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Development and Field Evaluation of an Interdisciplinary Measure of Job Design

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The development of an interdisciplinary job design questionnaire and a study of its interrelationships with a variety of outcomes is described. A taxonomy of job design approaches was developed from literature of different disciplines: (a) a motivational approach from organizational psychology; (b) a mechanistic approach from classic industrial engineering; (c) a biological approach from work physiology and biomechanics; and (d) a perceptual/motor approach from experimental psychology. The Multimethod Job Design Questionnaire (MJDQ) was developed reflecting these approaches. A corresponding taxonomy of job outcomes was developed, and hypotheses were generated as to relationships between job design approaches and outcomes. A field study involved 121 jobs, 215 incumbents, and 23 supervisors from five plants. Results indicated the MJDQ was reliable, and most hypotheses were supported. Different job design approaches influence different outcomes and may have some costs as well as benefits; an interdisciplinary perspective is needed to integrate major theories of job design.

Even a cursory examination of the job design literature reveals many different schools of thought: industrial engineering approaches of scientific management and time and motion study, the psychological approaches of job enrichment and motivating job characteristics, the human factors or ergonomics approaches, and sociotechnical approaches to job design. Although there is some overlap in the recommendations made for proper job design, there is considerable divergence in focus and even some direct conflict in advice. Proponents, however, claim that their job designs positively influence most of the outcome spectrum for both the individual and the organization.

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The present study addresses this confusion by pulling together the diverse literature on job design, delineating major approaches, and demonstrating that each approach is geared toward a particular subset of outcomes. More specifically, this study (a) develops a job design taxonomy, (b) develops a corresponding job outcome taxonomy, (c) develops measures that reflect the design taxonomy, (d) develops measures which reflect the outcome taxonomy, and (e) evaluates differential predictions of job design–outcome relationships in a field setting.

Taxonomy of Job Design Approaches

The first step was to consult the literature and extract specific job design rules. Nearly 700 job design rules resulted, suggesting adequate coverage of the content domain. Rules were then sorted into fairly homogeneous groups based on underlying theoretical perspectives. Similar rules were combined into a principle that summarized their main content. Principles were written to represent the consensus from the literature, each reflecting common content from a large number of specific rules. They were also broad enough to be applicable across diverse jobs, yet specific enough to allow objective and quantifiable judgments about jobs. The end product was four sets of principles, each set constituting a job design approach.

The content coverage of the resulting sets of principles appeared adequate because of the variety of literature consulted, the number of job design rules discovered, the fact that only two percent of the rules could not be grouped into design approaches, and the fact that only 11% of the rules could not be combined into the job design principles. Reproducibility was assessed by having a naive judge reclassify the principles back into job design approaches, resulting in 83.8% agreement.

The four job design approaches that emerged are described below.

Motivational

This approach came from literature on job enrichment and enlargement (Ford, 1969; Herzberg, 1966, 1968; Hulin and Blood, 1968; Mayer, 1971; Walters, 1975), research and reviews on characteristics of motivating jobs (Griffin, 1982; Hackman & Lawler, 1971; Hackman & Oldham, 1980; Pierce & Dunham, 1976; Turner & Lawrence, 1965), instruments used to measure jobs' motivating features (Hackman & Oldham, 1975; Jenkins, Nadler, Lawler, & Cammann, 1975; Sims, Szilagyi, & Keller, 1976), theories of work motivation and organizational behavior (Argyris, 1964; Likert, 1961; McGregor, 1960; Mitchell, 1976; Steers & Mowday, 1977; Vroom, 1964), texts in industrial and organizational psychology (Cascio, 1978; Dunnette, 1976; Wexley & Yukl, 1977), and psychological principles from sociotechnical design approaches (Cherns, 1976; Engelstad, 1979; Rousseau, 1977). The 16 principles extracted are contained in Table 1. The main discipline base is organizational psychology.

Mechanistic

These principles were extracted from classic texts on scientific management (F. Taylor, 1911) and motion study (Gilbreth, 1911), two main handbooks of industrial engineering (Ireson & Grant, 1971; Maynard, 1971), and texts by other writers on time and motion study, work simplification, and specialization (Barnes, 1980; Konz, 1979; Mundel, 1970; Nadler, 1963). The 13 principles are in Table 2. The discipline base is classic industrial engineering. "Classic" is used because many modern day writers on industrial engineering address a variety of job design approaches (e.g., Konz, 1979).

Biological

This approach derives from a book on biomechanics (Tichauer, 1978), articles on posture (Ayoub, 1973; Floyd & Ward, 1966; Grandjean & Hunting, 1977; Van Wely, 1970) and lifting strength (Chaffin, 1974; Park & Chaffin, 1975; Snook & Irvine, 1967), books

Table 1
Descriptions, Means, Standard Deviations, and Item-Total Correlations on the Items in the Motivational Job Design Scale

Description	*n*	*M*	*SD*	*r*[a]
1. Autonomy, responsibility, vertical loading	121	3.16	.94	.74
2. Intrinsic job feedback	121	3.79	.72	.43
3. Extrinsic job feedback	121	3.22	.82	.76
4. Social interaction	121	3.16	.76	.38
5. Task/goal clarity	121	4.06	.47	.19
6. Task variety, horizontal loading	121	2.84	.96	.56
7. Ability/skill requirements and variety	121	2.64	.87	.82
8. Task identity	121	3.31	.94	.71
9. Task significance	121	3.07	.96	.81
10. Growth, learning, advancing responsibility	121	2.95	.90	.67
11. Promotion	121	3.07	.94	−.69
12. Achievement	121	3.05	.70	.73
13. Participation	121	2.86	.85	.83
14. Communication	121	2.89	.67	.68
15. Pay adequacy	121	3.20	.40	.18
16. Job security	121	3.05	.67	.68
Total score[b]	121	3.15	.48	.89[c]

[a] Item–total correlations. All correlations significant at $p < .05$.
[b] Based on average of all items per job.
[c] Coefficient alpha (Cronbach, 1951).

on work physiology (Astrand & Rodahl, 1977) and anthropometry (Hertzberg, 1972; Roebuck, Kroemer, & Thompson, 1975), ergonomic texts that cover many approaches including the biological approach (e.g., Grandjean, 1980), and industrial engineering texts, which include sections on biological approaches (H. Davis & Miller, 1971; Konz, 1979). The 18 principles composing this approach are contained in Table 3. The discipline bases are the biological sciences, especially work physiology, biomechanics, and anthropometry.

Table 2
Descriptions, Means, Standard Deviations, and Item-Total Correlations on the Items in the Mechanistic Job Design Scale

Description	*n*	*M*	*SD*	*r*[a]
1. Task fractionalization/specialization	121	3.77	1.02	.73
2. Specialization of materials, tools, procedures	121	3.98	.77	.52
3. Task simplification	121	3.82	1.01	.50
4. Skill simplification	121	3.60	1.00	.47
5. Repetition/pacing	121	3.67	.96	.60
6. Idle time/capacity	121	3.74	.96	.26
7. Motion economy—materials handling	78	3.88	.79	.55
8. Motion economy—prepositioning of materials, tools	70	4.00	.72	.78
9. Motion economy—eye and head movements	106	2.81	1.03	.46
10. Motion economy—muscle movement	107	3.28	.84	.29
11. Motion economy—muscle rhythm	73	3.85	.49	.54
12. Motion economy—muscle movement style	74	3.66	.71	.45
13. Mechanization	117	2.86	.84	−.15
Total score[b]	121	3.55	.48	.82[c]

[a] Item-total correlations. Items with missing data estimated as mean of applicable items for each job and included in the calculations. All correlations significant at $p < .05$.
[b] Based on average of applicable items per job.
[c] Coefficient alpha (Cronbach, 1951).

Table 3
Descriptions, Means, Standard Deviations, and Item-Total Correlations on the Items in the Biological Job Design Scale

Description	*n*	*M*	*SD*	*r*[a]
1. Seating	121	3.02	1.14	.69
2. Tool design	15	3.33	.49	.92
3. Anthropometry	121	3.29	.68	.57
4. Static effort	121	3.47	.91	.67
5. Endurance	121	3.26	.85	.75
6. Strength	121	3.28	.78	.53
7. Lifting	121	3.31	.88	.56
8. Posture, lower back	121	2.92	.98	.77
9. Muscular adequacy	119	3.60	.73	.71
10. Wrists	121	2.95	1.09	.58
11. Stress concentration	121	3.20	.70	.70
12. Vibration	121	3.11	1.05	.19
13. Noise	121	2.69	.89	.59
14. Climate	121	1.70	.82	.55
15. Atmosphere	121	2.90	.92	.30
16. Worker protection—safety	121	4.15	1.10	.49
17. Work breaks	121	3.40	.69	.31
18. Shift work	121	3.85	.56	−.15
Total score[b]	121	3.18	.52	.86[c]

[a] Item-total correlations. Items with missing data estimated as mean of applicable items for each job and included in the calculations. All correlations significant at $p < .05$.
[b] Based on average of applicable items per job.
[c] Coefficient alpha (Cronbach, 1951).

Perceptual/Motor

Relevant literature includes the many handbooks on human engineering (McCormick, 1976; Morgan, Cook, Chapanis, & Lund, 1963; Van Cott & Kinkade, 1972; Woodson, 1954, 1981; Woodson & Conover, 1964), a text that deals with many aspects of human factors or ergonomics (Grandjean, 1980), literature on skilled performance (Kahneman, 1973; Welford, 1976), and theoretical treatments of people as information processors (Fogel, 1967; Gagne, 1962; Goodstein, 1981; Rasmussen, 1981). The 23 principles are in Table 4. The base is experimental psychology.

Taxonomy of Job Outcomes

A taxonomy of job outcomes was developed from the literature to correspond to the taxonomy of job design approaches. An examination of the content of each approach, the dependent variables used in research, and the underlying theories revealed that each approach was actually geared toward a specific category of outcomes. Each outcome category was fairly cohesive and homogeneous, representing a common theme or purpose. The four categories of job outcomes are described below with illustrative measures of each.

Table 4
Descriptions, Means, Standard Deviations, and Item-Total Correlations on the Items in the Perceptual/Motor Job Design Scale

Description	*n*	*M*	*SD*	*r*[a]
1. Workplace lighting—general	121	3.22	.57	.37
2. Workplace lighting—glare/contrast	121	3.22	.58	.33
3. Control and display identification	84	3.15	.90	.56
4. Display visibility/legibility	42	3.64	.58	.60
5. Displays—information content	42	4.05	.31	.62
6. Control/display movement relationships	81	3.52	.62	.54
7. Control/display ratios	75	3.71	.56	.42
8. Control resistance/feedback	79	3.54	.57	.54
9. Controls—accidental activation	85	2.54	.89	.48
10. Controls—anthropometry/biomechanics	82	3.40	.78	.53
11. Controls—motion economy	83	3.80	.60	.35
12. Warning devices	11	3.82	.41	.81
13. Printed job materials	29	3.90	.31	.71
14. Panel layout	76	3.28	.74	.46
15. Input requirements	121	3.38	.76	.56
16. Output requirements	121	3.36	.78	.63
17. Information processing requirements	121	3.66	.82	.46
18. Memory requirements	121	3.85	.91	.34
19. Boredom	121	3.00	.85	−.05
20. Arousal	121	3.16	.83	.37
21. Stress	121	3.05	.93	.58
22. Workplace layout—safety	121	2.73	.95	.40
23. Workplace layout—visual and auditory links	121	3.22	.65	.65
Total score[b]	121	3.36	.36	.85[c]

[a] Item-total correlations. Items with missing data estimated as mean of applicable items for each job and included in the calculations. All correlations, except for item 19, significant at $p < .05$.
[b] Based on average of applicable items per job.
[c] Coefficient alpha (Cronbach, 1951).

Satisfaction

This category refers to affective, motivational, or attitudinal outcomes from work such as job satisfaction, job involvement, and intrinsic work motivation. It includes certain behavioral indexes such as job performance and absenteeism.

Efficiency

This category refers to human resource efficiency and flexibility. Measures include estimates of utilization levels or the percentage of people who could perform the job. Other measures include estimates of training time and measures estimating idle time on the job.

Comfort

This category includes most of the physical well-being outcomes. Measures include subjective effort, physical fatigue, comfort, health records, and health complaints, such as reports of back problems, muscle strain, and hearing loss.

Reliability

This category may seem less obvious than the others. It refers to safety, system reliability, and user reactions to equipment, facilities, or workplaces. System safety variables such as accident rates and accident-prone situations (Swain, 1973), as well as medical data on injuries, are included. System reliability is reflected in measures of error rate or error-likely situations (Swain, 1973). Another common theme is user reaction toward the system as to work overload or underload, mental fatigue or task aversion (Bartley and Chute, 1947), and attitudes toward equipment.

Hypotheses

The motivational job design approach is predicted to correlate most positively with the satisfaction outcome category, as it was originally derived from that literature. On a speculative basis, the motivational approach may correlate negatively with the efficiency outcome category, because more motivating and satisfying jobs often involve higher skill levels and more responsibility and thus would exhibit lower utilization levels and increased training time. The motivational approach is not logically expected to correlate with the other two outcome categories.

The mechanistic job design approach is predicted to correlate most positively with the efficiency outcome category, because the primary goals of classic industrial engineering practices were economic. It is also speculated that the mechanistic approach may correlate positively with the reliability category due to its concern with safety and reliability. The mechanistic approach is expected to correlate negatively with the satisfaction and comfort categories because of the overwhelming evidence on the negative attitudinal and health consequences of mechanistically designed work (e.g., Caplan, Cobb, French, Van Harrison, & Pinneau, 1975; Frankenhaeuser, 1977; Johansson, Aronsson, & Lindstrom, 1978; Karasek, 1979; Kornhauser, 1965; Salvendy & Smith, 1981; Shepard, 1969, 1970; Walker & Guest, 1952; Weber, Fussler, O'Hanlon, Gierer, & Grandjean, 1980).

The biological job design approach is clearly most concerned with the physical well-being of the worker and thus is predicted to correlate most positively with the comfort outcome category. The approach may also be positively correlated with all the other categories because healthier and more comfortable workers may be more satisfied, efficient, and reliable.

The perceptual/motor approach is predicted to correlate most positively with the reliability outcome category. The primary goal is to enhance the person–machine fit by attending to people's perceptual/motor capabilities and limitations, thus preventing errors and accidents and reducing boredom and task aversion. Positive user regard is another indication that this match has been achieved. Positive, or at least nonnegative, correlations will exist with the other categories because good person–machine fit might enhance other attitudinal outcomes, efficient human resource utilization, and effort or comfort.

Support for convergent and discriminant validity (Campbell & Fiske, 1959) of the main hypotheses will be indicated if each job design approach is more positively correlated with that one outcome category than the others. Support for directional, speculative hypotheses will come from relationships in the predicted direction or near zero relationships; relationships in the direction opposite to that predicted will indicate lack of support.

Method

Sample

Power analysis (Cohen, 1977) suggested a sample of 112 jobs to detect a minimum correlation (between job design scales and outcomes) of .30 with desired power of .90. The actual sample of jobs was 121, representing a complete census of hourly production jobs in five Southern wood products operations of a large company: a plywood plant (40 jobs), a sawmill (33 jobs), a fiberwood plant (25 jobs), a wood treatment (e.g., landscape timber) facility (14 jobs), and a merchandiser (i.e., log sorting/grading) facility (9 jobs). In terms of Equal Employment Opportunity (EEO) codes, the jobs were 23 skilled/craft, 63 semiskilled/operative, 34 unskilled labor, and 1 clerical. Pay ranged from \$5.25 to \$9.18 per hour (M = 6.19, SD = .98).

Data were collected from two incumbents for 94 of the jobs and from one incumbent for the remainder. Thus, the sample of job incumbents was 215. They were 77.2% male, 69.8% black, 29.3% white, and .9% Hispanic. Median age was 29.9 years (range = 19 to 63), median education was 11.9 years (range = 2 to 15), median company tenure was 5.7 years (range = .5 to 17), and median job tenure was 1.5 years (range = .1 to 12.5).

Data were also collected from two supervisors for 97 of the jobs and from one supervisor for the remainder. Because each supervised many jobs, this resulted in data from 23 different supervisors. They were 87.0% male, 30.4% black, and 69.6% white. Median age was 38.5 years (range = 27 to 58), and median tenure as a supervisor was 9 years (range = 2 to 17).

Job Design Measurement

A number of methodological issues contributed to measurement decisions. First, an observational approach was chosen because self-reports are susceptible to method bias (Pierce & Dunham, 1976; Roberts & Glick, 1981) and many forms of perceptual biases (Caldwell & O'Reilly, 1982; O'Reilly & Caldwell, 1979; O'Reilly, Parlette, & Bloom, 1980; Shaw, 1980). Second, 5-point rating scales were anchored with verbal descriptions, definitions, or examples to enhance interrater reliability. Anchor descriptions used adjectives whose psychophysical values aided discriminability (Bass, Cascio, & O'Connor, 1974). A 3-point relevance rating was also included for each item, and a space for comments permitted justification of borderline ratings.

Because additive models are as good as or better than multiplicative models for combining job design elements (Pierce & Dunham, 1976), and unit weighting is generally preferable to differential weighting schemes (Einhorn & Hogarth, 1975; Wainer, 1976), scores on job design principles were summed to form a composite within each job design approach.

In summary, the job design analysis instrument is applicable to a wide range of jobs. It has four sections, one for each approach, and is completed by an analyst at the job site based primarily on observations. Scale points are anchored, and total scores for scales are simple sums.

An illustrative item from each of the four sections is contained in the Appendix. The complete 70-item instrument is entitled the Multimethod Job Design Questionnaire (MJDQ).[1]

In a pilot study, two experienced analysts completed MJDQs on 30 diverse jobs. Each job was observed for 15 to 30 min with occasional informal questioning of the worker about less observable job aspects (e.g., infrequent tasks). Questionnaires were then completed independently. Interrater reliabilities on the total scale scores ranged from .89 ($p < .001$) to .93. Mean agreement between raters across scales ranged from .12 to .17 on the 5-point scale.[2]

Job Outcome Measurement

Multiple indexes were included for each outcome category, and data were collected from a variety of sources. Interviews were used to collect much of the data in order to ensure thoughtful answers, minimize missing data, and eliminate problems arising from the reading-level abilities of some respondents. Multiple sources included incumbents, supervisors, and archival records. An attempt was made to collect data from all three sources for each outcome category. Two incumbents and two supervisors were interviewed in most cases to reduce idiosyncratic biases. Questions were as objective as possible, and descriptive anchors defined most rating scales. Finally, outcome measurement was guided by the literature in each of the job design areas.[3]

Job incumbent interview. Pilot work indicated that question complexity had to be appropriate to a wide range of educational backgrounds and communicable in noisy and distracting work sites. Questions could not be of a threatening nature (e.g., too efficiency oriented) if honest answers were desired.

A 23-item interview was developed. Six attitudinal items assessed three of the constructs in the satisfaction outcome category: two each on job satisfaction (Brayfield & Rothe, 1951), intrinsic work motivation (Hackman & Lawler, 1971), and job involvement (Lodahl & Kejner, 1965). Four items assessed constructs in the efficiency category: two on estimates of utilization levels (i.e., percentages of people who could perform the jobs), one on training time, and one on idle time on the job. Five items measured constructs in the comfort category: one each on physical effort (Borg, 1962) and physical fatigue (Kinsman & Weiser, 1976), two on various forms of discomfort (e.g., backaches), and a checklist of health complaints (Corlett & Bishop, 1976). Finally, eight items addressed the reliability category: two on the accident proneness of the job (Swain, 1973), one on error-likelihoods (Swain, 1973), three on work overload/underload (Ivancevich & Matteson, 1980; McCormick, 1976), one on mental fatigue (Pearson, 1957), and one on attitudes toward equipment (Bare, 1966).

Supervisor interview. Information was collected from supervisors because they have observed many different incumbents in each job, can better see interrelationships between jobs, and are not threatened by job evaluation questions. Because each was to evaluate many jobs, the interview was kept short by including only one or two global questions for each outcome category. Many questions took advantage of the supervisor's unique position by asking for relative comparisons between jobs.

The supervisor interview contained 10 questions. Two were checks to eliminate recently changed jobs and inexperienced supervisors. Neither was encountered. Ratings were included for each of the four outcome categories. One assessed job performance as part of the satisfaction category. The four items on efficiency asked of the incumbent were also in the supervisor interview. One overall item on physical demands was included for the comfort category. Finally, two scales, one on mental demands and another on error likelihoods, were included for the reliability category.

Archival data. Absenteeism is an archival measure in the satisfaction category. Based on a review of problems with this type of data (e.g., Hammer & Landau, 1981), information was collected on occurrences absent (Mdn = 2.5 per 12 months, range = 0 to 8.9), days absent (Mdn = 4.2 per 12 months, range = 0 to 31.8), and partially missed work days (Mdn = 1.6 per 12 months, range = 0 to 5.4). It was not possible to distinguish voluntary from involuntary absences due to recordkeeping differences among plants. Data were collected for the previous 18 months and only on employees with at least 6 months job experience (n = 169).

Medical data related to both the comfort and reliability categories. Because of recordkeeping differences between plants, only the total number of medical incidents was recorded per employee for the entire job tenure, excluding those with less than 6 months tenure (n = 169, Mdn = .5 per 12 months, range = 0 to 2.7).

Procedure

Measures were typically obtained in one department at a time until the plant was completed. The study was explained to managers and hourly employees through production or safety meetings, followed by a tour of the department with the supervisor. Next an MJDQ was completed on each hourly production job based primarily on observation, with occasional informal questioning. It was completed before the outcome interviews to avoid experimenter bias. Usually the two incumbents and supervisors were from different shifts. To ensure thoughtful answers, considerable time was spent becoming familiar with the respondents and explaining that the study was not company sponsored. Archival data were collected from personnel and medical records just before the researchers left the plant.

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[1] The MJDQ is available in M. A. Campion, M.A. (1985): The multimethod job design questionnaire (MJDQ). *Psychological Documents, 15* (1) or from the first author.

[2] Reliability and agreement analyses on individual items are available from the first author.

[3] Copies of all measurement protocols are available from the first author.

Results

Analyses of Measures—Job Design

Tables 1 through 4 indicate that most items on the MJDQ are applicable to most jobs. There is substantial variance; no range restriction is apparent. All but four of the item-total correlations are positive and significant, and internal consistencies are in the .80s across the scales. Table 5 presents the intercorrelations among the job design scales.

Analysis of Measures—Outcomes

The 35 job outcomes showed reasonable variance and no severe restriction.[4] Two composites of the outcome items were formed to allow a simplified presentation of the results. First, an intercorrelated subset of items from each category of the outcome taxonomy was formed into a composite via standardized equal weighting. These composites are referred to as the theoretical composites. Internal consistencies are as follows: Satisfaction (5 items, alpha = .69), Efficiency (6 items, alpha = .72), Comfort (5 items, alpha = .66), and Reliability (8 items, alpha = .67). Intercorrelations are displayed in Table 6.

The second data-reduction approach was to factor analyze the entire set of outcome items using varimax rotation. Five factors, explaining 78.3% of the variance, emerged with eigenvalues exceeding 1.0. Factor scores were calculated and given descriptive labels. Their correlations with the theoretical composites are in Table 7. Notice that the Mental Ease, Physical Ease, and Attitude Favorability factors are nearly identical to the Efficiency, Comfort, and Satisfaction theoretical composites, respectively. The Absenteeism factor is made up of the absenteeism items from the satisfaction category that were not included in the Satisfaction composite. The Nonstressfulness factor is composed mostly of a few items (e.g., work overload) from the Reliability composite.

Table 5
Intercorrelations Among the Total Scores of the Job Design Scales

	Motivational	Mechanistic	Biological
Mechanistic	−.69*		
Biological	.33*	−.06	
Perceptual/ Motor	−.29*	.21*	.47*

Note. $n = 121$ * $p < .05$.

Table 6
Intercorrelations Among the Theoretical Job Outcome Composites

	Satisfaction	Efficiency	Comfort
Efficiency	−.21*		
Comfort	.27*	−.12*	
Reliability	.09	.58*	.26*

Note. $n = 206$ * $p < .05$.

Tests of Hypotheses

The two incumbents and supervisors for each job were randomly assigned to two samples so that each analysis could be cross validated. A sample of averaged responses was also formed. Hypotheses were tested on both samples and the averaged sample. Coefficients of congruence (Wrigley & Neuhaus, 1955) between the results in the two samples and the averaged sample range from .96 to .99. Thus, only the results for the averaged sample are presented. Furthermore, each hypothesis was tested with the individual items, the theoretical composites, and the factor scores. Again, because the results are so highly consistent in terms of direction and magnitude, only those for the theoretical composites are presented.[5]

Table 8 contains the correlations between the job design scales and the theoretical composites. Correlations relevant to the main hypotheses are in the diagonal from top left to bottom right. All these correlations are positive and significant as predicted. Regarding the speculative hypotheses (off-diagonal), the results in Table 8 are consistent for the Mechanistic, Biological, and Perceptual/Motor scales but not entirely as expected for the Motivational scale. It exhibits a very strong,

[4] Descriptive statistics and intercorrelations among the outcome items are available from the first author.
[5] Analyses with individual outcome items and factor scores and analyses using the cross-validation samples are available from the first author.

Table 7
Correlations Between the Theoretical Job Outcome Composites and the Factor Scores of the Job Outcomes

	Theoretical composite			
Factor score	Satisfaction	Efficiency	Comfort	Reliability
Mental Ease	−.18*	.94*	−.03	.66*
Physical Ease	.14*	−.02	.90*	.24*
Attitude Favorability	.96*	−.17*	.16*	.07
Absenteeism	−.03	.00	−.04	−.02
Nonstressfulness	.14*	.06	.21*	.52*

Note. $n = 169$. * $p < .05$.

negative correlation with the Efficiency composite, positive correlation with the Comfort composite, and negative correlation with the Reliability composite.

Archival measures were not included in the theoretical composites but did correlate with the job design scales. Occurrences absent correlated negatively (i.e., fewer absences) with the Motivational (ave. r via z transformation = −.31) and Biological (ave. $r = -.25$) scales, but positively with the Mechanistic (ave. $r = .23$) scale. Medical incidents correlated negatively (i.e., fewer incidents) with the Biological (ave. $r = -.35$) and Motivational (ave. $r = -.23$) scales.

It was also predicted that each job design scale would relate to its corresponding outcome category more strongly than to any other. Table 8 reveals some clear exceptions, especially for the Motivational and Perceptual/Motor scales and the Efficiency and Reliability composites.

Correlations between the job design scales and the factor scores were also computed.[5] If the Mental Ease, Physical Ease, and Attitude Favorability factors can be equated with the Efficiency, Comfort, and Satisfaction composites, respectively, the results are essentially the same as in Table 8. The Absenteeism factor shows the same pattern of correlations as did the individual items, and the Nonstressfulness factor shows no consistent correlations.

Because this study examinees the relationship between two sets of variables, a canonical correlation analysis was conducted (Darlington, Weinberg, & Walberg, 1973; Harris, 1975). This analysis is an overall multivariate test of the hypothesis that the job design scales are significantly related to the outcomes (Harris, 1975). Table 9 shows that two large, significant canonical correlations resulted. Two common traits or links best explain the relationship between the job design scales and the theoretical outcome composites.

The correlations with the canonical variates indicate which variables contribute most to the links (Cooley & Lohnes, 1971; Darlington et al., 1973; Levine, 1977; Meredith, 1964). In terms of the items that make up the outcome composites, the first canonical variate shows that jobs low on the Motivational scale but high on the Mechanistic and Perceptual/Motor scales tend to have high utilization levels, low training times, low error likelihoods, and low mental demands. Also, these jobs may produce less satisfaction and less physical comfort. Thus, this first link seems to reflect the mental demands of the job, and it is the largest of the two links.

The second canonical variate taps a physical demands link. The largest correlation on the independent variable side is for the Biological scale, and the largest correlation on the dependent variable side is for the Comfort composite.

Canonical analyses with the factor scores strongly supports the speculation that the first canonical variate taps a mental demands link, whereas the second taps a physical demands link.[7] That is, although the job design scales correlate with the variates in a nearly identical fashion as in Table 9, on the outcome side the Mental Ease factor is the major contributor to the first variate, and the Phys-

[6] See Footnote 5.
[7] See Footnote 5.

Table 8
Correlations Between the Job Design Scales and the Theoretical Job Outcome Composites

	Theoretical job outcome composite			
Job design scale	Satisfaction	Efficiency	Comfort	Reliability
Motivational	.32*	−.77*	.28*	−.49*
Mechanistic	−.22*	.54*	−.06	.39*
Biological	.15	−.12	.50*	.01
Perceptual/Motor	−.08	.49*	.01	.45*

Note. $n = 121$. * $p < .05$.

ical Ease factor is the main contributor to the second variate.

A canonical analysis also indicates the amount of variance that can be explained in one set of variables given information about the other set through a redundancy index (Cooley & Lohnes, 1971; Stewart & Love, 1968). The redundancies in Table 9 reveal that the job design scales can account for 35% of the variation in the theoretical composites.

Supplementary Analyses

Three types of potential moderators of the job design–outcome relationships were explored: biographical variables (e.g., sex, age, race, tenure), plant differences, and job level. The first two had no effect. Partial correlations while controlling for job level, defined in terms of EEO code and pay, resulted in only slight drops in most correlations. However, controlling for job level eliminates the correlations between the Motivational scale and the Satisfaction and Comfort composites, but it still remains negatively correlated with the Efficiency (e.g., partial $r = -.45$) and Reliability (e.g., partial $r = -.28$) composites. Furthermore, job level does not completely explain the correlations between the Motivational scale and absenteeism (e.g., partial $r = -.21$).

Table 9
Results of the Canonical Correlation Analysis Between the Job Design Scales and the Theoretical Job Outcome Composites: Component–Variate Correlations, Canonical Correlations, and Redundancies

Measure	Canonical variate 1	Canonical variate 2
Job design scale		
Motivational	−.94*	−.07
Mechanistic	.63*	.31*
Biological	−.25*	.85*
Perceptual/Motor	.57*	.31*
Theoretical job outcome composite		
Satisfaction	−.36*	.04
Efficiency	.96*	.21*
Comfort	−.37*	.89*
Reliability	.66*	.24*
Canonical correlation	.84*	.52*
Redundancy	.29	.06

Note. $n = 121$. * $p < .05$.

Discussion

The four scales of the MJDQ show very good psychometric properties, especially interrater reliability and agreement. Future research should examine the generalizability of the MJDQ in larger and different samples of jobs, including nonmanufacturing and non-blue collar jobs, and further assess reliability by using analysts less familiar with its content and with the jobs. If such research verifies the two canonical factors, then the MJDQ should be revised. Future research might also compare the MJDQ with other measurement instruments, such as the Job Diagnostic Survey (Hackman & Oldham, 1975) or the Job Characteristics Inventory (Sims et al., 1975).

The intercorrelations among the scales can be understood on rational and theoretical grounds. The Motivational scale has a strong, negative correlation with the Mechanistic scale due to their diverging evaluations of features such as task variety and skill usage. From a theoretical standpoint, the motivational approach was a reaction against early mechanistic practices (L. Davis & J. Taylor, 1979). The Motivational scale has a moderate, negative correlation with the Perceptual/Motor scale. Recall that the Perceptual/Motor scale gives higher scores to jobs with fewer information processing demands, whereas the Motivational scale generally scores these jobs lower. The moderate, positive correlation between the Motivational and Biological scales is best understood in terms of their joint relationship to job level.

The lack of correlation between the Mechanistic and Biological scales is unexpected because of the evidence that highly mechanized work may have negative health consequences (e.g., Johansson et al., 1978). This lack of correlation is due to the compensatory effect of the muscle motion economy items in the Mechanistic scale. When the Mechanistic scale is recalculated excluding these items, it correlates negatively ($r = -.40$) with the Biological scale. The Mechanistic and Perceptual/Motor scales correlate positively because they both highly score jobs with fewer mental demands. This also makes sense, as industrial engineering is a major contributor to the field of human factors (Meister, 1971; Meister & Rabideau, 1965).

The Biological and Perceptual/Motor scales also positively correlate probably because of their joint concern for proper person–machine fit. Although the former is concerned with biological fit and the latter with perceptual/motor fit, the modern-day practice of human factors or ergonomics includes both considerations (e.g., Grandjean, 1980).

To simplify the presentation of the results, the pool of outcomes was reduced to two sets of scales: four theoretical composites and five factor scores. Development and analyses of these scales yields three types of evidence supporting the accuracy of the outcome taxonomy. First, it is possible to form an internally consistent composite within each category that includes most of the items. Second, the empirical clustering of the outcome items via factor analysis largely reproduces three of the four theoretical composites. Third, the pattern of intercorrelations among the theoretical composites is similar to the pattern of intercorrelations among the corresponding job design scales. For example, comparing Tables 6 with 5 shows that the Satisfaction composite correlates negatively with the Efficiency and positively with the Comfort composites. Similarly, the Motivational design scale correlates negatively with the Mechanistic and positively with the Biological scales. These results suggest an empirical as well as a theoretical symmetry between the job design and outcome taxonomies.

When the hypotheses were tested, the results were consistent across the various techniques, samples, and outcome combinations. In general, the main hypotheses are well supported. Jobs that score high on the Motivational scale have employees who are more satisfied and motivated, have higher rated job performance, and exhibit less absenteeism. Jobs high on the Mechanistic scale have higher utilization levels and lower training requirements. Jobs high on the Biological scale require less physical effort, produce fewer aches and pains, and result in fewer medical incidents. Finally, jobs high on the Perceptual/Motor scale are less likely to produce accidents, errors, stress, and work overload, and require fewer mental demands.

With few exceptions, most of the speculative hypotheses are also supported. Jobs with more motivational features require more training time and have lower utilization levels. Contrary to predictions, jobs with more motivational features have lower effort requirements, greater comfort, and fewer health complaints. But this finding may be the spurious result of their joint relationship with job level. Also unexpected, high motivational jobs have greater accident and error likelihoods, more stress and overload, and more mental demands. Although these variables also correlate with job level, more motivating jobs may simply have more mental demands and greater chances of error and overload in general.

No other major exceptions to the speculative hypotheses occurred. Jobs high on the Mechanistic scale may have less satisfied employees and slightly higher absenteeism, but they tend to be less accident and error likely and less prone to mental overload. Mechanistic design shows no relationship with physical outcomes. But when the Mechanistic scale is recalculated excluding the muscle motion economy items, it correlates negatively with physical outcomes (e.g., ave. $r = -.28$). The biological features of a job are unrelated to any of the outcomes, aside from the physical outcomes. Finally, perceptual/motor characteristics are unrelated to attitudes, effort, or health but are positively associated with higher utilization levels and less training time.

It was also predicted that each job design scale would relate most strongly to its corresponding outcome category. This prediction was not supported. Recall, however, that the job design scales were developed based on a content evaluation of current theories and not on an empirical clustering scheme. If additional research on larger and more diverse samples of jobs yields comparable results, these unexpected findings should lead to reexamination of theories rather than to renaming of scales.

Canonical correlation analyses showed that two links explain most of the relationship among the job design scales and outcomes. The largest link reflects the mental demands of the job, whereas the smaller reflects a physical demands component. This suggests a simplified two-factor schema of the influence of job design on important outcomes. The large portion of the variation that the job design scales can account for in the outcomes indicates the practical as well as the theoretical importance of the results.

When potential moderators of the job design–outcome relationships were explored, job level reduced the magnitudes of most of the correlations slightly, especially those between the Motivational scale and the Satisfaction and Comfort composites. But the fact that higher level jobs are typically more satisfying and motivating and less physically demanding does not diminish the theoretical importance of the scale or the previous findings for many reasons. First, it is more likely that a job's characteristics determine the job's level and pay, rather than the reverse. Second, job level and pay would be poor substitutes for the Motivational scale, as they yield little information as to why jobs are satisfying and motivating. Finally, even when job level and pay are partialed out, the scale still correlates with absenteeism.

Theoretical Implications

This study demonstrates that different approaches to job design can be reliably measured in a field setting, and they relate to important outcomes for both the individual and the organization. As no single approach can fully explain all outcomes, an interdisciplinary perspective is suggested. The job design taxomony derived may have merit for this purpose. It reflects the content of all current theories, and it has criterion-related validity with the outcomes. The MJDQ operationally defines the taxonomy for purposes of research and application.

The outcome taxonomy may also be a useful way to conceptualize outcomes from job design. It reflects the theoretical framework of the design taxonomy and shows similar internal relationships. It is empirically supported by a factor analysis of a large set of outcomes. Finally, much of the variation in the outcomes is explained by the scales of the MJDQ.

Although there is some overlap between the job design approaches, there are also some basic conflicts. Most of these differences are between the motivational approach and the perceptual/motor and mechanistic approaches. Although the motivational and perceptual/motor approaches were both derived from psychology, they intercorrelate negatively and show some negative relationships with each other's outcomes. Clearly, each approach has a different orientation. The perceptual/motor approach strives to develop equipment and jobs that are simple, safe, reliable, and minimize the mental demands required of workers. Conversely, the motivational approach stresses that more complicated and challenging jobs are more rewarding and should be encouraged.

The most glaring conflict is between the motivational and mechanistic approaches. They make nearly opposite recommendations in terms of job complexity and mental demands, and they show many negative correlations with each other's outcomes. It is curious that so many authors write of the negative consequences for individuals of mechanistic designed jobs, but few comment on the costs of the motivational approach in terms of important organizational outcomes such as utilization levels, training times, accident potential, and error likelihood.

These conflicts may be partially resolved, however. A job could gain on one approach without sacrificing its status on others, but trade offs will probably be necessary. As to trade offs, mental and physical demands of jobs seem to be relatively independent. Physical demands of jobs can probably be reduced without sacrificing the jobs' mental demands. The major trade offs will most likely involve mental demands. One might conceive of a mental demands continuum with motivationally designed (mentally demanding) jobs on one end that maximize individual outcomes like high satisfaction and high motivation. On the other end are mechanistic and perceptual/motor designed (less mentally demanding) jobs that maximize such organizational outcomes as high utilization levels, short training times, and low error likelihoods. Which trade offs will be made depend on which outcomes one wants to maximize, and the choice of outcomes depends on one's values (L. Davis, Canter, & Hoffman, 1955; J. Taylor, 1979). Trade offs will depend partly upon how one values individual versus organizational outcomes.

In summary, findings of this study may serve as a vehicle for rethinking major theories of job design. The taxonomies, measures, and findings of this study may help clarify the similarities and differences among the approaches, delineate the costs and benefits of each approach, rectify or find compromises for apparent conflicts among some of the approaches, and integrate the approaches into a comprehensive interdisciplinary theory of job design.

Practical Implications

Most of the practical implications of this study relate to the use of the MJDQ in applied job design research. The MJDQ is an easy-to-use, analytical aid for the researcher (e.g., psychologist, engineer, ergonomist, manager, technician). It might encourage the examination of job design as an important organizational variable and provide an integrated and structured means of doing so.

At least three types of practical uses could be made of the MJDQ. First, when organizational problems occur, it could be used to determine if problems exist with the design of the jobs. For example, the authors encountered a situation where an employee was being reprimanded for poor performance, whereas the MJDQ revealed that the job created such extreme biomechanical stresses in the back and legs such that it was nearly impossible to perform satisfactorily for any extended period. Second, the MJDQ may be useful in job redesign projects to help identify jobs that need redesign, to tell the nature of the redesign needed, and to evaluate jobs after they have been modified. Third, the MJDQ would be useful during many of the phases of system development: as a guide for job design recommendations in the design phase; as a checklist for evaluating equipment, workplace, and other design prototypes during the development phase; and as an evaluation instrument once the system is fully developed. In short, the MJDQ would be a useful aid for the designer to help assure that both mental and physical needs and limitations of people are recognized. It may be possible to design jobs that are optimal from all perspectives, thus satisfying the needs of both the individual and the organization.

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Appendix

Sample Items From the Multimethod Job Design Questionnaire (MJDQ)

Sample Item From the Motivational Job Design Scale

(#1) *Autonomy, responsibility, vertical loading:* Does the job allow autonomy? To what extent does the job allow freedom, independence, or discretion in work scheduling or sequence, work methods or procedures, or quality control, etc.? How much control or responsibility for decision making concerning the work does this job allow? Is the job vertically loaded?

5. The job allows *almost complete* autonomy in work sequencing, methods, etc. Employee has almost complete responsibility for decision making concerning the work.
3. The job allows *some* autonomy and responsibility for decision making, but some of the decisions are fixed or made by supervisors or others within the organization.
1. The job allows *very little* autonomy and responsibility for decision making. Almost all decisions concerning scheduling, methods, procedures, etc., are fixed or made by others.

(Note: The following relevance scale and comments line are included for each item of the MJDQ.)

3. Highly relevant
2. Minimally relevant
1. Irrelevant (not rated)

Comments: ______________________

Sample Item From the Mechanistic Job Design Scale

(#4) *Skill simplification:* To what extent is the job designed in such a way that it requires as little skill and training time as possible? To what extent can nearly anyone perform the job with little practice?

5. The job requires *very little* skill and training time. Most anyone can perform the job with little practice. Training time is only from a few hours to a few days.
3. The job requires *only moderate amounts* of skill and training time. Complete mastery of the job takes from a few weeks to a few months.
1. The job requires a *great deal* of skill and training time. Training time for this job/skill takes from a year to a few years.

Sample Item From the Biological Job Design Scale

(#6) *Strength:* To what extent are the muscular strength requirements of the job reasonable? Do any of the tasks require strength levels that may exceed the capabilities of the workers required to perform them? Aside from maximum strength levels required, also consider the continuous versus intermittent nature of the tasks.

5. This job requires only a *limited amount* of muscular strength. Only minimal strength is required for continuous tasks, and only moderate strength is required for intermittent tasks; strength levels required would not exceed the average capability level of the general population.
3. The job requires a *moderate amount* of muscular strength. Only moderate strength is required for continuous tasks, and higher levels of strength are required only intermittently; strength levels required would slightly exceed the average capability level of the general population.
1. The job requires a *great amount* of muscular strength. High levels of strength are required on a continuous basis, and/or excessive levels of strength are required intermittently; strength levels required would greatly exceed the average capability level of the general population.

Sample Item From the Perceptual/Motor Job Design Scale

(#15) *Input requirements:* To what extent are the information input requirements on the job within the limitations of the least capable potential worker? Considering all forms of information that must be sensed and perceived to effectively perform the job, does the quantity of information, the rate presented, the quality (e.g., discriminability) of the stimuli, etc., result in job requirements that could be met by the least capable potential worker?

5. The information input requirements on this job are *minimal.* They are within the capabilities of nearly all potential workers and require little mental effort or training/experience.
3. The information input requirements on this job are *moderate.* They are within the capabilities of the average potential worker but require some mental effort and/or training/experience.
1. The information input requirements on this job are *considerable.* They are within the capabilities of only the above average potential worker and require much mental effort and/or training/experience.

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