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MINIMIZING TRADEOFFS WHEN REDESIGNING WORK: EVIDENCE FROM A LONGITUDINAL QUASI-EXPERIMENT

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Although cross-sectional job design research highlights a tradeoff between motivational and mechanistic work design, the redesign literature is more equivocal. We develop a work redesign process that suggests the tradeoffs can be minimized if both motivational and mechanistic approaches are explicitly considered when work is designed and the ultimate outcomes of the design effort (e.g., satisfaction, efficiency, or both) are taken into account when work is redesigned. In a longitudinal quasi-experiment, we examined how jobs can be differentially changed in terms of their motivational and mechanistic properties. Results showed at least partial support for all expected relationships. This suggests that the tradeoffs previously considered inherent in job design may not always occur, particularly if conceptual and methodological consideration is given to their minimization.

Although work design enjoys a long and diverse history in the applied realm, the bulk of research in industrial-organizational (I-O) psychology has not reflected this diversity, instead focusing almost exclusively on motivational issues (e.g., job characteristics theory; Hackman & Oldham, 1980). This motivational approach is limited, however, because it only considers a narrow set of work design factors and ignores mechanistically oriented approaches that have focused on such things as work simplification and specialization. This omission is all the more glaring because much of modern work design practice is largely based on mechanistic design principles (Morgeson & Campion, in press; Wall & Martin, 1987).

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Because of the relatively parochial nature of work design research in I-O psychology, only recently have fundamental tradeoffs between different approaches to job design been acknowledged (Campion, 1988; Edwards, Scully, & Brtek, 1999). This research has found that motivational and mechanistic approaches are at odds. For example, if the motivational properties of work are improved, satisfaction with the work increases, but the efficiency with which work is performed (an important outcome of mechanistic approaches) tends to decrease. Other research has found these tradeoffs, but finds that they do not always occur (Campion & McClelland, 1993) or only occur in certain circumstances (Edwards, Scully, & Brtek, 2000).

Unfortunately, no research has directly tested whether these tradeoffs can actually be minimized or whether satisfaction and efficiency-oriented outcomes can be independently influenced. We address these gaps in the literature by suggesting that the tradeoffs can be minimized if jobs are redesigned in certain ways, both motivational and mechanistic approaches are explicitly considered when work is designed, and the ultimate outcomes of the design effort (e.g., satisfaction, efficiency, or both) are taken into account when work is redesigned. We investigated this possibility by redesigning computer information systems jobs according to one of three design goals: (a) increasing both motivational and mechanistic aspects of work; (b) increasing only motivational aspects of work; and (c) increasing only mechanistic aspects of work. We then examined changes over time in these groups across several dependent measures in a 2-year longitudinal, quasi-experimental study at a large pharmaceutical company.

This study contributes to the work design literature in four ways. First, it is the only redesign study that simultaneously examines both motivational and mechanistic work design approaches. Previous redesign research has tended to focus on motivational or mechanistic redesign, but not both. Second, the vast majority of work design research has been cross-sectional in nature. The quasi-experimental design of the present study adds value because it shows how actual changes to jobs impact a variety of outcome measures. Third, the redesign research that has been conducted has generally used relatively short-term evaluations (e.g., 6 months). The current research investigates redesign changes over a 2-year period. Finally, the jobs in the current study are high-skill, knowledge-work jobs. As such, they are reflective of the shift away from manufacturing-based organizations where goods are produced using physical labor to knowledge-based organizations where services are provided through mental effort. This is different from the bulk of the work redesign literature that has primarily focused on manufacturing and entry-level jobs.

Understanding Motivational and Mechanistic Design Tradeoffs

Perhaps the first attempt to systematically design jobs utilizing scientific principles occurred in the early part of the 20th century through efforts such as those by Taylor (1911) and Gilbreth (1911). These mechanistically oriented approaches focused on principles such as specialization and simplification as a means of easing staffing difficulties and lowering training requirements. Partly as a reaction to the reductionistic nature of mechanistic job design, and partly as an acknowledgment of human potential and higher order needs, organizational theorists described job characteristics that could enhance worker satisfaction and provide for intrinsic needs (e.g., Herzberg, Mausner, & Snyderman, 1959; Likert, 1961; McGregor, 1960). This became manifested in a motivationally oriented approach that identified a set of core job characteristics that determined the motivational nature of jobs (e.g., Hackman & Oldham, 1975; Hulin & Blood, 1968). Interestingly, this motivational approach has tended to completely ignore mechanistic approaches and the consequences of focusing solely on motivational issues.

Campion (1988, 1989; Campion & McClelland, 1991; Campion & Thayer, 1985) and Edwards et al. (1999, 2000) have provided evidence that mechanistically oriented job designs are associated with efficiency-related outcomes, whereas motivationally oriented job designs are associated with satisfaction-related outcomes. In addition, these two designs typically show strong negative relationships to each other (Campion, 1988; Campion & Thayer, 1985). That is, if a job possesses efficiency-related characteristics, it is unlikely to also possess satisfaction-related characteristics. This evidence has led to the advice that job designers should be cognizant of the inherent tradeoffs and conflicts among these different approaches (Campion, 1988).

The initial research that uncovered the satisfaction/efficiency dilemma, however, was cross sectional in nature. As such, this literature could not provide conclusive evidence with respect to what happens when jobs are specifically constructed according to the theoretical principles of these forms of job design. To understand what happens when jobs are actually changed, it is necessary to examine research that involves work redesign.

A number of field studies of job redesign interventions have appeared in the organizational psychology literature. These attempts can be classified into two broad categories, those that attempted to enhance motivational design and those that had other purposes. In virtually all of these studies, however, evaluation was focused primarily on motivational features of work and its associated benefits (i.e., satisfaction).

The bulk of the evidence suggests that when interventions are guided by motivational approaches, job satisfaction increases (e.g., Graen, Scandura, & Graen, 1986; Griffeth, 1985; Griffin, 1983; Hackman, Oldham, Janson, & Purdy, 1975; Ondrack & Evans, 1986). When interventions are not guided by the motivational approach, they tend to follow the principles of the mechanistic approach via efficiency-oriented changes in equipment or operating procedures. These efforts generally have negative or no effects on job satisfaction (e.g., Billings, Klimoski, & Breaugh, 1977; Hackman, Pearce, & Wolfe, 1978; Oldham & Brass, 1979).

Extending this research, Campion and McClelland (1991) conducted quasi-experimental research into the effects of motivational job design on satisfaction- and efficiency-related outcomes. They found that when jobs were enlarged, they had better motivational design and worse mechanistic design (Campion & McClelland, 1991). This resulted in greater employee satisfaction, greater chances of catching errors, and better customer service. At the same time, however, enlarged jobs also resulted in higher training requirements, higher basic skills, and higher compensable factors. This evidence tended to confirm that of the cross-sectional research; motivational job design increases satisfaction, but decreases efficiency outcomes.

In a 2-year follow-up, Campion and McClelland (1993) found that motivational and mechanistic job design were not always negatively related. That is, in some cases, they are both positively related to the same outcomes. This unexpected finding led to the recommendation that attempts should be made to "develop a theory or a technology to minimize tradeoffs and maximize the benefits of all models" of job design (Campion & McClelland, 1993, p. 350). The present research builds on this research by developing and empirically testing a work redesign process that seeks to achieve these goals.

Redesigning Work to Minimize Tradeoffs

The present study outlines a 4-stage work redesign process that describes how work might be redesigned to minimize the tradeoffs commonly observed in work design. As such, this provides a general description of how work can be redesigned for others to use or modify as needed. Following this, we describe why such a process is likely to work and outline a set of research questions.

A Work Redesign Process

Defining task clusters. The work redesign process begins by selecting a practically useful level of analysis. Although there are many possible levels (e.g., task, duty, or job levels), only the job level has been used in published research. For example, Hackman and Oldham (1980) suggested that redesign efforts should focus on such characteristics as the amount of autonomy, variety, and feedback involved in the job. One drawback to the use of this level is that it does not provide a fine-grained enough unit of analysis when making changes to jobs. That is, jobs as a whole are changed, and this may serve to exacerbate the tensions between different work design models because it is difficult to make subtle changes to jobs.

To address this weakness, we adopted task clusters as the level of analysis (Cascio, 1995). Task clusters are the smallest collection of logically related tasks that are normally performed by a single person such that they form a whole or natural work process. In this regard, task clusters possess four distinguishing features. First, they are usually larger than a task and smaller than a duty. We found that it took from 8 to 17 task clusters to adequately describe a job. Second, task clusters constitute a set of activities or tasks that are typically and most effectively performed by one person. Third, task clusters are comprised of a complete and identifiable piece of work and otherwise recognized by job incumbents as constituting a natural work process. Finally, task clusters are composed of interdependent tasks that cohere in a meaningful manner. One advantage of using task clusters as the unit of analysis is that once they are defined, they can be combined or grouped in many different ways so that alternative job configurations can be evaluated. In the current redesign effort, once task clusters were defined for each job, multiple configurations were considered prior to finalizing the job redesign.

Quantifying the task clusters. Once task clusters are defined, the next step involves quantifying them into metrics that facilitate redesign efforts. Although there are a potentially large number of ways to quantify task clusters, we identified at least four as being important in this context. The first involves quantifying the units with respect to their motivational and mechanistic properties. This provides a mechanism whereby multiple job design models can be explicitly considered. For example, if one wishes to consider both satisfaction- and efficiency-oriented outcomes, it is necessary to rate the units of work in terms of their motivational (e.g., autonomy, significance, feedback) and mechanistic (e.g., specialization, simplification) properties. Doing this helps enhance outcomes important to the redesign project and also helps identify potential tradeoffs. By understanding the tradeoffs, it may be possible to minimize them.

A second way to quantify task clusters involves ratings on the interdependencies among the clusters. The amount of interdependence provides important information about the extent to which the performance of one cluster influences the performance of other clusters, particularly in terms of such things as work flow, information needs, and implications for quality. Interdependence can increase motivational characteristics such as identity and feedback and mechanistic characteristics such as specialization and repetition. Research has shown, however, that from a motivational point of view, a moderate amount of interdependence is optimal, primarily because excessively high interdependence may make a job overly narrow and mechanized (Wong & Campion, 1991).

A third way to quantify task clusters involves ratings on the extent to which clusters from other jobs should be integrated into the focal job. Key considerations involve whether integrating the task clusters might improve the focal job in terms of such factors as increases in satisfaction, efficiency, or interdependence. The other jobs to rate might include those in the work area or others that are linked to the focal job in terms of work flow, work process, customer, department, resources, and so on. This aspect of the redesign process highlights the value of redesigning multiple jobs in a work area rather than a single job in isolation.

A fourth way to quantify task clusters involves ratings on whether the clusters should be kept as part of the job or assigned to another job (or not performed at all). This provides a means of jettisoning task clusters that are inefficient, unsatisfying, or simply do not make sense to be included given the work processes or interdependencies inherent in the job. If task clusters should be assigned to another job, it is usually important to identify which other job should perform the task cluster or the skill level required of the other job that would perform the cluster.

Reconstructing jobs. The third component of our work redesign process involves taking the task clusters and reconstructing the jobs. Combining the task clusters back into jobs is accomplished by simultaneously considering the quantitative information, the goals of the redesign project, recommendations of subject matter experts, and logical analysis. That is, alternative job configurations are proposed and scrutinized that are likely to enhance the job characteristics rated (e.g., either motivational design, mechanistic design, or both), that are composed of task clusters that are at least moderately interdependent, and that consider pulling in (or reassigning) task clusters from other jobs. Critical to the reconstruction process is the idea that there exists a central contribution or purpose for each job. This "core" is commonly identified based on the initial task clusters assigned to the job. The job can then be reconstructed around this core. It is important to emphasize that this reconstruction process is guided by both quantitative (e.g., considering the ratings of the task clusters) and qualitative (e.g., considering redesign goals and the central purpose of a job) information.

Evaluating the jobs. The fourth component of our work redesign process involves evaluating the reconfigured job. The nature of this evaluation differs from the previous quantification of task clusters because it is focused at the job level. This evaluation may consist of collecting both quantitative and qualitative information, but should minimally include judgments on the dimensions used to quantify the task clusters (e.g., motivational and mechanistic design principles). This information is most helpful if it can be compared to prejob change measures because it helps to determine whether the project was successful as well as to provide feedback on which to base iterative improvements in the jobs.

Understanding the Mechanisms Underlying the Work Redesign Process

The preceding discussion highlights an overall process by which work can be redesigned to consider multiple job design models and minimize tradeoffs. However, it only indirectly describes the reasons why this process might help one minimize the tradeoffs. There are at least three reasons why this work redesign process might actually work. First, the task cluster level of analysis provides a level of specificity heretofore unseen in the work redesign literature. This enables those making redesign decisions to understand both the motivational and mechanistic elements of work and take this into account when making changes to jobs. Recent research by Edwards et al. (2000) has shown why this is the case.

Using confirmatory analyses, Edwards et al. (2000) found that the negative relationship typically observed between motivational and mechanistic approaches is often due to a negative relationship between skill usage and task simplicity. As task simplicity increased, skill usage decreased, leading to the common tradeoffs between motivational and mechanistic design. But they also found that task simplicity and specialization, two key components of a mechanistic approach, were negatively related. This suggests that different aspects of mechanistic approaches are not necessarily consistent with one another. For example, task specialization may actually require high levels of certain skills. Thus, it may be possible to minimize the common tradeoffs by increasing task specialization because it makes work more efficient as well as increases skill utilization (which makes work more motivating). It would be impossible to redesign work in this way, however, if job-level data (instead of task clusters) were used to plan changes to jobs.

Second, when reconstructing jobs, the goals of the job redesigners are one of the primary influences on the ultimate configuration of the job. That is, the character of the final job is driven by the intentions of those charged with reconstructing the jobs. These intentions are due, at least in part, to the current state of the jobs as well as broader strategic goals. This can be thought of as a functional approach to job design, where job designers specify the outcomes wanted, and then make redesign choices to achieve those outcomes (Morgeson & Hofmann, 1999). Starting with the outcomes of satisfaction and efficiency at the outset of the design process might enable different design considerations.

Third, if the goal of a redesign effort is to maximize both motivational and mechanistic job design, then one is attempting to balance two competing demands or resolve inherent tensions in work design. This is similar to the tensions identified in sociotechnical systems theory, which suggested that optimal organizational functioning would occur only if the social and technical systems were designed to fit each other (Cherns, 1978). Analogously, we suggest motivational and mechanistic tradeoffs can be minimized if both aspects are taken into account when work is redesigned and the two fit each other. If motivational or mechanistic job elements are emphasized to the exclusion of the other, imbalances occur, resulting in the tradeoffs noted earlier.

Research Questions

By employing the methodology outlined above, we sought to investigate what happens when jobs are redesigned in accordance with different job design theories. This implies three job redesign groups, which form the basis for the empirical tests reported in the current study. In the first redesign group, we sought to increase both mechanistic and motivational design. *We hypothesize that focusing on both aspects of job design will* lead to increases in job satisfaction, a common benefit of motivational job redesign, but will have no effect on training requirements or work simplicity, two benefits of mechanistic design. Thus, we expect the first job redesign group to experience the positive benefits of motivational design but not its tradeoffs.

In the second job redesign group, we sought to increase only motivational job design. We hypothesize this will increase job satisfaction and reduce work simplicity, but will also increase training requirements. Thus, we expect the second job redesign group to experience the positive benefits of motivational job redesign but also to encounter the common tradeoffs that manifest themselves in terms of increased amounts of training needed to perform the job.

In the third job redesign group, we sought to increase only mechanistic job design. We hypothesize this will reduce training requirements but also will increase work simplicity. Thus, we expect the third job redesign group to experience the positive benefits of mechanistic job design but also to encounter the common tradeoffs (from the motivational perspective) that manifest themselves in terms of increased boredom and little job variety.

To summarize, these three job redesign groups should evidence very different patterns of relationships with the various outcome measures, depending on their initial redesign goals. The first redesign group is not expected to display the common job design tradeoffs, whereas the other two redesign groups are expected to display these tradeoffs. To minimize or create these tradeoffs, we propose that motivational and mechanistic job design can be jointly increased, or influenced independently of one another.

Method

Setting and Research Strategy

The organization was a large pharmaceutical company. The department of interest was responsible for managing the data that results from clinical trials of new drug compounds. The jobs involved collecting, cleaning, loading, analyzing, and reporting data from clinical trials for eventual submission to the Food and Drug Administration and other regulatory bodies.

The study provides a pretest with multiple posttests quasi-experiment with three groups: employees in jobs that were redesigned to improve both motivational and mechanistic design, employees in jobs that were redesigned to improve only motivational design, and employees in jobs that were redesigned to improve only mechanistic design. The jobs were assigned to each condition based on a host of department and organizational goals. For example, some of the jobs in this organization had extensive contact with medical doctors who conduct the clinical drug trials. There had been concerns that contact with these important external customers had not been as effective as possible. As such, these jobs were redesigned in order to increase the customer service by enhancing the efficiency of the interaction with these customers. As another example, the organization sought to centralize some of the major data analysis functions to make the loading of data more efficient (and reduce the amount of time it took to analyze clinical drug trial data). This broad organizational initiative drove the redesign of these jobs.

Thus, there were multiple reasons jobs were assigned to the different redesign groups. It should be noted, however, that pretest scores were not formally used to assign jobs to redesign conditions (the data was only used to suggest changes after jobs were assigned to groups) and the job incumbents were not involved in this assignment process. All jobs were assessed at the beginning of the redesign project prior to any changes. The first posttest occurred 1 year after the work design changes and the second posttest occurred 2 years after the work design changes. Thus, there are pretest, Year 1 posttest, and Year 2 posttest assessments.

Jobs Studied and Sample

Seven different information systems jobs were studied, whose job titles at pretest were: data entry analysts, personal computing tools and programming analysts, reporting analysts, statistical analysts, product analysts, team leaders, and project leaders. Sample sizes were: pretest $n = 63$, Year 1 posttest $n = 72$, Year 2 posttest $n = 96$. Response rates averaged approximately 80% for the first two data collections and 90% for the Year 2 posttest. The larger sample size at the Year 2 posttest was partly due to the higher response rate, but also due to the fact that the department had increased in size. Statistical power to detect a significant R^2 in the regression analysis was 35% for a small effect ($R^2 = .0196$, $p < .05$) and 99% for a medium effect ($R^2 = .13, p < .05$; Cohen, 1988). Although statistical power for any particular mean comparison would be lower, generally speaking we had traditionally acceptable levels of power (80%) for effect sizes in the small to medium range.

Measures

The measures were taken from the Multimethod Job Design Questionnaire (MJDQ; Campion, 1988). These measures have demonstrated adequate psychometric qualities in a number of previous studies (e.g., Campion, 1988; Campion & McClelland, 1991, 1993; Edwards et al., 1999, 2000). To assess the design of work itself, shortened versions of the motivational (5 items; e.g., "This job allows autonomy or freedom in terms of methods, sequencing, or decision making; The job is important to the mission of the organization") and mechanistic scales (5 items; e.g., "The job is quite simple and uncomplicated to perform; The job allows efficiency gains through repetition") were used. It is important to note that these questions focused on evaluations of the job itself, and not on how the incumbent feels about the job. All items were rated on a 5-point response scale ranging from 5 = *strongly agree* to 1 = *strongly disagree*.

To assess the work design outcomes, overall job satisfaction (7 items; e.g., "I feel a great sense of personal satisfaction when I do my job well; Considering everything, I am satisfied with my job"), training requirements (3 items; e.g., "How much on-the-job training would it take the average employee to learn this job"), and work simplicity (3 items; e.g., "How often do you have too little to do") were measured. Job satisfaction was rated on a 5-point response scale ranging from 5 = *strongly agree* to 1 = *strongly disagree*, training requirements was rated on a 5-point response scale with several different anchors, and work simplicity was rated on a 5-point response scale ranging from 5 = *daily* to

1 = *never/almost never*. Scores were averages of applicable items, with larger values indicating more of the relevant variable.

Table 2 contains the internal consistency (Cronbach's alpha) and interrater reliability (ICC[2]; Bartko, 1976) estimates for the study variables at each measurement occasion. Internal consistency reliability estimates are all above .62, with average reliability of .79 (using Fisher's transformation) over all measures and measurement occasions. This 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 reliability estimates are also uniformly high and significant with one exception. Summing across measurement occasions and scales yielded an average interrater reliability of .81. Thus, as a set, the reliabilities were judged to be adequately high.

Work Redesign Procedures

Six steps were undertaken in redesigning these jobs. First, a pilot study was conducted to assess whether the project plan would be likely to work in this organizational context. This involved focus groups and interviews with managers and samples of employees in which the major issues and challenges facing the organization were reviewed. Special emphasis was given to the strategies and objectives of the organization, and how the redesign could enhance them. This helped establish the specific redesign goals for different jobs. For example, some of these information systems jobs had become overly complex and the organization sought to simplify them to reduce staffing requirements. Existing job analysis data were also compiled to provide input into the redesign project and to help define the units of work. In particular, work flow analyses that mapped the major business processes were made available to assist in the redesign.

Second, a steering committee was established and a series of meetings were held with subject matter experts (SMEs) from each job title to define the task clusters. Existing job analysis data were used in conjunction with SME judgments to identify and refine the task clusters. This resulted in 8 to 17 task clusters for each job. The task clusters were defined to be understandable to the employees (see Table 1 for examples). These meetings also involved initial brainstorming discussions of possible changes to the jobs.

Third, SMEs rated each of the clusters for their particular job ("focal job"). This included ratings on the task clusters' motivational aspects, mechanistic aspects, the interdependence between a given cluster and all other clusters in the focal job, what task clusters from other jobs

TABLE 1

Example Task Clusters

- Validate and document requirements with data management and others in cluster.
- Obtain peer review and migrate to production.
- Develop data access strategy and identify macros that would need to be used.
- Build and test new modules.
- Communicate changes to medical training, users, and management.
- Consult with others regarding the creation of new tables or making modifications to existing tables.
- Validate data design with both data and process customers.
- Design conversion of logical to physical model including evaluating alternatives and compromises.
- Consult on the database management system technology.
- Investigate methods for increasing efficiency of global process.
- Gather requirements and develop document of understanding.
- Support internal and external customers.
- Develop desktop tool training.
- Identify and communicate team resource requirements.
- Identify, facilitate, and support process improvements.

TABLE 2

Means, Standard Deviations, Internal Consistency Reliabilities, Interrater Reliabilities, and Intercorrelations on Measures at Pretest and Posttest

Outcome measure	*M*	*SD*	Internal consistency[a]	Interrater reliability[b]	1	2	3	4
			Pretest (n = 63)					
1. Motivational design	3.75	.87	.87	.87**	–			
2. Mechanistic design	2.43	.62	.62	.81**	−.05	–		
3. Overall job satisfaction	3.34	1.00	.94	.75**	.81**	.06	–	
4. Training requirements	3.29	1.96	.80	.92**	.42**	−.46**	.42**	–
5. Work simplicity	2.08	1.02	.78	.82**	−.66**	.06	−.66**	−.45**
			Posttest[c] (n = 168)					
1. Motivational design	3.75	.67	.74	.74**	–			
2. Mechanistic design	2.69	.59	.63	.86**	−.35**	–		
3. Overall job satisfaction	3.77	.72	.90	.43	.76**	−.17	–	
4. Training requirements	3.34	.90	.72	.92**	.33*	−.52**	.19*	–
5. Work simplicity	1.98	.88	.71	.77**	−.59**	.33**	−.56**	−.36**

[a] Cronbach's alpha.
[b] Intraclass correlation.
[c] Combining data across two posttest measurement occasions.
*$p < .05$ **$p < .01$, one-tailed.

should be included in the focal job, and what task clusters should be removed from the focal job. It is important to note that these ratings were collected only to guide the redesign process. As such, they are only indirectly related to the actual changes made to the jobs. The jobs as a whole were also rated in terms of the outcome measures identified above, and these constituted the pretest measures.

Fourth, after the data were collected, redesign meetings were held with incumbents in order to evaluate the data and determine potential changes to the jobs. Fifth, teams were formed that planned and implemented the changes. Sixth, two follow-up surveys of the outcomes were made at yearly intervals to evaluate the changes that had been made.

Examples of Changes Made to Jobs

The preceding discussion outlines the process that was followed to plan and implement changes to the jobs. We now provide an example of how the jobs were changed in each of the three redesign groups. Four jobs were redesigned to increase both motivational and mechanistic job design (project leaders, team leaders, statistical analysts, personal computing tools and programming analysts). For example, statistical analysts conducted a variety of analyses of clinical trial data and acted as an internal resource for other groups. Unfortunately, this job was slotted between two other roles, resulting in low task identity. In addition, the job lacked task significance because employees felt they added little value to the department. In terms of efficiency, because the work activities were so fragmented, it was difficult to have any kind of standard operating procedures. This also hindered the attempts to provide training. To address these issues, it was decided to increase both motivational and mechanistic design.

This was accomplished in the following ways. First, it was decided to take several roles and combine them into a centralized function. This involved integrating task clusters from a number of similar jobs. Within this centralized function, employees would take on distinct roles based on their expertise and skill sets. In effect, this redesign increased efficiency by centralizing the function and creating specialized roles within this function. Yet, it would also increase the motivational properties of work because employees would be able to focus in great depth in an area of expertise and then be considered the expert in a particular area. This created ownership for such things as process improvements and problem solutions, thereby increasing task identity and significance.

One job was redesigned to increase motivational job design (data entry analysts). This job involved defining several different systems used in the collection and entry of data collected in clinical trials. This job was generally viewed as too routine and demotivating, so the decision was made to increase its motivational properties. Ten existing task clusters were retained in the job, and 3 were added. The 10 that were retained involved relatively routine data entry tasks. The 3 that were added, however, all involved participating in the creation, modification, design, or implementation of data entry systems. These were clearly higher-level, more involving and autonomous activities. Because autonomy is one of the key elements of motivational design, it was expected these additions would positively impact the motivational properties of work.

Two jobs were redesigned to increase mechanistic job design (product analyst, reporting analysts). These jobs encountered the greatest number of changes in terms of modification to the task clusters. For example, reporting analysts designed, developed, and generated statistical reports to be used by a wide variety of internal customers and external regulatory bodies. Prior to the redesign, these jobs were viewed as being complex and performed in a difficult environment. There were many sources of inefficiency in these jobs. The department was inexperienced, with a number of lower tenure employees. This was coupled with the fact that there was a relatively long learning curve in this job (6 months to a year). In addition, the technical environment was diverse (both PCs and mainframe computers were used), there were limited opportunities to receive developmental coaching, and when an employee switched from working on one drug compound to another, there was a large learning curve (i.e., much of the existing knowledge failed to transfer from one drug to another).

Given these issues, it was decided to redesign the work to increase the efficiency with which it is performed. This was accomplished by focusing the job on the central purpose of the role—designing, developing, validating, and maintaining the reports. Eleven task clusters were retained that pertained to these activities. Four task clusters were eliminated, and they primarily revolved around actually running the reports on a day-to-day basis. Thus, such time-consuming activities as accessing and extracting data, running production reports, and delivering reports were shifted out of this role.

Results

Descriptive Statistics

Table 2 contains the means, standard deviations, and intercorrelations for the study variables at the pretest and posttest measurement occasions (the two posttest measurements were combined for analysis purposes). Motivational design was positively correlated with overall job satisfaction and training requirements and negatively correlated with work simplicity. Mechanistic design was generally unrelated to overall job satisfaction, negatively related to training requirements, and positively related to work simplicity. Finally, the relationship between motivational and mechanistic design was nonsignificant at the pretest, and moderately negatively related at posttest. These bivariate relationships across job redesign groups are consistent with prior cross-sectional research that has found evidence for common job design tradeoffs. The critical question for the present research, however, is whether these tradeoffs occur when jobs are explicitly designed to minimize them.

Tests of Hypotheses

Multiple regression analyses were conducted to test the formal hypotheses. Because we are concerned with changes between the pretest and posttest time periods, we compared the Time 1 responses to the average of Time 2 and 3 responses for each of the job redesign groups. Averaging across the two posttest occasions provides the most accurate estimate of pre- to posttest change. This was accomplished by contrast coding the job redesign groups over the three time periods. To do this, five orthogonal contrasts (see Hardy, 1993; Pedhazur, 1982) were created and simultaneously entered into the regression equation for each of the dependent measures. The significance test of the β-weight for a particular contrast can then be unambiguously interpreted as the significance of pretest to posttest mean change (Cohen & Cohen, 1983).

Table 3 contains the means, standard deviations, and sample sizes for the job redesign conditions on the motivational and mechanistic design measures at the pretest and posttest measurement occasions. This table highlights whether motivational and mechanistic job design can be jointly and independently increased. In the first redesign group, we sought to increase both motivational and mechanistic job design. Inspection of Table 3 reveals that motivational job design increased, but this was not statistically significant ($\beta = .03, ns$). Mechanistic design did significantly increase ($\beta = .11, p < .05$), with the mechanistic design measure increasing over time.

In the second redesign group we sought to increase only motivational job design. There were substantive increases in motivational design ($\beta = .16, p < .01$) and no change in mechanistic design ($\beta = .01, ns$), as expected. In the third redesign group we sought to increase only mechanistic job design. As expected, there was a significant increase in mechanistic design ($\beta = .19, p < .01$). There was also a decrease in motivational job design ($\beta = -.25, p < .01$), indicating the presence of work design tradeoffs. In total, this evidence suggests that it is possible to

TABLE 3

Means, Standard Deviations, and Sample Size on Motivational and Mechanistic Job Design Variables for Job Redesign Groups at Pretest and Posttest

		Design characteristics			
		Motivational design		Mechanistic design	
Job redesign group		Pretest	Posttest+	Pretest	Posttest+
Group 1: Increased motivational and mechanistic design	*M*	3.75[a]	3.88[a]	2.28[a]	2.50[b]
	SD	.83	.69	.63	.53
	N	31	64	31	64
Group 2: Increased motivational design	*M*	2.71[a]	3.68[b]	3.20[a]	3.17[a]
	SD	.70	.61	.54	.54
	N	9	23	9	23
Group 3: Increased mechanistic design	*M*	4.17[a]	3.65[b]	2.33[a]	2.71[b]
	SD	.61	.66	.36	.57
	N	23	81	23	81

Note: Different subscripts for job redesign group means within a given design characteristic indicate statistically significant pre- to posttest differences ($p < .05$).

+ Combining data across two posttest measurement occasions.

increase either motivational or mechanistic job design, but more difficult to increase both.

Table 4 contains the means, standard deviations, and sample sizes for the job redesign conditions on the overall satisfaction, training requirements, and work simplicity measures at the pretest and posttest measurement occasions. This table highlights whether the manner in which the jobs were redesigned resulted in the tradeoffs typically observed. In the first redesign group, we expected increased overall job satisfaction and no changes in training requirements and work simplicity. Examination of Table 4 reveals a significant increase in overall job satisfaction ($\beta = .17, p < .01$). There was a slight increase in training requirements ($\beta = .06$) and slight decrease in work simplicity ($\beta = -.09$), but neither was statistically significant. This provides support for the notion that it may be possible to minimize some of the tradeoffs commonly encountered in job design research.

We expected the second job redesign group to increase in overall job satisfaction and training requirements as well as a decrease in work simplicity. Examination of Table 4 reveals that job satisfaction ($\beta = .22$, $p < .01$) and training requirements ($\beta = .11$, $p < .05$) significantly increased. Although the mean level of work simplicity substantively decreased, it failed to achieve conventional statistical significance levels ($\beta = -.08, p < .09$). In total, however, the second job redesign group demonstrated the common job design tradeoffs.

We expected the third job redesign group to decrease in training requirements but increase in work simplicity. Consistent with this, train-

TABLE 4

Means, Standard Deviations, and Sample Size on Overall Job Satisfaction, Training Requirements, and Work Simplicity for Job Redesign Groups at Pretest and Posttest

		Work design outcomes					
		Overall job satisfaction		Training requirements		Work simplicity	
Job redesign group		Pretest	Posttest+	Pretest	Posttest+	Pretest	Posttest+
Group 1:	*M*	3.31[a]	3.87[b]	3.33[a]	3.63[a]	2.11[a]	1.77[a]
Increased motivational and	*SD*	.98	.67	.89	.87	.94	.88
mechanistic design	*N*	31	64	31	64	31	64
Group 2:	*M*	2.52[a]	3.89[b]	1.83[a]	2.79[b]	2.85[a]	2.19[a]
Increased motivational	*SD*	1.18	.64	.77	.71	1.27	.93
design	*N*	9	23	9	23	9	23
Group 3:	*M*	3.69[a]	3.65[a]	3.80[a]	3.27[b]	1.75[a]	2.09[b]
Increased mechanistic	*SD*	.78	.77	.97	.88	.87	.85
design	*N*	23	79	23	81	23	79

Note: Different subscripts for job redesign group means within a given work design outcome indicate statistically significant pre- to posttest differences ($p < .05$).
+Combining data across two posttest measurement occasions.

ing requirements significantly decreased following redesign ($\beta = -.19$, $p < .01$) and work simplicity significantly increased ($\beta = .13, p < .05$). This evidence suggests that this redesign group also experienced the tradeoffs commonly observed in job design research.

Supplemental Analyses

As discussed in the limitations section below, there are some potential selection and statistical regression threats to the internal validity of this study. To investigate these issues, a number of supplemental analyses were conducted. In terms of selection, four different individual-level variables were examined to determine if the composition of the redesign groups differed (i.e., whether the respondent worked for the company or was a contractor, whether the respondent participated in the pretest survey, whether the respondent participated in the Year 1 posttest survey, and how long the respondent had worked in the company). We investigated potential mean differences among the redesign groups at the Year 1 posttest and the Year 2 posttest (data on these variables were unavailable for the pretest). There was only one significant difference. Specifically, at the Year 2 posttest, there were more contractors in Group 2 than the other two groups. This evidence, coupled with the other study design factors outlined earlier, suggests that individuals were not assigned differentially to redesign conditions and that selection threats are minimal.

To investigate potential regression effects, we estimated true scores for each respondent across the five dependent measures. To do this, we first standardized the observed scores within each redesign condition across time. Each standardized score was then multiplied by the square root of the reliability (which is the correlation between true and observed scores; see Ghiselli, Campbell, & Zedeck, 1981). This produces an estimated true z-score (Nunnally & Bernstein, 1994). These estimated true scores were then used as dependent variables in the regression equations. This provides a stringent test of regression effects because the estimated true scores have the same mean across time (via standardization) and measure unreliability is taken into account. Regression to the mean would be present if the pre- to posttest differences that were significant with observed scores were eliminated when estimated true scores were used.

This analysis indicated that all hypothesized changes that were found to be statistically significant with observed scores continued to be statistically significant (and in the correct direction) when estimated true scores were used. In fact, this additional analysis yielded only one different result. Specifically, when using estimated true scores, it was found that the first job redesign group decreased in work simplicity following the work redesign. We expected to find no change in work simplicity, so this additional analysis suggests that perhaps some tradeoffs were observed. Notwithstanding this result, however, it appears that regression to the mean is not responsible for the bulk of the current findings.

Discussion

Overall, the results provide partial support for the work redesign process outlined earlier. It appears that this process may help begin to minimize some of the tradeoffs so often observed in the work design literature. The differential predictions, quasi-experimental design, and longitudinal nature of the data collection help strengthen the results.

To summarize the results, the group whose jobs were redesigned to increase in motivational and mechanistic design experienced increases in overall satisfaction and few changes in training requirements or work simplification. This suggests that redesigning work with the goal of increasing both motivational and mechanistic design may help job designers minimize the satisfaction/efficiency tradeoff commonly observed in these forms of job design. It should be acknowledged, however, that this group did not report a concomitant increase in motivational design. Although this may have indicated that the motivational properties of work were unaffected by the redesign, this group did experience a significant increase in job satisfaction, a critical outcome of motivational design. Recent work by Edwards et al. (1999) suggests that the failure to observe an increase in motivational design could be due to measurement problems with our motivational design measure. Because the original MJDQ scales do not factor out along the lines suggested here (Edwards et al., 1999, found that a 10-factor solution was most appropriate) and we used a reduced set of the original MJDQ scales, it is likely that a more factorally pure measure of motivational design would have shown differences. Research is clearly needed to further refine the MJDQ.

In addition, mechanistic design increased over time. It could be that the efficiency-related effects were delayed in this context. Because much of the previous job redesign research fails to measure the job over an extended period of time, the delayed nature of these effects may be unrecognized.

The group whose jobs were redesigned to increase motivational design experienced increases in overall satisfaction and training requirements, and some decreases in work simplification. The group whose jobs were redesigned to increase mechanistic design experienced decreases in training requirements and increases in work simplification. As such, these groups evidenced the tradeoffs typically observed in work design, and showed that it is possible to independently increase the motivational or mechanistic design properties of work.

Limitations in the Quasi-Experimental Design

As noted and investigated in the Results section, there are potential selection and statistical regression threats to the internal validity of the present quasi-experimental design. In terms of selection, it was not possible to randomly assign employees to redesign conditions. In addition, because surveys were administered anonymously, individual-level responses could not be matched over time. This leaves open the possibility that the results may be due to systematic differences between employees on some unmeasured variables. Such selection threats, however, are mitigated by several other features of the study. First, individual employees could not choose which condition to be assigned, thus avoiding self-selection biases. Second, an examination of a range of possible membership variables, such as tenure and employment status, revealed no consistent differences among the three conditions in terms of their composition.

Third, the differential predictions for improvements in some measures and not others help rule out simple Hawthorne effects and some other potential threats to internal validity (Cook & Campbell, 1979). Simple demand effects are unlikely because the incumbents did not know the condition they were in, and they would likely inflate all measures and not show a differential pattern if demand effects were operating. Fourth, due to the widespread use of job rotation in this organization, any selection threat would be substantially diluted. That is, of the employees participating at the Year 1 posttest, only 35% also participated in the pretest, and of the employees participating at the Year 2 posttest, only 27% also participated in the pretest and only 53% also participated in the Year 1 posttest. Thus, the respondents are quite different at each time period, which should reduce the potential for selection and Hawthorne effects. Fifth, incumbents were informants about the job, not the object of the study themselves. They were primarily asked to provide ratings about the job, not about themselves. This is routinely done in job analysis research where aggregated incumbent responses are used as the best available measure of a job's standing on a wide range of constructs (Morgeson & Campion, 1997). The generally high levels of interrater reliability discussed earlier provided evidence for the appropriateness of grouping individual responses to the job level.

In terms of statistical regression, it is possible that certain jobs may have been assigned to a redesign condition because they are low on either motivational or mechanistic design. The pattern of results appears to suggest that this may have occurred. If this was the case, observed improvement may reflect regression to the population mean. There are three reasons why this is not likely to have happened in the present study. First, because regression is more likely to occur when measures are unreliable (Cook & Campbell, 1979), the fact that the measures used in the present study demonstrated adequate reliability lessens the possibility of regression effects.

Second, the supplemental analyses where estimated true scores were used as dependent measures in the regression analyses show no support for regression to the mean. Third, and perhaps more importantly, when discussing questions of research design and internal validity in quasi-experimental settings, an issue often neglected is that there may be good reasons why a redesign condition may evidence low pretest scores. That is, one of the goals of any work redesign effort is to improve the characteristics of work, particularly for jobs that are poorly designed. What may be interpreted as regression may be real (and intended) change.

Implications

There are several implications of this research for the theory and practice of work design. In terms of practice, this research affirms the utility of adopting an interdisciplinary perspective on work design. Only by explicitly acknowledging multiple work design models can redesign efforts begin to independently effect these different aspects of jobs, thus potentially minimizing inherent tradeoffs by achieving multiple benefits and minimizing costs.

In terms of theory, this research introduces several new concepts and techniques that broaden our conceptualization of work design. First, the task cluster concept provides an intermediate level of abstraction that lies between the task and job levels. As the building blocks of jobs, task clusters are amenable to analysis and reconfiguration and supply a level of detail that is useful for redesign purposes. Second, the explicit consideration of interdependencies is important because this information reflects phenomena that exist between the task clusters. As a result, this information cannot be obtained by an examination of the task clusters in the abstract. To fully understand a job, it is thus necessary to understand its constituent parts as well as the interdependencies that exist among them.

Third, in suggesting that all jobs have a central purpose or "core," we have provided a mechanism for beginning the actual redesign process as well as highlighting the fact that all jobs have a particular function or contribution in the context of the wider system. More specifically, when jobs are initially designed, they commonly fulfill a specific need or function. Over time, many duties, responsibilities, and tasks get added to the job, often in a piecemeal and unsystematic fashion. This can result in inefficiencies in the job, redundancies with other jobs, dissatisfied incumbents, and difficulties in staffing and training. By specifying, clarifying, or updating the original function of the job at the start of the redesign effort, it may be possible to eliminate the inefficiencies and rekindle the motivational aspects at the same time. The reinvented job can then be "built up" around these essential functions, purposes, or contributions.

Fourth, the identification of a functional approach to job design provides some insight into how tradeoffs can be minimized. This approach suggests that job redesigners should first specify the desired outcomes of the redesign process. Identifying these outcomes becomes important because there are innumerable ways to redesign work, yet only a handful of important outcomes. In the present study, there were three distinct groups, each with different redesign goals. Redesigners can use these goals as guidelines when making redesign choices. This allows flexibility in the configuration of task clusters because the specific form of the job changes are important only in so far as they assist in achieving the desired outcome.

Finally, the principle of joint optimization borrowed from sociotechnical systems theory suggests that balance in job design is key to minimizing tradeoffs. We found that when both motivational and mechanistic approaches were considered, tradeoffs were lessened. When one or the other form of job design was emphasized, tradeoffs emerged. Although it may not be possible to maximize both (as indicated by our results), a compromise approach may be most appropriate.

In conclusion, it is hoped that this study will stimulate a renewed interest in conducting and evaluating work redesign projects. Organizations continue to design and redesign work, but often in the absence of scientifically grounded principles. The work design process outlined here can help practitioners and scholars understand how to go about redesigning work and explicitly take into account different job design models when attempting to manage the tradeoffs that can occur.

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