Journal of Applied Psychology
2006, Vol. 91, No. 6, 1321–1339

0021-9010/06/$12.00 DOI: 10.1037/0021-9010.91.6.1321

The Work Design Questionnaire (WDQ): Developing and Validating a Comprehensive Measure for Assessing Job Design and the Nature of Work

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Although there are thousands of studies investigating work and job design, existing measures are incomplete. In an effort to address this gap, the authors reviewed the work design literature, identified and integrated previously described work characteristics, and developed a measure to tap those work characteristics. The resultant Work Design Questionnaire (WDQ) was validated with 540 incumbents holding 243 distinct jobs and demonstrated excellent reliability and convergent and discriminant validity. In addition, the authors found that, although both task and knowledge work characteristics predicted satisfaction, only knowledge characteristics were related to training and compensation requirements. Finally, the results showed that social support incrementally predicted satisfaction beyond motivational work characteristics but was not related to increased training and compensation requirements. These results provide new insight into how to avoid the trade-offs commonly observed in work design research. Taken together, the WDQ appears to hold promise as a general measure of work characteristics that can be used by scholars and practitioners to conduct basic research on the nature of work or to design and redesign jobs in organizations.

Keywords: job design, work design, job characteristics, work characteristics, work conditions

The different ways work can be designed has long captured the attention of management scholars. From the early time–motion studies of Taylor (1911) to the intense interest in motivational aspects of work in the 1970s (Hackman & Oldham, 1975), literally thousands of studies have been conducted examining work design issues. There is good reason for such interest, as study after study has shown that work design is important for a range of individual, group, and organizational outcomes (Morgeson & Campion, 2003; Parker & Wall, 1998; Wall & Martin, 1987). Despite the intense interest in and importance of work design, research into the measurement of job and work characteristics has been narrow, incomplete, and problematic.

For example, the most commonly used job design measure, the Job Diagnostic Survey (JDS; Hackman & Oldham, 1980), has focused on a narrow set of motivational job characteristics. This is problematic because numerous other work characteristics have been neglected (Parker, Wall, & Cordery, 2001). If scholars simply use the JDS without examining the larger work design literature, their research runs the risk of being deficient. Moreover, the psychometric properties of the JDS are questionable. In their meta-analytic review, Taber and Taylor (1990) concluded that "a difficulty with the JDS scales is their low internal consistency" (p. 475), and numerous other researchers have identified several problems with the factor structure of the JDS (Harvey, Billings, & Nilan, 1985; Idaszak & Drasgow, 1987; Kulik, Oldham, & Langer, 1988).

In an attempt to address some of these weaknesses, Campion (1988; Campion & Thayer, 1985) developed the more comprehensive Multimethod Job Design Questionnaire (MJDQ). Although this included a greater variety of job characteristics, it too suffered from measurement problems and gaps in construct measurement (Edwards, Scully, & Brtek, 1999, 2000). For example, Edwards et al. (1999) found that the MJDQ was better conceptualized as capturing 10 factors, rather than the 4-factor structure proposed by Campion (1988). Yet, even Edwards et al. (1999) noted that their conceptualization missed such key work characteristics as autonomy. Still others have articulated aspects of work design that have expanded our understanding of specific characteristics of the work environment (e.g., interdependence; Kiggundu, 1983) but have not clearly linked these work characteristics to other aspects of work. Given the limited nature of past work design research, a "consideration of modern forms of work and employment indicates the need to encompass a wider range of work characteristics" (Parker et al., 2001, p. 422).

A comprehensive and integrative work design measure is needed for at least three reasons. First, although there is a long history of job-specific task-oriented measures (see Harvey, 1991, for an overview) and a renewed interest in attribute-oriented measures (Peterson et al., 2001), these are both too specific (in the case of task measures) and too general (in the case of attribute measures) for use in analyzing and redesigning a range of jobs. What is needed is a measure that can capture the middle ground between task and attribute measures. Second, when designing or redesign-

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We thank Michael Campion and John Hollenbeck for their comments on earlier versions of this article. Their input resulted in many meaningful improvements. Also thanks to Kelly Delaney-Klinger for her assistance in data collection and Anne Downey for her data entry, proofreading, and editing assistance.

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ing jobs, one is largely limited by the range of job characteristics considered. If only a small number of motivational job characteristics are considered (e.g., autonomy and variety), the types of design decisions are likely to be highly restricted. In contrast, if a more comprehensive set of work characteristics is considered (e.g., autonomy, variety, social support, and physical demands), more fine-grained changes to work can be made (Morgeson & Campion, 2002). This may help address some of the trade-offs commonly observed in the work redesign literature (Campion, Mumford, Morgeson, & Nahrgang, 2005).

Third, theorizing in the area of work design has slowed dramatically. The dominant theoretical model in work design remains Hackman and Oldham's (1975, 1976) Job Characteristics Theory, forwarded 30 years ago. The most recent attempt to offer a new theoretical perspective was Campion's (1988; Campion & Thayer, 1985) interdisciplinary model. Thus, there has been little new theoretical work in this area over the past 20 years. In addition, although there are distinct work design perspectives, there is little integration among the different perspectives (see Campion & Thayer, 1985, for a notable exception). Thus, different scholars who have investigated work design issues have done so relatively independently of each other. As such, their theoretical models tend to be relatively parochial. One potential reason for the lack of integration is that there have been few measures that assess a wide range of work design factors. By broadening the focus to simultaneously include the motivational, social, and work context aspects of work, we hope to stimulate both empirical research and broader theoretical models. With a more comprehensive measure, it may be possible to create a composite theory of work design that incorporates ideas from all work design perspectives, explicitly recognizing the costs and benefits of each.

To address these issues, we sought to build on existing research and to develop a comprehensive measure we call the Work Design Questionnaire (WDQ). Our focus is on work design (as opposed to the narrower term *job design*) because it acknowledges both the job and the link between jobs and the broader environment (Parker & Wall, 1998). To develop the WDQ, we reviewed the work design literature, identifying key work characteristics and the measures previously used. This review was then used to develop a series of items designed to tap into the characteristics identified. This item generation sought to address weaknesses in existing measures and offer a parsimonious set of scales. The WDQ was subsequently administered to 540 job incumbents in 243 distinct job titles. We present the results of our efforts in two phases. In the first phase, we discuss the development of the WDQ and examine its measurement properties and factor structure. In the second phase, we develop a set of hypotheses designed to explore the construct validity of the WDQ and its relationships with a number of outcome measures.

Phase 1: Development of the WDQ

Methodology Used to Identify Work Characteristics

A fairly large number of terms have been used to describe similar work characteristics, which are defined as the attributes of the task, job, and social and organizational environment. Many of these characteristics overlap at least partially (and, in some cases, fully) with other characteristics that have different names. To develop a parsimonious and comprehensive measure, we first sought to identify as many work characteristic terms as possible and combine them where applicable into homogeneous work characteristic categories. Once we identified the work characteristic categories, we simply referred to the categories as *work characteristics*.

To identify work characteristic terms, we searched PsycInfo and ABI–Inform databases for all articles related to job or work design using the following terms: *work design*, *job design*, *work characteristics*, *job characteristics*, *job demands*, and *job content*. We also checked the reference sections of those articles reviewed and examined the most recent literature review on the work design literature (Morgeson & Campion, 2003). Finally, we reviewed the recently developed Occupational Information Network (O*NET) job analysis database (Peterson et al., 2001) for relevant work characteristic terms. In particular, we reviewed the generalized work activity, work context, and organizational context domains of the O*NET. These three domains reflect the occupational requirements component of O*NET (Mumford & Peterson, 1999). This is the component of O*NET that is most directly related to what is done in a job and the surrounding context of that job.

In total, 107 work characteristic terms were identified that have been discussed or measured in the literature. We then independently sorted these terms into homogeneous categories on the basis of the underlying content of the work characteristic. Our sorting process was adapted from Fleishman and Quaintance (1984). First, we defined the *descriptor domain* as any research that has been done in the field of job or work design (see our search terms). Our goal was to evaluate all relevant work characteristic terms that have been identified in the literature. Second, we individually qualitatively classified these terms into homogeneous categories on the basis of perceived similarity. We used a form of monothetic classification, which involves defining the categories in terms of a small set of unique attributes. These attributes then dictated whether a particular term was placed in a given category. Third, we individually formalized the definitions of the categories and ensured that all categorized terms were placed in the appropriate category. Fourth, we then met to discuss the categories and review the terms included in each category. The independent sorting process resulted in 20 and 21 distinct categories, respectively. This review process helped sharpen the category definitions, highlight inconsistencies in the categorization of different terms, and highlight redundancies in some of the categories. Disagreements were resolved through dialogue and the level of support each of us could marshal for the placement of a particular term or the importance of a particular term. For example, one of us identified three distinct work characteristic categories that included "autonomy," "work scheduling," and "decision-making authority." Following discussion, it was noted that both work scheduling and decision-making authority can be conceptualized as different aspects of autonomy rather than as separate constructs. As such, these categories were combined into the autonomy category, although this distinction did inform the development of items to tap into these different aspects of autonomy. As a result of this process, 18 work characteristic categories were subsequently developed. A brief definition and discussion of these work characteristics are provided.

To help organize our discussion, we adapted the framework developed by Morgeson and Campion (2003) and placed the work characteristics into three major categories: motivational, social,

and contextual. In their comprehensive review of the work design literature, Morgeson and Campion concluded that there was considerable evidence across a variety of different sources for such a three-component structure of work. The first category includes the motivational characteristics, which have been the most investigated in the literature and are thought to reflect the overall complexity of work (Dunham, 1976; Loher, Noe, Moeller, & Fitzgerald, 1985; Oldham, Kulik, Ambrose, Stepina, & Brand, 1986; Oldham & Miller, 1979). The basic principle of the motivational approach is that jobs will be enriched (i.e., made more motivating and satisfying) if high levels of these characteristics are present. We further subdivided this category of work characteristics into those work characteristics that reflect the task and knowledge requirements of work (see Campion & McClelland, 1993). The second category includes the social characteristics, which reflect the fact that work is performed within a broader social environment. The interpersonal and social aspects of work have historically been studied less than the motivational aspects (Morgeson & Campion, 2003; Seers & Graen, 1984), even though they have been thought to be important for work design (Trist & Bamforth, 1951) and are viewed by job incumbents as a major aspect of work (Stone & Gueutal, 1985). The third category includes the contextual characteristics, which reflect the context within which work is performed, including the physical and environmental contexts. With the exception of the MJDQ, the work context has been largely neglected in work design research. In the discussion that follows, the work characteristics are defined and linked to the broader work design literature. The final set of items included in the WDQ is provided in the Appendix.

Motivational Work Characteristics

Task Characteristics

Task characteristics have been the most commonly investigated motivational work design characteristics. Task characteristics are primarily concerned with how the work itself is accomplished and the range and nature of tasks associated with a particular job.

Autonomy. Perhaps the most widely studied work characteristic is that of autonomy, which has assumed a central place in motivational work design approaches (Campion, 1988; Hackman & Oldham, 1976). Initially viewed as the amount of freedom and independence an individual has in terms of carrying out his or her work assignment (Hackman & Oldham, 1975), recent research has expanded this conceptualization to suggest that autonomy reflects the extent to which a job allows freedom, independence, and discretion to schedule work, make decisions, and choose the methods used to perform tasks (Breaugh, 1985; Wall, Jackson, & Davids, 1992; Wall, Jackson, & Mullarkey, 1995). Thus, autonomy includes three interrelated aspects centered on freedom in (a) work scheduling, (b) decision making, and (c) work methods.

Task variety. Task variety refers to the degree to which a job requires employees to perform a wide range of tasks on the job. As such, it is similar to notions of task enlargement discussed in the literature (Herzberg, 1968; Lawler, 1969). Jobs that involve the performance of a number of different work activities are likely to be more interesting and enjoyable to perform (Sims, Szilagyi, & Keller, 1976).

Task significance. Task significance reflects the degree to which a job influences the lives or work of others, whether inside or outside the organization (Hackman & Oldham, 1975). People in jobs that have a significant effect on the physical or psychological well-being of others are likely to experience greater meaningfulness in the work (Hackman & Oldham, 1980).

Task identity. Task identity reflects the degree to which a job involves a whole piece of work, the results of which can be easily identified (Sims et al., 1976). Jobs that involve an intact task, such as providing a complete unit of service or putting together an entire product, are invariably more interesting to perform than jobs that involve only small parts of the task (Hackman & Oldham, 1980).

Feedback from job. Feedback from job reflects the degree to which the job provides direct and clear information about the effectiveness of task performance (Hackman & Oldham, 1976). The focus is on feedback directly from the job itself or knowledge of one's own work activities, as opposed to feedback from others. This is thought to enhance knowledge of the results of the job (Hackman & Oldham, 1980).

Knowledge Characteristics

Knowledge characteristics reflect the kinds of knowledge, skill, and ability demands that are placed on an individual as a function of what is done on the job. Distinguishing task from knowledge characteristics acknowledges the fact that jobs can be designed or redesigned to increase the task demands, knowledge demands, or both (Campion & McClelland, 1993).

Job complexity. Job complexity refers to the extent to which the tasks on a job are complex and difficult to perform (we focus on the "positive" aspect of complexity; the opposite is task simplicity; Campion, 1988). Although originally conceptualized as an aspect of mechanistic job design, Edwards et al. (2000) found that complexity is a distinct factor. Because work that involves complex tasks requires the use of numerous high-level skills and is more mentally demanding and challenging, it is likely to have positive motivational outcomes.

Information processing. The amount of information processing needed at work reflects the degree to which a job requires attending to and processing data or other information. Some jobs require higher levels of monitoring and active information processing than others (Martin & Wall, 1989; Wall & Jackson, 1995; Wall et al., 1995). High cognitive demands are characteristic of the motivational approach because of the complexity of enriched work (Campion, 1989).

Problem solving. Problem solving reflects the degree to which a job requires unique ideas or solutions and reflects the more active cognitive processing requirements of a job (Jackson, Wall, Martin, & Davids, 1993; Wall et al., 1995). Problem solving involves generating unique or innovative ideas or solutions, diagnosing and solving nonroutine problems, and preventing or recovering from errors (Jackson et al., 1993; Wall, Corbett, Clegg, Jackson, & Martin, 1990). As such, it is conceptually related to the creativity demands of work and is a natural extension to the information demands of a job (Shalley, Gilson, & Blum, 2000).

Skill variety. Skill variety reflects the extent to which a job requires an individual to use a variety of different skills to complete the work (Hackman & Oldham, 1980). It is important to distinguish skill variety from task variety because the use of multiple skills is distinct from the performance of multiple tasks.

The use of multiple skills is often challenging and thereby engaging to perform.

Specialization. Specialization reflects the extent to which a job involves performing specialized tasks or possessing specialized knowledge and skill. This notion of specialization was first identified by Campion (1988) and later clarified by Edwards et al. (1999). As opposed to the breadth of activities and skills inherent in task and skill variety, specialization reflects a depth of knowledge and skill in a particular area.

Social Characteristics

Social support. Social support reflects the degree to which a job provides opportunities for advice and assistance from others. This includes Karasek's (Karasek, 1979; Karasek, Brisson, Kawakami, Houtman, Bongers, & Amick, 1998) notion of supervisor and coworker social support and the construct of friendship opportunities at work posited by Sims et al. (1976). Although not traditionally studied in job design contexts, research from other domains suggests that social support is critical for well-being (Ryan & Deci, 2001; Wrzesniewski, Dutton, & Debebe, 2003), particularly for jobs that are stressful or lack many motivational work characteristics.

Interdependence. Interdependence reflects the degree to which the job depends on others and others depend on it to complete the work (Kiggundu, 1981). As such, interdependence reflects the "connectedness" of jobs to each other. Integral to this definition are two distinct forms of interdependence (Kiggundu, 1981): (a) the extent to which work flows from one job to other jobs (initiated interdependence) and (b) the extent to which a job is affected by work from other jobs (received interdependence).

Interaction outside the organization. Interaction outside the organization reflects the extent to which the job requires employees to interact and communicate with individuals external to the organization. This interaction could take place with suppliers, customers, or any other external entity. The "dealing with others" construct (Sims et al., 1976) is similar, although we focus solely on interactions with individuals beyond the organization's boundaries. It is also similar to the "serves the public" dimension identified by Stone and Gueutal (1985), although the interaction outside the organization construct goes beyond simply interacting with and serving customers.

Feedback from others. Feedback from others reflects the degree to which others in the organization provide information about performance. Although Hackman and Oldham (1975) focused on feedback from the job itself, early theorizing suggested that feedback could also come from other people (Hackman & Lawler, 1971) given a job's particular place in the organizational structure. In particular, coworkers and supervisors are two potentially important sources of feedback.

Contextual Characteristics

Ergonomics. Ergonomics reflects the degree to which a job allows correct or appropriate posture and movement. The importance of this aspect of work design can be found in the extensive ergonomics literature as well as job design research (Campion & Thayer, 1985; Edwards et al., 1999).

Physical demands. Physical demands reflect the level of physical activity or effort required in the job. This is similar to the physical ease factor identified by Edwards et al. (1999) and is consistent with the physical demand dimension highlighted by Stone and Gueutal (1985), although we focus only on the physical strength, endurance, effort, and activity aspects of the job. The equipment responsibilities and health hazards identified by Stone and Gueutal were included as distinct factors in the present research.

Work conditions. Work conditions reflect the environment within which a job is performed. It includes the presence of health hazards (Stone & Gueutal, 1985) and noise, temperature, and cleanliness of the working environment (Campion & McClelland, 1991; Edwards et al., 1999).

Equipment use. Equipment use reflects the variety and complexity of the technology and equipment used in a job. Although not previously assessed by job design measures, other research has identified the importance of considering the equipment and technology used at work (Goodman, 1986; Harvey, Friedman, Hakel, & Cornelius, 1988).

Method

Measure Development Strategy

In developing the WDQ, we began by searching the literature to find existing items for each of the constructs. Although our goal was to use existing items (without revising them) wherever possible, this was not always possible. When we could not use existing items, we adapted existing items and developed new items. When we were choosing, revising, or writing new items, several principles directed our efforts. First, item choice, revision, and writing were guided by our definition of the construct (which was derived from the work design literature). When there were numerous potential items, we chose those that best reflected the construct definition. When revisions were made to existing items, changes were made to better measure the underlying construct or otherwise clarify the item. When we created new items, we sought to write items that (a) reflected the construct definition and (b) were distinct from the other identified work characteristics. The WDQ is thus a mix of existing items (17%), adapted items (33%), and new items (50%). All items are contained in the Appendix.

Second, we chose to use a relatively simple response scale. We did this because the use of more complex response scales in the job design area has been shown to add substantial amounts of construct-irrelevant variance (Harvey et al., 1985). As such, all items used a simple 5-point *strongly disagree* to *strongly agree* scale. Third, because negatively worded items have been shown to produce factor structure problems in other work design measures (Idaszak & Drasgow, 1987), items were positively worded such that greater levels of agreement indicated the presence of more of the work characteristic. The only exceptions to this were the job complexity scale and one ergonomics item, because they are easier to comprehend when worded in the negative. Fourth, to achieve adequate internal consistency reliability yet maintain reasonable survey length, a minimum of four items was used to assess each construct. The only exception to this rule was when multiple dimensions of a construct were thought to exist (i.e., the three aspects of autonomy). In instances such as this, three items were used to measure each subdimension (e.g., the autonomy scale has nine items).

Fifth, most items referred to the job itself as opposed to an individual's reaction to the job. This was done because it is the properties of the job itself, and not idiosyncratic reactions to the job, that are important in work design measurement. A small number of items did reference the broader work environment (e.g., "the workplace is free from excessive noise") or personal experiences (e.g., "people I work with are friendly") to reflect some of the construct definitions. Sixth, the items were grouped by work characteristic construct (instead of being randomly distributed). Research

has shown that grouping items has distinct psychometric advantages, particularly with work characteristics (Schriesheim, Solomon, & Kopelman, 1989).

Procedure

As part of a management course assignment, junior- and senior-level business students analyzed the job of a family member or acquaintance (job incumbent) who had worked full time for at least 10 years. There were two parts to this assignment. In the first part, the student administered a paper-and-pencil version of the WDQ to the job incumbent. After the job incumbent completed the WDQ, the student interviewed the job incumbent to find out more information about the job, such as the key tasks and duties of the job. Following this, the student used the knowledge gained to identify the *Dictionary of Occupational Titles* (DOT; U.S. Department of Labor, 1991) and O*NET job codes for the specific job being analyzed. Collecting such detailed data on the job was done to ensure identification of the correct job codes.

The business students identified the job incumbents (generally a family member with considerable work experience) and interviewed and administered the WDQ to them. Thus, although the job incumbent completed the WDQ, the business students were responsible for searching the O*NET and DOT for the appropriate job or occupational codes. This particular sampling strategy was employed so that data could be collected on a wide range of different jobs given that the substantive hypotheses were to be tested at the job level. Similar sampling strategies have been used when the goal has been to sample a wide range of different jobs (see Raymark, Schmit, & Guion, 1997).

Sample

Participants were 540 job incumbents who held 243 distinct jobs. This sample included most major occupational groups. Participants were approximately 48 years old, had worked in their current job for 15 years, and 58% were men. Table 1 presents the number of incumbents, their age, work experience, and sex by occupational group. The occupational groups used in Table 1 were taken from the Standard Occupational Classification (SOC) developed and used by the U.S. Department of Commerce (2000).

Although its purpose is primarily descriptive, Table 1 presents several interesting pieces of information. First, of the 23 SOC occupational groups, 22 are represented in our sample (with building and grounds cleaning being the exception). Second, although perhaps not unexpected because of the sampling method, professional jobs (e.g., management, business and financial) were more heavily weighted in our data set than nonprofessional jobs (e.g., transportation and material moving, construction and extraction). Third, within all occupations, the job experience of incumbents was high. This suggests that incumbents have had enough time to experience all the work characteristics present in the job.

Results

Factor Structure of the WDQ

In developing a comprehensive measure of work, one key issue involves understanding its underlying structure. Although it is possible to identify and discuss a range of work design characteristics, it is not clear whether each of these aspects is distinct. As such, it is important to articulate alternative structures. There has been some suggestion that the domain of work design characteristics can be summarized in terms of the four broad categories used to organize the preceding literature review (i.e., task, knowledge, social, and contextual work characteristics). Yet, the current review argues against such a reductionist viewpoint by suggesting there are at least 18 distinct aspects of work design. This is considerably more differentiated than previous conceptualizations and derives from the literature reviewed earlier. In addition, there are potentially other, more complex conceptualizations of work.

Table 1
Incumbent Population by Occupation

SOC occupation category	*n*	Age (years)		Job experience (years)		Sex (% men)
		M	*SD*	*M*	*SD*	
Management	177	49.28	6.87	12.79	9.63	72
Business and financial	46	48.47	6.01	15.53	9.43	56
Computer and mathematical	14	44.00	8.46	8.84	7.35	64
Architecture and engineering	21	48.48	8.76	17.23	9.63	90
Life, physical, and social science	10	49.00	7.20	20.77	8.44	50
Community and social services	13	48.92	6.72	16.12	7.84	38
Legal	15	52.13	6.19	15.64	9.29	53
Education, training, and library	50	52.04	5.61	19.82	9.63	18
Arts, design, entertainment, sports, and media	10	48.90	5.55	15.73	9.02	40
Health care practitioners and technical	40	49.73	6.71	19.30	9.65	43
Health care support	3	55.33	.58	9.61	3.18	0
Protective service	5	45.80	12.83	16.28	4.53	80
Food preparation and serving related	10	36.10	10.08	11.79	7.87	50
Personal care and service	4	46.00	2.65	10.98	4.62	0
Sales and related	41	48.13	7.68	14.35	8.35	68
Office and administrative support	37	43.61	8.78	12.72	11.29	14
Farming, fishing, and forestry	2	54.00	2.83	32.50	10.61	100
Construction and extraction	8	46.25	13.27	20.16	12.84	100
Installation, maintenance, and repair	12	45.25	6.59	15.64	10.34	100
Production	13	49.85	4.93	19.10	8.08	85
Transportation and material moving	7	46.67	10.91	12.42	10.95	100
Military specific	2	31.50	3.54	10.33	3.06	100
Total	540	48.45	7.69	15.05	9.80	58

To investigate the factor structure of the WDQ, we tested five different models using confirmatory factor analytic (CFA) techniques. A 4-factor model examines the four broad categories of work characteristics used to organize the literature review. An 18-factor model examines our a priori specified dimensions of work. A 19-factor model separates interdependence into its received and initiated components. A 20-factor model separates autonomy into its three components, which includes autonomy in work scheduling, decision making, and work methods. Finally, a 21-factor model separates both interdependence and autonomy into the identified components.

We evaluated the WDQ's factor structure by conducting several CFAs using EQS version 5.7b (Bentler, 1995). Using CFA techniques is more appropriate for our study than exploratory factor analysis (EFA) for two reasons. First, given that we had several competing possible factor structures, using CFA allowed us to directly test these competing models. Thus, our conclusions are based not only on the absolute fit of one model but also on the relative fit of alternative models. Second, as models are specified a priori when using CFA, researchers are less likely to capitalize on chance, as they often are with EFA (Fabrigar, Wegener, MacCallum, & Strahan, 1999).

We present four different fit indicators, each of which can be used to help interpret the fit of our model: χ^2/df ratio, comparative fit index (CFI), the standardized root-mean-square residual (SRMR), and the root-mean-square error of approximation (RMSEA). For χ^2/df ratio, a ratio of 2.0 has often been used to indicate good fit (Arbuckle, 1997). For CFI, higher values indicate better fit, with the value of .90 generally indicating good fit. In contrast, lower values on both SRMR and RMSEA indicate better fit. With SRMR, a value of .08 generally indicates good fit, whereas a value of .05 on RMSEA indicates good fit, and values between .05 and .08 indicate adequate fit. Finally, we compare alternative models by testing the change in χ^2 across models.

The results of our CFAs are presented in Table 2. First, the 4-factor model showed poor fit, as all fit statistics were off of the generally accepted levels. Second, the 18-factor solution showed adequate fit, with the SRMR and RMSEA reaching acceptable levels, whereas the CFI was slightly low and the χ^2/df ratio was slightly high. In addition, this model was significantly better than the 4-factor model (χ^2 change = 13324, *df* change = 161, $p < .001$). Third, we tested the 19-factor model, which separated interdependence into 2 factors. The results of this analysis show that fit significantly increased (χ^2 change = 405, *df* change = 19, $p < .001$) and all fit statistics reached acceptable levels. Fourth, we tested the 20-factor model, which separated autonomy into 3 factors. This model was significantly better than the 18-factor model (χ^2 change = 251, *df* change = 39, $p < .001$), although it was worse than the 19-factor model (χ^2 change = –154, *df* change = 20, $p < .001$). Finally, we tested the 21-factor solution. This model was the best model overall, with the lowest χ^2/df ratio, SRMR, and RMSEA, and the highest CFI. In addition, this model was significantly better than the 18-factor (χ^2 change = 660, *df* change = 60, $p < .001$) and 19-factor models (χ^2 change = 254, *df* change = 41, $p < .001$). Thus, the 21-factor model, which separates interdependence into 2 factors and autonomy into 3 factors, fit our data the best. We averaged the items into scales for all subsequent analyses.

Reliability of the WDQ Scales

Table 3 presents the descriptive and psychometric statistics for all study measures (several measures in Table 3 will be introduced in Phase 2 of the study). The first two columns present the means and standard deviations. Overall, the WDQ scales demonstrate good variability with little evidence of floor or ceiling effects. The third column shows the internal consistency reliabilities. As a set, the WDQ scales demonstrate excellent internal consistency reliability. Average reliability (following an *r* to *z* transformation) was .87, and only the ergonomics scale was below .70, which some have suggested is a minimum level of reliability needed for psychometric adequacy (Nunnally & Bernstein, 1994).

The fourth and fifth columns present interrater reliability (intraclass correlations or ICC[2]; Bliese, 2000) and interrater agreement (r_{wg}; James, Demaree, & Wolf, 1984; Kozlowski & Hattrup, 1992). The intraclass correlation used to index interrater reliability assesses the extent to which incumbent judgments of their jobs covary with each other relative to incumbents in other jobs. Interrater agreement reflects the absolute level of agreement across raters and thus assesses the extent to which raters make similar mean-level ratings. Generally, these statistics suggest that the incumbents within a job code agree on work characteristics. There are three exceptions: feedback from job, feedback from others, and initiated interdependence. These variables demonstrate essentially zero interrater reliability. This could be due to a lack of between-job variability in this sample or that perhaps these aspects of work are not stable characteristics of a job and instead reflect idiosyncratic elements of job holders. Yet, the high levels of interrater agreement would suggest that these are not idiosyncratic perceptions because multiple incumbents agreed in their perceptions. Clearly, additional research should be conducted on these scales to determine the reasons for low interrater reliability. Taken as a

Table 2
Results of Confirmatory Factor Analyses

Model	χ^2	*df*	χ^2/df ratio	SRMR	RMSEA	CFI
4-factor	19010	2839	6.70	.12	.11	.40
18-factor	5686	2678	2.12	.06	.05	.89
19-factor (split interdependence)	5280	2659	1.99	.06	.04	.90
20-factor (split autonomy)	5435	2639	2.06	.06	.05	.90
21-factor	5027	2618	1.92	.06	.04	.91

Note. SRMR = standardized root-mean-square residual; RMSEA = root-mean-square error of approximation; CFI = comparative fit index.

Table 3
Means, Standard Deviations, Reliability, and Agreement Statistics

Construct	*M*	*SD*	Internal consistency[a]	Interrater reliability[b]	Interrater agreement[c]
Task characteristics					
Work scheduling autonomy	3.93	.89	.85	.53**	.76
Decision-making autonomy	4.12	.74	.85	.46**	.84
Work methods autonomy	3.99	.80	.88	.44**	.79
Task variety	4.13	.69	.95	.34**	.91
Significance	3.95	.81	.87	.30**	.80
Task identity	3.61	.84	.88	.21*	.77
Feedback from job	3.91	.64	.86	.01	.82
Knowledge characteristics					
Job complexity	3.85	.73	.87	.31**	.81
Information processing	4.31	.67	.87	.58**	.92
Problem solving	3.78	.83	.84	.38**	.83
Skill variety	4.24	.59	.86	.27**	.90
Specialization	3.99	.72	.84	.29**	.82
Social characteristics					
Social support	4.12	.52	.82	.29**	.91
Initiated interdependence	3.56	.82	.80	.14	.68
Received interdependence	3.69	.86	.84	.40**	.75
Interaction outside organization	3.54	1.03	.91	.51**	.82
Feedback from others	3.54	.72	.88	.07	.78
Work context					
Ergonomics	3.70	.77	.64	.42**	.80
Physical demands	2.33	1.11	.95	.53**	.77
Work conditions	3.64	1.00	.87	.58**	.83
Equipment use	3.37	.93	.82	.41**	.70
Outcomes and correlates					
Satisfaction	4.25	.56	.86	.36**	.92
Training requirements	3.41	1.17			
Compensation requirements	52688	26101			
Data	4.08	1.42			
Cognitive ability	3.01	.69			
Information GWA	3.40	1.03			
People	3.18	2.17			
Communicate GWA	3.03	.90			
Physical ability	1.13	.82			
Performing physical GWA	2.31	.72			
Physical work context	2.19	.39			

Note. GWA = generalized work activities.
[a] Coefficient alpha. [b] ICC(2). [c] r_{wg}.
* $p < .05$. ** $p < .01$.

whole, however, these data suggest that it is appropriate to aggregate to the job level and there are high levels of agreement about a job's standing on the work characteristics.

Phase 2: Exploring Construct Validity and Relationships With Outcomes

With the measurement properties thus established, the second phase of this research involved exploring the construct validity of the WDQ and relationships between the WDQ and several different outcome measures.

Construct Validity

For any new measure, another important task is to establish its construct validity. One way to assess the construct validity of the WDQ scales is to determine the extent to which they converge with existing published job or occupational databases, a strategy used by a number of researchers in the work design area (Campion, 1989; Gerhart, 1988; Spector & Jex, 1991). The cognitive ability-oriented, social- and interaction-related, and work context descriptors in the DOT and O*NET were used to provide independent convergent and discriminant validity evidence for each of the major categories of work characteristics. Evidence that responses to the WDQ are related to these external measures would be powerful because it suggests that the measures correspond to some larger objective reality unaffected by perceptual biases.

First, we expected that the task characteristics in the motivational category would be largely independent of cognitive ability-oriented descriptors, in part because these work characteristics reflect how jobs are structured and performed but do not necessarily require additional job incumbent capabilities to perform the tasks associated with the job. In essence, differences in the nature of the work itself do not necessarily suggest that greater knowledge, skills, or abilities are needed. Perhaps the only exception to this would be task variety, which may place additional cognitive ability demands on the job. However, we did expect the knowledge

characteristics to be positively related to cognitive ability-oriented descriptors for two reasons. First, the knowledge characteristics involve aspects of work that would require enhanced cognitive ability. For example, the kind of monitoring and problem analysis involved in the information-processing and problem-solving work characteristics reflect the enhanced mental demands that underlie this type of motivationally oriented work (Campion, 1989). Second, performing several complicated tasks (i.e., multitasking) and using a variety of different skills require enhanced self-regulation and the dedication of considerable cognitive resources, thereby increasing the ability requirements of work (Kanfer & Ackerman, 1989).

Hypothesis 1: (a) Task characteristics will be unrelated to cognitive ability-oriented descriptors; (b) knowledge characteristics will be positively related to cognitive ability-oriented descriptors.

Second, we expected that the social characteristics of initiated interdependence, received interdependence, and interaction outside the organization would be related to the extent to which the job involves working with, interacting, and communicating with others. This is likely to be the case because interdependence reflects the extent to which jobs are linked to others within and outside an organization, and interaction outside the organization is, by definition, interaction and communication with others. In contrast, we did not expect that social support or feedback from others would be related to working with, interacting, and communicating with others, as simply interacting with others will not necessarily result in receiving social support or feedback. That is, it is possible for one to interact with others without receiving advice and assistance (i.e., social support) or information about one's performance (i.e., feedback from others), as these social characteristics reflect behaviors that are more complex than simple interaction.

Hypothesis 2: (a) Initiated interdependence, (b) received interdependence, and (c) interaction outside the organization will be positively related to social- and interpersonally oriented descriptors; (d) social support and (e) feedback from others will be unrelated to social- and interpersonally oriented descriptors.

Third, we expected all of the work context characteristics to be related to a number of archival measures of work context, with positive relationships expected from physical demands and equipment use (signifying more physically demanding work) and negative relationships expected from ergonomics and work context (signifying less physically demanding jobs). This includes physical abilities from the O*NET ability domain, performing physical and manual work activities from the O*NET generalized work activity domain, and physical work conditions from the O*NET work context domain. Given the similarity between the work context characteristics in the WDQ and the archival descriptors, these relations are likely to be the strongest of all the WDQ and archival descriptor relationships.

Hypothesis 3: The work context characteristics will be related to the archival physical demands and work environment descriptors.

Differences Between Occupations

Another way to validate the WDQ is to examine whether it is able to detect differences between occupations. That is, certain occupations are likely to have higher or lower levels of particular work characteristics. We examined four occupational differences in work characteristics.

First, we expected that jobs in professional occupations (e.g., managerial jobs) would be higher in both the broad set of knowledge characteristics and the three components of autonomy than jobs in nonprofessional occupations (e.g., transportation and material moving) because professional occupations, in contrast to nonprofessional occupations, generally involve complex, nonroutine work that requires flexible and adaptive behavior where higher levels of autonomy are present. Second, we expected jobs in nonprofessional occupations, as compared with those in professional occupations, to be higher in physical demands and lower on work conditions because these jobs generally involve more physical exertion in less than optimal work environments. Third, we expected jobs in occupations that involve the protection and promotion of human life (e.g., health care and protective services) to have higher levels of task significance because behavior in these occupations directly affects important outcomes (namely, people). Fourth, we expected jobs in sales occupations to be higher in interaction outside the organization because sales occupations are specifically focused on providing products and services to other organizations.

Hypothesis 4a: Jobs in professional occupations will have higher levels of knowledge characteristics and autonomy than jobs in nonprofessional occupations.

Hypothesis 4b: Jobs in nonprofessional occupations will have higher levels of physical demands and less positive work conditions than jobs in professional occupations.

Hypothesis 4c: Jobs in "human life" occupations will have higher levels of task significance than jobs in other occupations.

Hypothesis 4d: Jobs in sales occupations will have higher levels of interaction outside the organization than jobs in other occupations.

Relationships to Outcomes

Finally, it is important that the WDQ enable opportunities for advancing work design theory. Given the expanded range of work characteristics measured, there are several opportunities for such a contribution. As research expanded the range of work design outcomes studied, it became clear that designing work according to the principles of a motivational model (the predominant model in organizational psychology) involved several distinct trade-offs (Morgeson & Campion, 2002, 2003). In particular, although increasing motivational work design had the benefit of improved affective outcomes (i.e., job satisfaction), it also had the cost of increased training and compensation requirements, two important human resource outcomes (Campion, 1988; Campion & Thayer, 1985; Morgeson & Campion, 2003).

The present distinction between task and knowledge characteristics and the resulting measures of each perhaps suggest a way to

mitigate this trade-off. Given the extensive research that has found a positive relationship between motivational characteristics and job satisfaction, it is likely that both task and knowledge characteristics will be positively related to job satisfaction (Fried & Ferris, 1987; Loher et al., 1985). Yet, it is likely that only knowledge characteristics will be positively related to training and compensation requirements. This is due to the fact that only changes to the knowledge-based aspects of work are likely to increase the number and level of knowledge, skills, and abilities required (Campion & Berger, 1990). In addition, as described earlier, knowledge characteristics are likely to be related to the mental demands of work, which are logically related to heightened training and compensation requirements.

> *Hypothesis 5:* Both (a) task and (b) knowledge characteristics will be positively related to satisfaction; only knowledge characteristics will be positively related to (c) training and (d) compensation requirements.

As noted earlier and elsewhere (Morgeson & Campion, 2003; Seers & Graen, 1984), the social characteristics have often been ignored in the organizational literature. Yet, the social characteristics may also hold some promise for mitigating the trade-offs typically observed. In particular, social support has been found to be a valued aspect of work. In fact, there has been increasing recognition that individuals seek meaning through a connection with others (Wrzesniewski et al., 2003) and "warm, trusting, and supportive interpersonal relationships" are essential for human well-being (Ryan & Deci, 2001, p. 154). These kinds of positive work relationships are likely to be just as effective at producing positive affective outcomes as are the more traditionally studied motivational work characteristics. In addition, there is no reason to believe that increased social support would result in higher levels of training and compensation requirements, largely because positive interpersonal relationships have no impact on the mental demands of the work. In fact, training requirements may be lower for jobs high in social support because of the ability to rely on the positive relationships in learning new tasks or getting help when problems arise.

> *Hypothesis 6:* Social support will (a) incrementally predict satisfaction beyond motivational work characteristics but will not be associated with (b) higher training or (c) compensation requirements.

Method

Sample

The same sample of 540 job incumbents was used in Phase 2.

Archival DOT and O*NET Measures

We used ratings on the jobs in our sample on the data and people functions from the last version of the DOT (U.S. Department of Labor, 1991). The data function concerns information-processing or mental demands (ranging from synthesizing to comparing) and the people function concerns working with others (ranging from mentoring to taking instructions; Fine, 1955). Past research has generally shown these ratings to be reliable (Cain & Green, 1983). We did not use data from the things scale because we felt that O*NET provides better measures of those aspects of work.

The O*NET was developed by the U.S. Department of Labor as a replacement for the DOT (Peterson et al., 2001). It contains a variety of domains that describe the world of work and was designed to be applicable to all jobs. We used data from the ability, generalized work activities (GWA), and work context domains from the online O*NET database. Specifically, we used cognitive (verbal and quantitative abilities) and physical (e.g., physical strength and endurance) ability ratings. The GWA constructs are composed of a set of behaviors performed by workers. From this domain, we used information/data processing, communicating/interacting, and performing physical and manual work activities. Finally, we used physical work context, which measures environmental factors within which work occurs. Research has demonstrated the reliability and validity of these measures (Peterson, Borman, Mumford, Jeannerete, & Fleishman, 1999; Peterson et al., 2001). We selected these particular measures from O*NET because they are most closely related to the various WDQ scales.

Occupations

We created three broad occupational categories to test the occupation-focused hypotheses. First, nonprofessional occupations were composed of the jobs within the food preparation and serving-related; farming, fishing, and forestry; construction and extraction; installation; maintenance and repair; production; transportation and material moving; and military-specific occupations. In contrast, the professional occupation category was composed of the jobs in the remaining occupations. The "human life" category was composed of the jobs within the community and social services, health care practitioners and technical, health care support, and protective service occupations, whereas the "nonhuman life" category was composed of the jobs in the remaining occupations. Finally, the sales category was composed solely of the jobs in the sales occupation category.

Outcome Measures

We examined three different outcome measures. First, the job incumbents rated their own level of job satisfaction, using a 5-item scale ("Considering everything, I am satisfied with my job"; $\alpha = .86$) adapted from Campion (1988). We included a measure of satisfaction because it is the most commonly measured outcome variable in the work design area. In fact, virtually every job design study conducted has included a measure of job satisfaction (Fried & Ferris, 1987; Loher et al., 1985). We used a global measure of job satisfaction because a number of work characteristics have been thought to be related to affective reactions at work. Most work design theory hypothesizes a relationship between work design and job satisfaction and measures job satisfaction using a global measure (e.g., Campion, 1988; Campion & Thayer, 1985; Hackman & Oldham, 1975, 1980).

Second, we measured training requirements by using the job zone measure from the O*NET database. Job zone ranks occupations on the level of experience and training necessary for job success. This measure parallels the specific vocational preparation measure previously included in the DOT and has been used in several other studies (e.g., Gerhart, 1988; Hadden, Kravets, & Muntaner, 2004). Finally, following past research (Glomb, Kammeyer-Mueller, & Rotundo, 2004), we measured compensation requirements with November 2003 wage data from the U.S. Bureau of Labor Statistics. This provided an estimate of the average yearly salary within a particular job. We used the O*NET measure of training requirements and Bureau of Labor Statistics measure of compensation requirements primarily because they are external, objective measures of the relevant requirements. We chose not to ask incumbents because of potential perceptual biases and common method bias concerns. Given our focus on the job level, such external, objective measures are a strength of the current research.

Analysis Strategy

When more than one respondent held the same job, data were aggregated to the job level. Analyses at the job level are particularly important because

Table 4
Intercorrelations Among Study Variables

Construct	1	2	3	4	5	6	7	8	9	10	11	12	13
Task characteristics													
1. Work scheduling autonomy	—												
2. Decision-making autonomy	.74**	—											
3. Work methods autonomy	.79**	.78**	—										
4. Task variety	.28**	.38**	.32**	—									
5. Significance	.20**	.22**	.21**	.22**	—								
6. Task identity	.05	−.01	.02	−.12	.01	—							
7. Feedback from job	.26**	.31**	.34**	.31**	.16**	.09	—						
Knowledge characteristics													
8. Job complexity	.20**	.26**	.14*	.35**	.25**	−.10	.02	—					
9. Information processing	.38**	.44**	.27**	.45**	.42**	−.02	.21**	.58**	—				
10. Problem solving	.39**	.46**	.39**	.46**	.21**	−.19**	.20**	.42**	.45**	—			
11. Skill variety	.38**	.46**	.36**	.39**	.35**	−.01	.25**	.47**	.51**	.49**	—		
12. Specialization	.15**	.20**	.11	.22**	.50**	.16*	.23**	.29**	.41**	.20**	.50**	—	
Social characteristics													
13. Social support	.23**	.34**	.28**	.33**	.13*	.08	.34**	.08	.23**	.13*	.28**	.16*	—
14. Initiated interdependence	−.07	−.05	−.12	.12	.06	.19**	.13*	.10	.15*	.00	.01	.11	.08
15. Received interdependence	−.09	.06	−.05	.16*	.03	−.03	.09	.12	.20**	.20**	.05	.07	.22**
16. Interaction outside organization	.32**	.30**	.31**	.32**	.23**	−.26**	.15*	.22**	.33**	.26**	.22**	.11	.29**
17. Feedback from others	−.04	.10	.05	.20**	.14*	.01	.42**	−.07	.08	.07	.05	.13*	.42**
Work context													
18. Ergonomics	.33**	.30**	.34**	.14**	.23**	.01	.12	.24**	.36**	.25**	.34**	.13*	.33**
19. Physical demands	−.19**	−.16*	−.11	.00	−.06	.09	.06	−.32**	−.34**	−.11	−.17**	.03	−.06
20. Work conditions	.31**	.26**	.27**	.03	.08	−.07	.08	.15*	.28**	.19**	.22**	−.02	.24**
21. Equipment use	−.04	.01	−.04	.19**	.16*	.23**	.05	.15*	.15*	.07	.32**	.48**	.10
Outcomes and correlates													
22. Satisfaction	.47**	.53**	.44**	.23**	.33**	.13*	.22**	.23**	.38**	.28**	.45**	.35**	.43**
23. Training requirements	.12	.18*	.12	.11	.16*	−.05	.04	.39**	.33**	.30**	.34**	.28**	−.09
24. Compensation requirements	.16*	.27**	.20**	.13	.23**	−.07	.05	.37**	.37**	.21**	.37**	.26**	−.10
25. Data	.08	.17**	.20**	.02	.03	−.03	−.04	.23**	.14*	.24**	.23**	.03	.09
26. Cognitive ability	.01	.06	.02	−.01	.09	−.13	−.07	.27**	.18*	.23**	.18*	.10	−.12
27. Information GWA	.08	.17*	.10	.06	.19**	−.13	−.11	.31**	.27**	.19**	.17*	.08	−.10
28. People	.12	.24**	.22**	.12	.13*	−.16*	.15*	.16*	.12	.18**	.21**	.07	.14*
29. Communicate GWA	.05	.17*	.07	.08	.13	−.23**	.00	.12	.16*	.21**	.09	−.08	.08
30. Physical ability	−.09	−.11	−.11	−.05	−.13	−.04	.03	−.22**	−.18*	−.13	.00	.12	−.06
31. Performing physical GWA	−.10	−.07	−.13	.05	−.08	−.06	−.05	−.13	−.09	−.02	.05	.14	.03
32. Physical work context	−.18*	−.17*	−.22**	−.10	−.12	.07	−.09	−.22**	−.19*	−.19*	−.08	.11	−.09

Note. n ranges from 151 to 243. GWA = generalized work activities.
* $p < .05$. ** $p < .01$.

most work design theorizing has occurred at the job level (despite the fact that the majority of empirical tests have occurred at the individual level; Morgeson & Campion, 2003). As we specified directional hypotheses, results were interpreted with one-tailed significance tests.

Results

Construct Validity of the WDQ

We first tested Hypotheses 1–3, which concerned relationships between the WDQ constructs and archival DOT and O*NET measures. Hypothesis 1a suggested that task characteristics (i.e., autonomy, task variety, task significance, task identity, and feedback from job) would not be related to the cognitive ability-oriented descriptors (i.e., DOT data function, cognitive ability, and information- and data-processing GWA). Across these task characteristics, only decision-making autonomy ($r = .17$, $p = .01$; Table 4) and work methods autonomy ($r = .20$, $p = .002$; Table 4) were significantly related to the data function, whereas the remainder of the task characteristics ranged in absolute magnitude between .03 and .08 (mean correlation of .01). Second, none of the task characteristics significantly related to cognitive ability, with correlations ranging in absolute magnitude from .01 to .13 (mean correlation of –.02). In addition, only task significance ($r = .19$, $p = .004$) and decision-making autonomy ($r = .17$, $p = .02$) were significantly related to information- and data-processing GWA, whereas the remaining characteristics ranged in absolute magnitude between .06 and .13 (mean correlation of .00). Because the power level in our study to find a small effect size ($r = .10$) was greater than .99 (Cohen, 1988), we concluded that the lack of significance and stability across the three measures suggests that there were only limited relationships between the WDQ

14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
—																	
.56**	—																
.04	.18**	—															
.13*	.27**	.17**	—														
−.10	.00	.27**	.03	—													
.11	.08	−.11	.14*	−.57**	—												
−.05	−.08	.21**	.02	.64**	−.59**	—											
.21**	.10	−.04	.05	−.11	.26**	−.28**	—										
−.09	−.02	.24**	.08	.29**	−.05	.20**	.12	—									
−.05	−.02	.03	−.09	.19**	−.20**	.23**	.06	.18*	—								
.05	.10	.17*	−.10	.27**	−.27**	.32**	.05	.15*	.68**	—							
−.02	.09	.15*	−.08	.27**	−.18**	.30**	−.12	.15*	.40**	.35**	—						
.07	.04	.13	−.07	.17*	−.16*	.20**	.05	−.03	.53**	.54**	.27**	—					
−.05	−.07	.06	−.11	.35**	−.39**	.38**	−.13	.08	.67**	.62**	.36**	.74**	—				
−.12	−.01	.12	−.05	.23**	−.10	.22**	−.13*	.21**	.30**	.24**	.46**	.05	.16*	—			
−.11	−.04	.20*	.01	.23**	−.25**	.33**	−.23**	.01	.37**	.28**	.33**	.48**	.58**	.32**	—		
.04	−.01	−.01	.02	−.39**	.60**	−.43**	.36**	−.08	−.22**	−.10	−.30**	−.04	−.37**	−.09	−.32**	—	
.05	.05	.02	.01	−.22**	.43**	−.29**	.38**	.02	−.13	−.09	−.13	.13	−.09	−.21**	−.03	.58**	—
.12	.10	.02	−.02	−.31**	.44**	−.44**	.32**	−.12	−.18*	−.05	−.19*	.15*	−.15*	−.19**	−.05	.64**	.70**

task characteristics and cognitive ability-oriented descriptors. In total, these data support Hypothesis 1a.

Next, we tested Hypothesis 1b, which predicted that knowledge characteristics (i.e., job complexity, information processing, problem solving, skill variety, and specialization) would be related to the cognitive ability descriptors. Four of the five knowledge characteristics significantly related to data (mean correlation of .17), cognitive ability requirements (mean correlation of .19), and information- and data-processing GWA (mean correlation of .21). The exception in all cases was specialization, which averaged a nonsignificant correlation of .07 across the three outcomes. Taken together, these results indicate support for Hypothesis 1b.

Implicit in Hypotheses 1a and 1b was that knowledge characteristics would more strongly relate to cognitive ability-oriented descriptors than would task characteristics. Using the average correlations among the knowledge characteristics, task characteristics, and the three cognitive ability-oriented descriptors, we tested for the significance of difference in these correlations (Cohen & Cohen, 1983). Results of these analyses first demonstrated that knowledge characteristics were more strongly related to data than were task characteristics, $t(240) = 2.36$, $r^2 = .02$, $p = .01$. This same pattern was demonstrated with both cognitive ability requirements, $t(240) = 3.29$, $r^2 = .04$, $p < .001$, and information- and data-processing GWA, $t(240) = 2.60$, $r^2 = .03$, $p = .005$. These results indicate that knowledge characteristics were more strongly related to cognitive ability-oriented descriptors than task characteristics, further supporting Hypothesis 1.

Hypothesis 2 focused on the WDQ social characteristics and social- and interpersonally oriented descriptors. More specifically, we predicted that (a) initiated interdependence, (b) received interdependence, and (c) interaction outside the organization would be positively related to the social- and interpersonally oriented de-

scriptors (i.e., people and communicate GWA), whereas (d) social support and (e) feedback from others would be unrelated. As shown in Table 4, initiated interdependence was not related to either people ($r = –.12$, $p = .07$) or communicate GWA ($r = –.11$, $p = .14$), failing to support Hypothesis 2a. Similarly, received interdependence was not related to either people ($r = –.01$, $p = .90$) or communicate GWA ($r = –.04$, $p = .59$), failing to support Hypothesis 2b. In contrast, interaction outside the organization was significantly related to communicate GWA ($r = .20$, $p = .003$) and people ($r = .12$, $p = .04$), providing support for Hypothesis 2c. Turning to social support, we found that it demonstrated a significant relationship with people ($r = .14$, $p = .02$) but a nonsignificant relationship with communicate GWA ($r = .08$, $p = .13$), providing partial support for Hypothesis 2d. Finally, feedback from others did not demonstrate a significant relationship with either people ($r = –.05$, $p = .20$) or communicate GWA ($r = .01$, $p = .43$), supporting Hypothesis 2e.

Hypothesis 3 predicted that the work context characteristics (i.e., ergonomics, physical demands, work conditions, equipment use) would be related to the archival physical demands and work environment descriptors (i.e., physical ability, performing physical GWA, and physical work context). As shown in Table 4, all four characteristics were significantly related to physical ability, with correlations ranging in absolute magnitude from .26 to .60 and in the hypothesized directions (mean of absolute value of correlations was .45). Second, we found a similar pattern of relationships with the performing physical work GWA, with the absolute magnitude of correlations ranging from .23 to .44 (mean of absolute value of correlations was .33). Finally, the work context WDQ constructs demonstrated the hypothesized relationships with physical work context, with the absolute magnitude of correlations ranging from .31 to .44 (mean of absolute value of correlations was .38). Thus, Hypothesis 3 was fully supported.

Differences Across Occupations

Our next set of hypotheses suggested that jobs within broad occupational categories would differ on certain work characteristics. First, Hypothesis 4a predicted that the knowledge characteristics and the three dimensions of autonomy would be higher for jobs in professional occupations than jobs in nonprofessional occupations. As shown in Table 5, jobs in professional occupations had higher levels of task complexity, $t(239) = 4.37$, $r^2 = .07$, $p < .001$, information processing, $t(239) = 5.73$, $r^2 = .12$, $p < .001$, problem solving, $t(239) = 2.01$, $r^2 = .02$, $p = .05$, skill variety, $t(239) = 3.32$, $r^2 = .04$, $p = .001$, work scheduling autonomy, $t(239) = 2.90$, $r^2 = .03$, $p = .004$, decision-making autonomy, $t(239) = 3.20$, $r^2 = .04$, $p = .002$, and work methods autonomy, $t(239) = 2.05$, $r^2 = .02$, $p = .04$. However, specialization did not differ across jobs, $t(239) = .57$, $r^2 = .00$, $p = .57$. Thus, Hypothesis 4a was supported for seven of the eight hypothesized work characteristics.

Second, Hypothesis 4b predicted that jobs in nonprofessional occupations would have higher levels of physical demands and less positive work conditions than jobs in professional occupations. Table 5 shows that this hypothesis was supported, as physical demands were significantly higher for jobs in nonprofessional occupations, $t(239) = 9.68$, $r^2 = .28$, $p < .001$, and work conditions were lower for jobs in nonprofessional occupations, $t(239) = –8.32$, $r^2 = .22$, $p < .001$. Third, Hypothesis 4c predicted that jobs in "human life"-focused occupations would have higher levels of task significance than other jobs. As shown in Table 5, this hypothesis was also supported, as the jobs in "human life"-focused occupations were significantly higher on task significance, $t(239) = 3.56$, $r^2 = .05$, $p < .001$. Finally, Hypothesis 4d predicted that jobs in sales occupations would be higher on interaction outside the organization. This hypothesis was also supported, as interaction outside organization was higher for jobs in sales occupations than other jobs, $t(239) = 3.65$, $r^2 = .05$, $p < .001$.

Table 5
Means of Jobs Across Occupational Categories

Work characteristic	Occupational category	
	Professional	Nonprofessional
Job complexity	3.94	3.12
Information processing	4.42	3.81
Problem solving	3.83	3.55
Skill variety	4.30	3.98
Specialization	4.00	3.93
Work scheduling autonomy	4.00	3.58
Decision-making autonomy	4.19	3.80
Work methods autonomy	4.03	3.76
Physical demands	2.06	3.60
Work conditions	3.86	2.62
	Human life-focused	Nonhuman life-focused
Significance	4.38	3.87
	Sales	Nonsales
Interaction outside organization	4.37	3.47

Note. All means across occupational categories are significantly different except specialization.

Relationships Between the WDQ and Outcomes

Our last set of hypotheses involved exploring whether a more complex conceptualization of work characteristics might be helpful in understanding some of the common work design trade-offs. First, Hypothesis 5 predicted that both (a) task and (b) knowledge characteristics would be positively related to satisfaction, whereas only knowledge characteristics would be positively related to (c) training and (d) compensation requirements. To test this, we examined the correlations between the task and knowledge characteristics and the work outcomes. First, as shown in Table 4, the five task characteristics were all significantly related to satisfaction, ranging in magnitude from .13 to .52 (mean correlation of .29). Similarly, Table 4 demonstrates that the five knowledge characteristics were all significantly related to satisfaction, ranging in magnitude between .29 and .39 (mean correlation of .34). This indicates full support for Hypotheses 5a and 5b.

Turning to Hypotheses 5c and 5d, we see that each of the seven knowledge characteristics correlated significantly with both training requirements (*r*s range from .28 to .39, mean correlation of .33) and compensation requirements (*r*s range from .21 to .37, mean correlation of .32). In contrast, the task characteristics did not demonstrate as strong a relationship with either training or com-

pensation requirements. Both decision-making autonomy ($r = .18$, $p = .01$) and task significance ($r = .16$, $p = .01$) demonstrated significant but small relationships with training requirements. In contrast, the other three task characteristics ranged in absolute magnitude between .04 and .12 (mean correlation of .10 across all task characteristics). Similarly, decision-making autonomy ($r = .26$, $p = .001$), work methods autonomy ($r = .19$, $p = .01$), and task significance ($r = .23$, $p = .001$) demonstrated significant relationships with compensation requirements, whereas the other task characteristics ranged in absolute magnitude between .05 and .14 (mean correlation of .13 across all task characteristics). We then tested whether the average correlations across the knowledge characteristics were more strongly related to training and compensation requirements than the average correlations across the task characteristics. Results of this test showed that the knowledge characteristics were significantly more strongly related to training requirements, $t(187) = 1.98$, $r^2 = .02$, $p = .02$, than were the task characteristics, supporting Hypothesis 5c. However, the knowledge characteristics were not significantly more strongly related to compensation requirements, $t(167) = 1.31$, $r^2 = .01$, $p = .10$. Thus, these data do not support Hypothesis 5d.

Finally, Hypothesis 6 predicted that social support would (a) incrementally predict satisfaction beyond the motivational work characteristics, but that it would not be related to either (b) training or (c) compensation requirements. To test this hypothesis, we conducted a hierarchical regression, in which we first regressed satisfaction on the 10 motivational characteristics. This step explained 39% of the variance in satisfaction, $F(12, 228) = 12.21$, $p < .001$. On the second step of the regression, we added social support. This step increased the R^2 by .06, $F(1, 227) = 24.02$, $p < .001$. Therefore, our results provide strong support for Hypothesis 6a.

We tested the other two hypotheses by both examining the zero-order correlations between social support and these outcomes and by again conducting a hierarchical regression with these two other outcomes. As shown in Table 4, social support demonstrated a nonsignificant relationship with both training requirements ($r = –.09$, $p = .11$) and compensation requirements ($r = –.10$, $p = .10$). We next conducted a hierarchical regression in which training requirements were regressed on the 10 motivational characteristics. The motivational characteristics explained 23% of the variance in training requirements, $F(12, 177) = 4.52$, $p < .001$. When social support was added in the second step, it explained an additional 2% of the variance in training requirements, $F(1, 176)$ change $= 5.49$, $p = .02$. Interestingly, the sign of the beta was negative for social support, meaning that increasing the level of social support was negatively related to the amount of training necessary on the job.

We next turned to compensation requirements, conducting the same hierarchical regression. The 10 motivational traits explained 23% of the variance in compensation requirements, $F(12, 156) = 4.46$, $p < .001$. In the second step, social support once again entered negatively, explaining an additional 4% of the variance in compensation requirements, $F(1, 155)$ change $= 8.15$, $p = .005$. Taken together, these results provide some support for both Hypotheses 6b and 6c, although it appears that social support has the opposite relationship with training and compensation requirements than its relationship with satisfaction.

Discussion

In this research, we sought to develop a comprehensive work design measure by using the extant literature and adapting or creating scales to measure theoretically distinct work characteristics. The resulting WDQ was administered to 540 job incumbents in 243 different jobs. CFAs indicated support for a 21-factor solution, and psychometric analyses indicate that the scales are reliable at both the individual and job levels. The WDQ scales were related to archival DOT and O*NET measures in theoretically meaningful ways, and the WDQ was able to detect expected differences in work characteristics between occupations, providing construct validity evidence. Finally, we found differential relationships between the work characteristics and satisfaction, training, and compensation requirements. This offers some new possibilities for addressing common work design trade-offs.

An obvious question about the WDQ concerns the extent to which it is "better" than existing measures and whether it represents a distinct and new contribution to the work design area. The WDQ makes at least seven distinct contributions to work design research. First, the WDQ is the most comprehensive measure of work design currently available. As such, it represents an integration of more than 40 years of work design research into a single parsimonious measure. Recent research (Edwards et al., 1999, 2000) has shown deficiencies in even the most comprehensive measures previously available. Second, the numerous problems identified in existing measures have been corrected in the WDQ. For example, overly complex response scales and negatively worded items have been shown to create psychometric problems in the measurement of work characteristics (Harvey et al., 1985; Idaszak & Drasgow, 1987). These problems are minimized in the WDQ.

Third, the internal consistency reliability of the WDQ scales is almost uniformly high (the ergonomic factor is the sole exception; average reliability across all the scales was .87). In fact, the reliability of the WDQ scales is much higher than the reliability of the most commonly used work design measure, the JDS. Taber and Taylor (1990) meta-analytically summarized the internal consistency reliability of the JDS scales. They found that the reliabilities ranged from .65 to .70, with an average reliability of .68. Thus, the WDQ represents a considerable improvement over the JDS. Fourth, previous work design research has found inconsistent factor solutions when examining the dimensionality of work. Using CFA techniques (it is interesting to note that much of the work design research has used less rigorous EFA), we found excellent support for a 21-factor model. This not only lends support to our more complex categorization scheme, it provides a model that can guide further research and application.

Fifth, we found evidence that the WDQ scales related meaningfully with independent job-based databases. Although previous work design research also has done this, we used a more extensive and contemporary (i.e., O*NET) set of external measures. This provides needed construct validity evidence, suggesting that the WDQ can assess objective job properties (as opposed to subjective job incumbent perceptions). Sixth, the WDQ was able to identify expected differences in various occupations. This suggests that the WDQ could be helpful in differentiating among occupations when used in organizational contexts for job classification or compensation purposes. Seventh, the WDQ, and the model that underlies

it, opens new avenues for work design theory. For example, the present findings suggest that the work design trade-offs commonly observed might be avoided if certain work characteristics are emphasized. This represents a new theoretical insight that has only been speculated about in the past (Morgeson & Campion, 2002, 2003).

Implications for Designing and Redesigning Work

One of the challenges facing individuals charged with designing or redesigning work concerns the variety of changes that can be made to a job and exactly what to change to achieve different redesign goals. Because the WDQ assesses 21 distinct work characteristics, the range of design choices is much greater than those in existing measures (e.g., the JDS, Job Characteristic Inventory, MJDQ). For example, if the goal of the redesign is to increase satisfaction, a range of design options is possible. Increasing virtually any of the motivational characteristics would serve to increase satisfaction. Yet, depending on the specific choices made, the job will take on a decidedly different character. Increasing the dimensions of autonomy will produce a distinctly different job than increasing skill or task variety. Related to this, it may be that certain jobs are already high on one of the motivational characteristics and that additional increases are simply not feasible or will have negligible effects on satisfaction. The WDQ enables an assessment of these different work characteristics so a wide range of options can be considered.

Morgeson and Campion (2002) provided an example of how a tool such as the WDQ might be used to redesign work. In their redesign process, task clusters for each job were rated in terms of their motivational and mechanistic properties, as well as their interdependence. This information was a key input when decisions were made about how to reconfigure jobs. Because the WDQ provides a much wider set of work characteristics (compared with Morgeson & Campion, 2002) to consider when redesigning jobs, it potentially provides more redesign options. For example, depending on the redesign goals, task clusters can be rated on any of the 21 WDQ scales. This is likely to offer more ideas about the changes that can be made to a particular set of jobs.

Another problem often encountered when redesigning existing jobs is that some changes are simply impossible to make. For example, increasing information processing or task variety may produce job overload in already complex jobs. If satisfaction is a desired outcome, however, this research suggests that there are several design options. Given their relationships with satisfaction, increases in social support or specialization might be appropriate. Without information on these characteristics, however, such choices are unlikely to be considered. Perhaps it is not surprising that these alternative routes to satisfaction have received little research attention.

Another issue when considering work redesign concerns whether organizations actually use measures such as the WDQ when redesigning work. It may be that redesign is more organic in nature, without any systematic process. We imagine that in many instances changes in work are incremental and occur without any sort of systematic plan. In fact, some recent research has suggested that individuals do alter their roles in ways that are consistent with their skills and abilities (Morgeson, Delaney-Klinger, & Hemingway, 2005). Yet, it is also true that a number of organizations have adopted a more systematic approach and have used questionnaires such as the WDQ. For example, Campion and McClelland (1991, 1993) and Morgeson and Campion (2002) documented work redesigns that were based, in part, on questionnaire results. In addition, the JDS was explicitly forwarded as a tool that can be used in a redesign context (Hackman & Oldham, 1975). For example, Hackman and Oldham (1975) suggested that the JDS "is designed to be of use both in the *diagnosis* of jobs prior to their redesign, and in *research and evaluation* activities aimed at assessing the effects of redesigned jobs on the people who do them. We believe that use of such an instrument to diagnose the motivational properties of jobs prior to redesign should aid change agents in wisely planning and implementing work redesign projects" (pp. 159–160). We hope that the WDQ is used to enhance work redesign.

Finally, one of the challenges associated with designing or redesigning work is potential individual differences in job incumbent attitudes and values and their responses to their working environment (Campion et al., 2005). The accumulated evidence suggests that there may be some moderators of the work characteristics–outcomes relationships (Morgeson & Campion, 2003). Yet, there are at least two reasons why such differences should not pose a major obstacle to work design interventions. First, when jobs are being designed for multiple employees, it is best to focus on the average or typical employee. Tailoring jobs to the individual preferences of each current incumbent is not only costly, but the jobs may not be well suited to future incumbents with different preferences. Second, the relationships between the work design characteristics and outcomes tend to be in the same direction for all employees, even if they differ in strength between employees. For example, although some employees may respond more positively to motivational characteristics, the relationship is rarely negative. That is, typically all employees respond positively to motivating work, but some employees respond more positively than others (White, 1978).

Implications for Work Design Theory

Other findings highlight less well-studied phenomena and identify potential new areas of inquiry. For example, the notion that motivational work characteristics reflect the underlying mental demands of work was supported and refined in this study. We explicitly measured task and knowledge characteristics, which had differential relationships with archival cognitive ability measures. This contributes to work design research because it provides a more complex view of work design and suggests that future research might want to assess the ability of job incumbents and determine whether these abilities moderate the relationship between work characteristics and various outcome measures, research that has been sorely lacking up to this point (Fried & Ferris, 1987). Bringing an ability-oriented perspective to work design may prove more fruitful than previous need-based investigations (e.g., growth need strength explanations) and may add to our understanding of person–job fit (Edwards, 1991). Given recent research that shows that job incumbents change their roles in ways that are consistent with their abilities (Morgeson et al., 2005), articulating the conceptual mechanisms by which this process occurs can enhance work design theory.

In addition, a key dilemma in work design theory has been the fundamental trade-off between satisfaction and training and compensation requirements. The current research suggests a new way to resolve this trade-off. For example, the task characteristics were generally unrelated to the training and compensation requirements. If the goal of a work redesign is to increase the motivational properties without increasing the training or compensation requirements, it would be advisable to focus on those task characteristics that have the weakest cognitive ability requirements.

If it is impossible to change the task characteristics, however, another option would be to modify the social context of work. Social support showed strong incremental prediction beyond the traditional motivational work characteristics. In addition, it was negatively related to training requirements. This suggests that, in jobs in which there are opportunities for social support, the work becomes more interesting to perform with the added benefit of lower training requirements. Thus, enhancing social support in the work is likely to yield both motivational and training benefits. The identification of these work characteristics and their outcomes can inform the development of new work design theory.

Limitations

This study has at least three limitations. First, this research collected data from incumbents on both the WDQ measures and satisfaction. Using the same source of data for both work characteristics and satisfaction may inflate the relationships between them. This is unlikely to have affected our hypotheses, however, because, by definition, variance that is shared by the predictors in simultaneous regression gets attributed to neither one (Cohen & Cohen, 1983). Therefore, the observed relationships are more likely to be the result of true covariation between the constructs rather than common method bias. In addition, with the exception of the satisfaction–work characteristics relationships, all other hypothesis tests were conducted with data from independent sources.

Second, because of our sampling strategy, there are some idiosyncrasies with this sample. For example, there were a large number of managers in the sample. It is also important to recognize, however, that there are important strengths to the sampling strategy used. For example, because we sought to examine relationships at the job level, it was important to gather data on a wide variety of different jobs. Our sampling strategy ensured a considerable number of different jobs (243 different job titles). This is a greater number of jobs than virtually all previous work design studies.

Finally, because this study was primarily focused on developing and examining the construct and predictive validity of a new measure of work design, only direct relationships between the WDQ scales and outcomes were discussed. There is a history in the work design literature, however, of investigating the moderators of these relationships. Clearly, future research should examine how the relationships between the expanded set of constructs measured by the WDQ and different outcomes might be moderated by individual differences.

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Appendix

Items Used in the Work Design Questionnaire

Task Characteristics

Autonomy

Work Scheduling Autonomy

1. The job allows me to make my own decisions about how to schedule my work.[a]
2. The job allows me to decide on the order in which things are done on the job.
3. The job allows me to plan how I do my work.

Decision-Making Autonomy

1. The job gives me a chance to use my personal initiative or judgment in carrying out the work.[c]
2. The job allows me to make a lot of decisions on my own.[d]
3. The job provides me with significant autonomy in making decisions.

Work Methods Autonomy

1. The job allows me to make decisions about what methods I use to complete my work.[a]
2. The job gives me considerable opportunity for independence and freedom in how I do the work.[c]
3. The job allows me to decide on my own how to go about doing my work.

Task Variety

1. The job involves a great deal of task variety.
2. The job involves doing a number of different things.[f]
3. The job requires the performance of a wide range of tasks.
4. The job involves performing a variety of tasks.

Task Significance

1. The results of my work are likely to significantly affect the lives of other people.[b]
2. The job itself is very significant and important in the broader scheme of things.[b]
3. The job has a large impact on people outside the organization.
4. The work performed on the job has a significant impact on people outside the organization.

Task Identity

1. The job involves completing a piece of work that has an obvious beginning and end.[b]
2. The job is arranged so that I can do an entire piece of work from beginning to end.[b]
3. The job provides me the chance to completely finish the pieces of work I begin.[b]
4. The job allows me to complete work I start.[f]

(*Appendix continues*)

Feedback From Job

1. The work activities themselves provide direct and clear information about the effectiveness (e.g., quality and quantity) of my job performance.[b]
2. The job itself provides feedback on my performance.
3. The job itself provides me with information about my performance.

Knowledge Characteristics

Job Complexity

1. The job requires that I only do one task or activity at a time (reverse scored).[a]
2. The tasks on the job are simple and uncomplicated (reverse scored).
3. The job comprises relatively uncomplicated tasks (reverse scored).
4. The job involves performing relatively simple tasks (reverse scored).

Information Processing

1. The job requires me to monitor a great deal of information.
2. The job requires that I engage in a large amount of thinking.
3. The job requires me to keep track of more than one thing at a time.
4. The job requires me to analyze a lot of information.

Problem Solving

1. The job involves solving problems that have no obvious correct answer.[g]
2. The job requires me to be creative.
3. The job often involves dealing with problems that I have not met before.[g]
4. The job requires unique ideas or solutions to problems.

Skill Variety

1. The job requires a variety of skills.[a]
2. The job requires me to utilize a variety of different skills in order to complete the work.
3. The job requires me to use a number of complex or high-level skills.[b]
4. The job requires the use of a number of skills.

Specialization

1. The job is highly specialized in terms of purpose, tasks, or activities.[a]
2. The tools, procedures, materials, and so forth used on this job are highly specialized in terms of purpose.[a]
3. The job requires very specialized knowledge and skills.
4. The job requires a depth of knowledge and expertise.

Social Characteristics

Social Support

1. I have the opportunity to develop close friendships in my job.[f]
2. I have the chance in my job to get to know other people.[f]
3. I have the opportunity to meet with others in my work.[f]
4. My supervisor is concerned about the welfare of the people that work for him/her.[d]
5. People I work with take a personal interest in me.[d]
6. People I work with are friendly.[d]

Interdependence

Initiated Interdependence

1. The job requires me to accomplish my job before others complete their job.
2. Other jobs depend directly on my job.[e]
3. Unless my job gets done, other jobs cannot be completed.[e]

Received Interdependence

1. The job activities are greatly affected by the work of other people.[e]
2. The job depends on the work of many different people for its completion.[e]
3. My job cannot be done unless others do their work.[e]

Interaction Outside Organization

1. The job requires spending a great deal of time with people outside my organization.
2. The job involves interaction with people who are not members of my organization.
3. On the job, I frequently communicate with people who do not work for the same organization as I do.
4. The job involves a great deal of interaction with people outside my organization.

Feedback From Others

1. I receive a great deal of information from my manager and coworkers about my job performance.[f]
2. Other people in the organization, such as managers and coworkers, provide information about the effectiveness (e.g., quality and quantity) of my job performance.[a]
3. I receive feedback on my performance from other people in my organization (such as my manager or coworkers).

Work Context

Ergonomics

1. The seating arrangements on the job are adequate (e.g., ample opportunities to sit, comfortable chairs, good postural support).[a]
2. The work place allows for all size differences between people in terms of clearance, reach, eye height, leg room, etc.[a]
3. The job involves excessive reaching (reverse scored).

Physical Demands

1. The job requires a great deal of muscular endurance.[a]
2. The job requires a great deal of muscular strength.[a]
3. The job requires a lot of physical effort.[d]

Work Conditions

1. The work place is free from excessive noise.
2. The climate at the work place is comfortable in terms of temperature and humidity.
3. The job has a low risk of accident.
4. The job takes place in an environment free from health hazards (e.g., chemicals, fumes, etc.).
5. The job occurs in a clean environment.

Equipment Use

1. The job involves the use of a variety of different equipment.
2. The job involves the use of complex equipment or technology.
3. A lot of time was required to learn the equipment used on the job.

Taken or adapted from

[a] Campion & McClelland (1991)

[b] Hackman & Oldham (1980)

[c] Idaszak & Drasgow (1987)

[d] Karasek et al. (1998)

[e] Kiggundu (1983)

[f] Sims, Szilagyi, & Keller (1976)

[g] Wall, Jackson, & Mullarkey (1995)

Received March 17, 2005
Revision received October 2, 2005
Accepted November 9, 2005 ■