90	7617.63	.035	.062	.52	−.13	.58	.84	−.06	.78	−.07	−.05
Job control, M 10	46.85 (34)	.88	.90	7616.02	.034	.068	.58	.15	.58	.81	−.03	.78	.08	−.02
Work social support, M 11	57.21* (36)	.81	.86	7426.15	.043	.070	—	—	.58	.99	.12	.78	—	.12
Job complexity, M 12	48.26 (34)	.93	.94	7877.57	.036	.058	.48	.21	.57	.81	−.10	.77	.10	−.08

Sample sizes were 364 and 348 for monozygotic and dizygotic twin pairs, respectively. RMSEA, root mean square error of approximation, AIC, Akaike's Information Criterion, TLI, Tucker–Lewis index, CFI, comparative fit index. SRMR, standardized root mean square residual. AE models were used in Cholesky Decomposition for all models except those including work social support. Parameters a_{11}, a_{21}, a_{22}, e_{11}, e_{21}, and e_{22} denote paths presented in Panel B, Figure 1; $a_{11} \times a_{21}$ and $e_{11} \times e_{21}$ represent correlations attributable to genetic and environmental effects. Path coefficient estimates below .05 are not significant at the .05 level, within the range between .06 and .15 significant at the .05 level, and larger than .16 significant at the .001 level. *$p < .05$

in Table 3), job control ($a_{21} = .15$, $p < .05$, Model 10), and job complexity ($a_{21} = .21$, $p < .001$, Model 12) also significantly affected physical well-being respectively. Thus H5a, H5b, and H5d were supported. No significant genetic influence appeared on work social support; thus H5c received no support.

Relative contributions of genetic and environmental influences in explaining the bivariate relationships

We also sought to examine the relative contributions of genetic and environmental effects in explaining the relationships of work characteristics with the two well-being variables. Subjective well-being's relationship with job demands was mainly genetic (76.9%, Table 4). On the contrary, its relationship with work social support was environmental (100%). Environmental and genetic influences appear to play an equally important role in the relationships of subjective well-being with job control (53.5% and 46.5%) and job complexity (44.3% and 55.7%), although the correlation between job complexity and subjective well-being was not significant ($r = .02$, $p < .05$).

Physical well-being's relationship with work social support was environmental (100%). In contrast, its relationship with job control was mainly genetic (80%). However, the relationships with job demands (56.7% and 43.3%) and job complexity (55.1% and 44.9%) were both genetic and environmental to a similar extent.

Discussion

Answering the call for examining person-related antecedents of work characteristics (Oldham & Hackman, 2010; Parker et al., 2001), we investigated employees' genetic influences on their work characteristics, the role of CSE, and the relative importance of genetic and environmental influences involved in the relations between work characteristics and well-being. Estimated genetic influences reflect aggregated hard-wired influences from the person. Genetic influences on work characteristics may be attributable to human evolution. Evolutionary psychology (e.g., Nicholson, 1997) suggests that psychological characteristics that confer fitness advantages to the environment (e.g., work environments) are likely to be selected and retained in human evolution. That is probably why Weiss (2013) recently pointed out that work and working are crucial characteristics of human nature.

Table 4. Percentage of phenotypic correlations among work characteristics, well-being, and core self-evaluations attributable to genetic and environmental influences (%).

Correlation	Due to genetic effects	Due to environmental effects
Core self-evaluations with		
Job demands	96.7	3.3
Job control	65.2	34.8
Work social support	0	100
Job complexity	85.9	14.1
Subjective well-being with		
Job demands	76.9	33.1
Job control	46.5	53.5
Work social support	0	100
Job complexity	55.7	44.3
Physical well-being with		
Job demands	56.7	43.3
Job control	80.0	20.0
Work social support	0	100
Job complexity	55.1	44.9

Sample sizes were 364 and 348 for monozygotic and dizygotic twin pairs, respectively.

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Theoretical implications

Genetic influences on work characteristics

The results show that employees' genetic endowments accounted for approximately 30% of the variance in their job demands, job control, and job complexity. The results are consistent with research on genetic effects on other work-related constructs, such as job satisfaction (Arvey, Bouchard, Segal, & Abraham, 1989; Ilies & Judge, 2003), leadership (Arvey et al., 2007), and entrepreneurship (Shane et al., 2010). Our findings suggest that employee work characteristics may not be independent of influences from the person. Challenging a traditional assumption that employee work characteristics are mostly determined by environmental factors in work design research (Oldham & Hackman, 2010), our findings align with the growing research on the important role of the person in proactively affecting the work environments (Grant & Parker, 2009).

Behavioral genetics research has long underscored the importance of genetic factors as reflective of influences from the person to affecting individuals' life environments. Plomin et al. (2013) stated that social and behavioral sciences have often conceptualized measured life environments as being independent of the person in the conventional stimulus-response model. However, accumulating evidence has consistently demonstrated that individuals' genetic makeup is associated with their life environments including parental treatment, family background, and life events (Kendler & Baker, 2007). This suggests that people select compatible environments through multiple processes of selection to fit their individual characteristics (Kristof-Brown & Guay, 2010), a phenomenon genetic researchers call *gene-environment correlation* (Plomin et al., 2013).

We argue that *measures* of employee work environments, not work environments per se, are associated with genetic influences. Environments lack DNA, but measures of the environment capture individuals' experiences in their environments, which may be influenced by their individual characteristics through selection (e.g., Spector, Zapf, Chen, & Frese, 2000).

Although the role of genetic influences is indispensible, environmental factors seem to play a more important role in affecting work characteristics. This is consistent with research on contextual effects on work characteristics, such as leadership (Piccolo & Colquitt, 2006) and culture (Li, Wang, Taylor, Shi, & He, 2008; Taylor, Li, Shi, & Borman, 2008). But controlling for genetic influences, as we did in this study, is essential to demonstrate the unique effects of environmental influences.

We observed no significant genetic effect on work social support. We performed supplemental analyses by breaking down the work social support measure into supervisory and coworker support but found nonsignificant genetic effects. The result was in line with social network research, which showed that genetics did not influence out-degree network, that is, how many friends a person names as being support sources (Fowler et al., 2009).

Previous studies have reported significant genetic effects on general social support (e.g., from family and friends, Kendler, 1997). One reason for the difference is that in organizations employees might be constrained in obtaining support on their own. In contrast, people enjoy greater autonomy in selecting friends and/or spouses. Recent social support literature suggests that various factors affect perceived social support, including willingness to seek help and characteristics of help providers (Hofmann, Lei, & Grant, 2009). The nonsignificant genetic effects on work social support merit further research.

The role of core self-evaluations in genetic influences on work characteristics

Genetic factors related to CSE were found to be one reason for genetic effects on job demands, job control, and job complexity. Given that genetic factors may influence human behaviors through multiple pathways, CSE tends to be a personality variable that captures multiple mechanisms of selection (Judge et al., 1997). Organizational research has also found personality to transmit genetic effects on job satisfaction (Ilies & Judge, 2003; Judge et al., 2012), and entrepreneurship (Shane et al., 2010). Genetic factors associated with personality cannot explain all the genetic effects, however. Future research should explore the contributions of other individual characteristics, such as intelligence and physical characteristics in transmitting genetic effects on work characteristics.

DOI: 10.1002/job

We also examined the relative merits of genetic *versus* environmental effects in explaining the links of CSE with work characteristics. The CSE–work social support link indicates environmental influences explained why they were related. This is an important finding, because researchers may extrapolate Judge et al.'s (2012) findings and assume that all relationships between CSE and other variables are explained by genetic influences. The previous finding provides an important exception. Similar to the relationship between CSE and work stress (e.g., Judge et al., 2012), the other three relationships were mainly accounted for by genetic influences, suggesting the importance of selection (e.g., occupational and organizational selection) attributable to CSE in explaining these relationships.

Relative importance of genetic and environmental effects responsible for relationships of work characteristics with well-being

Our results indicate that genetic and environmental factors contributed differentially in explaining the work characteristics–well-being links. The link between job demands and subjective well-being and that between job control and physical well-being were mostly accounted for by genetic influences. Put differently, influences from the person (reflected by genetic influences) are the major reason for the two relations. As we discussed previously, multiple processes of selection including occupational and organizational selection may be operative. Given that classical work design research has predominantly conceived managers and organizations as the major determinants of work characteristics (Oldham & Hackman, 2010), such findings represented a critical and timely challenge to work design research. Indeed, more recent work design research has been embracing the idea that the person can also influence employee work environments (Grant & Parker, 2009). Our findings underscore the notion that the person is an important stakeholder in work design research, perhaps more than moderators in the work characteristic–outcome relations. Our study suggests that work design research needs more refined theories on person-related antecedents of work characteristics (Barrick et al., 2013).

The relations between work social support and well-being were mostly environmental. All other relationships were attributed to both genetic and environmental factors. The results are consistent with previous research on stressful life events and depression showing that genetic effects are responsible for approximately one-third of the relationships and environmental factors are responsible for the remaining two-thirds (Kendler et al., 1999).

As one anonymous reviewer pointed out, genetic influences seemed to contribute to a greater extent to the job demands–subjective well-being relation as compared with the job demands–physical well-being relation. This suggests that selection is more important in affecting job demands' relation with subjective well-being. Similarly, job control's relation with physical well-being seemed to be more accounted for by genetic influences through selection than its relation with subjective well-being. This might be related to the finding that genetic factors appeared to explain more variance in physical well-being. Future research should develop a stronger theoretical rationale and explore in greater depth the differential roles of genetic and environmental influences in influencing these relations.

Study strengths, limitations, and directions for future research

Using a national twin sample, we adopted behavioral genetics approaches that take advantages of quasi-natural experiments (Plomin et al., 2013). Data for this study were from multiple sources (e.g., telephone interviews, occupational database, and self reports). All the above suggests the robustness of our results.

However, our study is limited in several ways. First, our findings may be restricted to the age of our sample, the US culture, and labor market with high job mobility during the MIDUS study. Research has found that genetic influences vary as people age (Li, Stanek, Zhang, Ones, & McGue, in press). Future research should replicate our results in different contexts. Second, the MIDUS study was initiated in 1990 before more comprehensive work design models were developed (Parker, 2014). Thus, future research can examine genetic influences on other work characteristics. Third, although this study provides evidence for genetic and environmental effects, it lacks information on specific genetic and environmental factors that may influence work characteristics and may be responsible for their relationships with well-being. Molecular genetic approaches (e.g., Chi, Li, Wang, & Song, in press; Song, Li, &

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Arvey, 2011) should be useful in pinpointing specific DNA variations. Fourth, we argue that various processes of selection may be operative in generating the congruence between individuals' genetic makeup and their work characteristics. However, they are rather complex and possible multiple processes may include occupation selection and organization selection. Future research should endeavor to tease apart those processes. Fifth, our data may be multilevel, for example, with individuals nested within different occupations. However, behavioral genetic research has not yet developed approaches for dealing with multilevel twin data (Plomin et al., 2013) so that issue can be examined when more sophisticated methodology is developed (Zyphur, Zhang, Barsky, & Li, 2013).

Practical implications

Because findings of genetic research may be controversial and can easily be misinterpreted, we maintain that our findings might be tentative and replication is needed. Nevertheless, our results may have important practical implications for both organizations and employees. First, significant genetic effects on job demands, job control, and job complexity do not mean that managers and organizations can merely rely on genetic information in employee selection, because so far there has been no solid direct evidence suggesting so. Instead, a recent study (Li et al., 2015) found that a specific gene had both positive and negative influences on leadership, indicating influences of specific genes on work outcomes may be more complicated than expected.

Second, our findings of significant genetic influences suggest that managers and organizations should more seriously consider employees' innate individual characteristics in work design. Organizations need not merely treat employees as passive recipients of standard work design practices (Oldham & Hackman, 2010). Instead, they may want to consider using more individualized practices to help employees realize their human potential and meet employees' idiosyncratic needs attributed to their genetic makeup. In the long run, such individualized practices can enhance employee motivation, self development, and well-being, which in turn contributes to organizational effectiveness (Rousseau, 2005). If organizations fail to do so, employees are apt to actively tailor their work, informally or formally, to fit their individual characteristics, which may run counter to organizational goals (Wrzesniewski & Dutton, 2001). The idea of individualized practices has long been stressed (Lawler, 1974) and has recently been revamped (Rousseau, 2005). Such practices as individualized medicine have also been highlighted in medicine (Evans & Relling, 2004), an area from which organizational researchers often borrow ideas. Coupled with prior research, our study suggests that individualized work design seems a plausible option complementary to the standardized approach. This is also echoed by Weiss and Rupp (2011) calling for person-centric work psychology by focusing more on employee well-being. Indeed, Oldham and Hackman (2010) optimistically envisioned, "it should be possible one day soon to move toward the more 'individualized' form of organization that Edward Lawler envisioned many years ago" (p. 472).

Third, for individual employees equipped with the knowledge of their innate individual differences (e.g., their genetic endowments), they may proactively seek suitable work environments that can facilitate their career development. For example, they might find work conditions that promote their innate potentials and compensate for possible deficits. Lastly, we found no evidence that genetic factors influence work social support and its relationships with well-being. The results suggest that managers may have ample room to intervene by promoting positive work relationships with both supervisors and colleagues to boost employee well-being.

Conclusion

Work is a critical manifestation of human nature (Marx, 1978; H. M. Weiss, 2013). Work design research has long concentrated on environmental influences. However, employee work characteristics are not independent of employees' individual characteristics. Our findings suggest that we simply cannot ignore the role of the person in

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influencing employee work characteristics and related relationships with well-being. We encourage future theoretical and empirical research in work design to consider the main effects of the human body, as well as interactions between the human body and environmental influences, in our scientific inquiry.

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