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Empirical Foundations for the Things-Data-People Taxonomy of Work

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The Things-Data-People (TDP) taxonomy was advanced in the 1950's by Fine's Functional Job Analysis (FJA) theory, and achieved widespread impact via its role in the *Dictionary of Occupational Titles* (DOT). However, little research has focused on identifying empirical support for this rationally-derived taxonomy; Common-Metric Questionnaire (CMQ) ratings of *N*=6,743 positions were examined to address this issue. Factor analysis of 1,222 items produced 78 first-order factors; second-order analyses revealed a clear 3-factor TDP solution. Similar solutions have been obtained from the DOT's planned replacement (the *Occupational Information Network,* or O*NET); however, much higher discriminant validity was evident in the CMQ factors, underscoring concerns regarding O*NET's *holistic* scales. These results support FJA's view that Things, Data, and People represent fundamental work-activity constructs; implications for efforts to replace the DOT are discussed.

Applied psychologists have long recognized the importance of being able to accurately describe the work activities that characterize jobs (i.e., *job analysis*; see Harvey, 1991a). Job analysis information is intended to form the foundation for a wide range of human resource management functions (e.g., Fine & Cronshaw, 1999), including the critical – but legally and logically distinct (e.g., *Uniform Guidelines*, 1978) – task of inferring the levels of various worker knowledge, skill (KS), ability, and "other" (AO) traits necessary for job success (i.e., *job-* or *worker specifications*; see Harvey, 1991a).

Perhaps more than any other applied use of job analysis data, the task of identifying accurate and valid job specifications has long challenged applied psychologists. For example, Motley (1956) observed the following with respect to the *Dictionary of Occupational Titles* (DOT) project that was begun in the 1930's:

> "The problem of maintaining a skilled workforce to meet the needs of national security and an expanding economy is becoming an increasing concern to all of us. Preparation and planning to meet this problem depend in good measure on our understanding of the worker characteristics and abilities that contribute to successful performance in all areas of work." (p. iii).

A similar assessment might well be offered today, and it is disconcerting to note that over 60 years after the inception of the DOT, it is arguably the case that (a) the task of identifying *demonstrably reliable* and *valid* job/worker specifications remains problematic (particularly when attempted on an economy-wide basis at the occupational-title level of analysis using single-item rating scales for the rated worker-trait requirements; e.g., see Cain & Green, 1983; Webb, Shavelson, Shea, & Morello, 1981); and (b) numerous questions remain unanswered regarding some of the most fundamental aspects of the job analysis process itself (e.g., for reviews, see Harvey, 1991a, Harvey & Wilson, 2000).

Regarding the latter, this study focused on the issue of identifying the general categories of work activity, or *work dimensions*, on which jobs vary. Much like the taxonomies of human abilities (e.g., Fleishman, Wetrogan, Uhlman, & Marshall-Mies, 1995) that have been developed to delineate the constructs that underlie individual differences in the domain of *worker traits* (e.g., *Inductive Reasoning, Trunk Strength, Color Vision*), a parallel need exists to identify a taxonomy of *general work activity* (GWA) constructs (e.g., *Skilled Mechanical Activities, Negotiating*) across which *jobs* vary.

The importance of developing comprehensive taxonomies to span the dimensionality of both the "work" (job activities) and "worker" (personal traits) domains – and of systematically linking these "two worlds of human behavioral taxonomies" – has long been noted (e.g., Dunnette, 1976, p. 477). Although some personnel functions (e.g., developing detailed work-sample tests or task-based training programs) can indeed be accomplished without the need to either define or accurately measure a taxonomy of GWAs, being able to draw meaningful comparisons between jobs in terms of a common profile, or *metric*, of GWA constructs is critical for many other functions. For example, the use of *job component validation* (JCV) to predict worker-trait requirements (e.g., Jeanneret, 1992; McCormick, Cunningham, & Thornton, 1967; McCormick, DeNisi, & Shaw, 1979; McCormick, Jeanneret, & Mecham, 1972) requires that each job be described on a common set of

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GWA dimensions before the statistical relations between the GWAs and each worker-trait criterion can be identified. When jobs are clustered to form job families or occupations (e.g., Harvey, 1986), similarity must be defined quantitatively in terms of each job's scores on a common profile of GWAs. Similarly, when dealing with workers with injuries or disabilities, practitioners must be able to accurately assess which GWAs can – and cannot – be performed in order to determine whether workers can return to their former occupations, and if not, to assess residual functionality and identify occupations for which they might be suitable. Thus, for functions that run the gamut from grouping jobs for validity generalization to matching occupations for skills-transferability, being able to accurately describe the work performed on positions, jobs, and occupations in terms of a comprehensive profile of GWAs is crucial to applied psychologists.

Efforts to Identify GWA Taxonomies

Given the vital role played by GWA taxonomies in job and occupational analysis, it is not surprising that considerable research attention has been directed toward developing and refining them; one factor that differentiates such studies concerns the degree to which they rely on a *rational* versus *empirical* strategy for identifying GWAs. Numerous examples of the rational approach can be identified, including the pioneering Things-Data-People (TDP) taxonomy that forms the core of Functional Job Analysis (FJA) theory (e.g., Fine, 1955; Fine & Cronshaw, 1999). FJA holds that all work activity can be described in terms of the level of its involvement with Things, Data, and People; this taxonomic view gained considerable impact by virtue of its being incorporated into such widely-used occupational systems as the Third (1965) and Fourth (1991) editions of the *Dictionary of Occupational Titles* (DOT) and the Canadian *Classification and Dictionary of Occupations* (1971).

In contrast, the empirical strategy typically relies on factor analytic methods to identify underlying dimensions of work activity (GWAs) that can account for observed patterns of covariation between work activities. Studies of this type focus on (a) developing standardized questionnaires that can describe a wide range of jobs using a common set of work descriptors; then (b) attempting to identify the latent GWA dimensions of work via factor analysis of these standardized job surveys. Notable in this category are the studies performed by McCormick and colleagues as part of a research program (e.g., Palmer & McCormick, 1961; Cunningham, 1964) that led to the Position Analysis Questionnaire (PAQ; e.g., McCormick, Jeanneret, & Mecham, 1972) and Job Element Inventory (JEI; Harvey, Friedman, Hakel, & Cornelius, 1988). Table 1 presents a summary of the factor analytic dimensions that were obtained from selected studies of this type.

Combinations of these two approaches have also been seen; arguably the most notable example in this category is the hierarchical GWA taxonomy developed for the *Occupational Information Network* (O*NET; e.g., Jeanneret, Borman, Kubisiak, & Hanson, 1999; Peterson, Mumford, Borman, Jeanneret, & Fleishman, 1999; Peterson, Mumford, Borman, Jeanneret, Fleishman, Levin, Campion, Mayfield, Morgeson, Pearlman, Gowing, Lancaster, Silver, & Dye, 2001) project that sought to replace the DOT with an online occupational database. In developing the O*NET's GWA taxonomy, a rational approach was used to develop 41 first-order GWA constructs (i.e., via qualitative review and integration of the results of past rational and empirical work-dimensionality research); then, to identify a smaller set of three second-order GWA constructs, an empirical approach was taken (i.e., factor analysis of ratings of the first-order GWAs).

Relative to many aspects of job and occupational analysis, a sizable amount of research has been conducted on the topic of GWA taxonomies (for a more detailed review, see Harvey, 1991a, pp. 146-155; Jeanneret et al., 1999, pp. 111-116); however, it can still be argued that significant additional research is needed. First, with respect to rationally derived GWA taxonomies, there is a need to conduct research to determine the degree to which empirical support exists for the hypothesized GWA structures. In the case of FJA, it is interesting to note that despite its widespread popularity and impact on the field, there has been relatively little interest in determining the degree to which the Things-Data-People GWAs can be derived or recovered via empirical analysis; addressing this issue was a primary focus of this study.

Second, with respect to empirically derived GWAs, the results obtained via factor analysis of standardized job surveys have clearly been valuable in stimulating the development of GWA taxonomies. However, a number of questions can be raised regarding the properties of the job surveys that were analyzed, as well as the specific factor analytic techniques that were used in past studies. These issues are summarized below; all point to the need for additional empirical GWA research.

Generalizability. Although there have been exceptions (e.g., Cunningham, Boese, Neeb, & Pass, 1983), much of the published research on the topic of work dimensionality has involved the PAQ, or highly similar instruments such as the JEI. Such studies have contributed much useful information; however, considerably more confidence regarding the generalizability of the GWA constructs that were identified from these studies would result if similar GWA factors were to be found based on factor analysis of item pools that are *not* based directly or indirectly on the PAQ.

Factor analysis procedures. Many empirically oriented GWA studies used factor analytic decision rules that have been widely questioned on technical grounds (e.g., see Fabrigar, Wegener, MacCallum, & Strahan, 1999; Ford, MacCallum, & Tait, 1986; Lee & Comrey, 1979; Linn, 1968; Tucker, Koopman, & Linn, 1969; Widaman, 1993). Specifically, these studies used combinations of (a) principal components analysis (e.g., McCormick et al., 1972; Jeanneret et al., 1999), which has been associated with producing biased factor loadings (e.g., Lee & Comrey, 1979); (b) retaining factors with eigenvalues > 1.0 (e.g., Jeanneret, 1969), an arbitrary decision rule that has been found to have no systematic relation to the correct number of factors (e.g., Tucker et al, 1969); and (c) orthogonal rotation (e.g., McCormick et al, 1972; Jeanneret et al., 1999), a practice that may distort the factor structure when the dimensions are non-independent (e.g., Fabrigar et al., 1999; Ford et al., 1986).

Although the number-of-factors decision has obvious relevance to the task of identifying a taxonomy of general work dimensions, the practice of imposing orthogonal rotations on factor solutions is equally troublesome, given that one might well expect nonzero correlations among general work dimensions. For example, Harvey (1987) reanalyzed the data used to develop the PAQ (Jeanneret, 1969), producing both a different – and *oblique* – 19-factor solution for the first-order factors, as well as a 3-factor *second-order* factor solution (i.e., *Working with People and Data, Physical Activities/ Environmental Conditions*, and *Using Machines/Equipment*) obtained by factoring the correlation matrix among the first-order factors. In addition to illustrating the fact that the use of different decision rules can produce an appreciably different GWA taxonomy, the Harvey (1987) findings showed that work dimensions often exhibit nonzero correlation.

The practice of computing oblique factor solutions does not hamper the development of GWA taxonomies, although the practice of forcing the factors to remain orthogonal arguably does (e.g., Ford et al., 1986) by virtue of the fact that if the true dimensions are oblique, they may not be evident via orthogonal rotation. Significantly, orthogonal rotations also hinder the search for *higher order* GWA factors. That is, many researchers have endorsed the conceptual value of developing a *hierarchical* structure of work activity in which a number of moderate-specificity first-level GWAs are clustered to form a smaller number of more abstract second-order GWAs. For example, the O*NET GWA taxonomy developed by Jeanneret et al. (1999) was intended to "link the resulting lower order GWAs to a broader set of higher order variables" (p. 111). As a practical matter, when solutions containing dozens of first-order factors are produced, it may well be useful to identify a smaller number of second-order factors to provide conceptual organization for the lower-order GWAs. However, an *oblique* first-order solution is a prerequisite for performing a second-order factor analysis.

Content coverage. A potentially serious limitation facing past work dimensionality studies concerns the degree to which the job questionnaires that were analyzed comprehensively span the domain of job activities. That is, if a job analysis survey lacks coverage of major aspects of work, a factor analyses of its content-deficient item pool is likely to produce an incomplete listing of latent work dimensions. In the case of the PAQ, questions have been raised regarding its coverage of managerial, supervisory, executive, and professional (MSEP) work (e.g., Lozada-Larsen, 1988; McCormick, Mecham, & Jeanneret, 1977; Mitchell & McCormick, 1979). For example, Mitchell and McCormick (1979) found that errors of prediction using the PAQ to predict compensation rates were larger for MSEP jobs; they concluded that "this instability at the higher end of the range of jobs is troublesome and hints that there is some kind of problem in the use of the PAQ with higher level jobs" (p. 4). They further noted that "there may be a ceiling effect on some of the PAQ scales" that may cause them to "not be sufficiently discriminating at the upper levels" of work (p. 5).

This perceived lack of sufficiently detailed coverage of MSEP activities by the PAQ item pool led to the development of the Professional and Managerial Position Questionnaire (PMPQ; Mitchell & McCormick, 1979) and other instruments (e.g., Lozada-Larsen, 1988; Page & Gomez, 1979) targeted at MSEP jobs. An inspection of the types of factor analytically derived dimensions produced by these MSEP-targeted surveys (see Table 1) indicates significant areas of departure from the GWAs produced by the PAQ (i.e., they more clearly differentiate managerial activities). Unfortunately, Table 1 also reveals that the PMPQ and other MSEP surveys suffer from a reverse type of content-coverage deficiency (i.e., poor coverage of GWAs defining *non*-MSEP work). Although one may attempt (e.g., Harvey, 1991a; Jeanneret et al., 1999) to construct taxonomies of work activity by integrating the factor analytic results obtained from studies conducted using instruments that are content-deficient regarding blue-collar work and from instruments lacking coverage of MSEP work, such a strategy implicitly assumes that *zero* overlap exists between the items (and work dimensions) that characterize MSEP versus non-MSEP jobs, and that if a factor analysis had been performed on the *combined* item pool formed by merging the MSEP and blue-collar items, the same latent factors would have emerged.

The tenability of such assumptions can easily be questioned. For example, it is not difficult to identify MSEP jobs that require workers to perform the types of "nonmanagerial" clerical, equipment-related, and physical activities that are missing from MSEP instruments, or to identify blue-collar jobs that involve at least some of the "managerial" activities (e.g., negotiation, external contacts, resource responsibility, etc.) that receive limited coverage in non-MSEP surveys. For taxonomic development purposes, it is therefore desirable to move beyond the past practice of attempting to rationally integrate results produced from separate analyses of blue-collar-deficient versus MSEP-deficient instruments, and instead focus on factoring a common item pool that spans both domains. If similar results are obtained, confidence in the generalizability of past findings would be enhanced; if divergent results are produced, it is important that such a fact be revealed.

Rating scale metric. A related issue concerns the nature of the scales that were used to describe the items rated in past work-dimensionality analyses. As Harvey (1991a, pp. 82-99) detailed, many surveys use scales that have a "relativistic" nature. For example, the JEI uses a *Relative Time Spent* (RTS) scale in which each item is rated in terms of whether the worker spends about the same time on it as on his/her "average" task, or relatively more or less time than the average task. Likewise, the most frequently used scale in the PAQ is *Importance*, and although Jeanneret, McCormick, and Mecham (1977) instructed raters to avoid using the "average" rating point on this scale as if it denoted "the relative importance of any given item in comparison with other items as they might apply to the specific job in question" (p. 5), they also acknowledged that "the concept of 'importance' is admittedly a rather ambiguous one," and that "the analyst should *consider whatever aspects seem to relate* to the importance of the item *to the job in question* … [such as] the influence of the item on overall job performance of the worker, the time spent, and the criticality of the activity *to the job*" being rated (p. 5, emphasis added).

In such cases, raters may produce item ratings that define a *within-job relative* metric that is – to a greater or lesser degree – *variable* in terms of its referent across different raters (even when rating the same job). Although relativistic scales may be useful for ranking activities *within* a position, they are arguably much less useful when comparisons *between* jobs or raters must be made (i.e., because different raters may rely on different benchmark activities to define the "typical" or "average" task that *vary* in terms of the actual amount of time, importance, etc., involved). Such scales may also cause difficulties when factor analyzing job analysis ratings, given that within-job relativistic judgments – when carried to their logical extreme – effectively constitute *ipsative* data, which can decidedly complicate the interpretation of the results of the factor analysis process (e.g., Cranny & Doherty, 1988).

Exploratory versus confirmatory research. A final issue concerns the lack of confirmatory, hypothesis-testing analyses. Although many of the studies discussed above were clearly exploratory in nature, in other studies (e.g., the Jeanneret et al., 1999, effort to identify higher-order factors underlying the O*NET's GWA taxonomy) the researchers clearly possessed testable hypotheses regarding the presumed latent structure of work (in the case of the O*NET, Jeanneret et al., 1999, discussed 4- and 9-factor variants of the "SOR" theory of work that specified how the first-level GWAs should cluster into second-order SOR constructs). In cases such as these in which clear a priori predictions are available (i.e., based on either theory, or the results of prior factor analyses), more powerful conclusions can be obtained through the use of *confirmatory* factor analytic methods rather than the exploratory factor analyses that have been relied on in past GWA research.

*The O*NET GWA Taxonomy*

Over the past decade, tens of millions of dollars have been invested in the development of the O*NET (e.g., Peterson et al., 2001), an online occupational analysis system designed to both replace the DOT, and considerably expand the types of information available. As Hubbard, McCloy, Campbell, Nottingham, Lewis, Rivkin, and Levine (2000) noted,

> "O*NET will be the most comprehensive standard source of occupational information in the United States. O*NET will be at the center of an extensive network of occupational information used by a wide range of audiences, from individuals making career decisions, to public agencies and schools making training investment decisions, to employers making job structure and hiring decisions. O*NET will also be widely used for administration of federal programs" (p. v).

As part of this ambitious undertaking, the hierarchical O*NET GWA taxonomy (Jeanneret et al., 1999) was developed (see Table 1; although it initially listed 42 constructs, the *Implementing Ideas, Programs, Systems, or Products* GWA was subsequently dropped). This taxonomy was intended to provide a comprehensive description of the work activities in both MSEP and non-MSEP work, and one might well ask – given the massive amounts of resources and data involved in its development, as well as its role as the "standard source of occupational information" for the US – whether additional research on the topic of GWA taxonomies is necessary.

A number of arguments can be offered to make the case that rather than reducing the need for additional work dimensionality research, the advent of the O*NET taxonomy has actually increased it. First, the 41 constructs in the first-level O*NET GWA taxonomy were developed via a largely rational process of reviewing past research and integrating the results (see Jeanneret et al, 1999, pp. 111-116). Although taxonomies developed via rational means may well prove useful in practice – e.g., the widely used TDP taxonomy in FJA – the mere process of postulating the existence of a list of GWA constructs does not, in and of itself, prove that these dimensions are empirically distinct, or that they comprehensively span the domain of work activities.

Second, the first-order O*NET GWA constructs arguably suffer from a lack of precise definition and operationalization, relative to GWAs derived using empirical methods. That is, the O*NET GWAs are defined in terms of a brief label and a short narrative description (e.g., see Figure 1). In contrast, GWA dimensions identified via factor analysis typically possess a wealth of additional detail provided by knowledge of the individual *items* that define each factor. This lack of item-level data regarding the *indicators* of each O*NET dimension causes a number of potential problems, including difficulties in *scoring* the amount of each GWA present in a job, and determining the degree to which these dimensions define the same kind of content as GWAs identified via factor analysis in prior research.

For example, based on the sorting of GWAs in Table 1, one might be tempted to conclude that the O*NET taxonomy lacks coverage of GWAs related to *External Contacts* (O*NET 27) in comparison to an instrument like EXCEL (which has 4 GWAs in that category), or that O*NET lacks a dimension to quantify working in hazardous environments. However, given the lack of data regarding the *item-level* activities that define each of the rationally identified GWAs in the O*NET taxonomy, such conclusions cannot be drawn with confidence; empirical evidence of convergent and discriminant validity is needed to resolve such questions. Unfortunately, such information was not reported by the developers of the O*NET's GWA taxonomy (e.g., Jeanneret et al., 1999).

The Present Study

This study focused on the following issues. First, the question of the generalizability of GWAs identified from PAQ-based item pools was addressed by examining the factor structure of a standardized job analysis survey composed of an item pool that did *not* have its origins in the PAQ – i.e., the Common-Metric Questionnaire (CMQ; Harvey, 1991b, 1993; Harvey & Lozada-Larsen,1993). Because the CMQ was designed to describe both MSEP and non-MSEP work activities in comparable detail, it was hypothesized that significant points of divergence would be evident in comparison to the GWA structure identified from the PAQ; in particular, that a much larger number of first-order factors would be present, and that the PAQ's large first factor would be split along the lines seen in the MSEP-targeted instruments in Table 1.

Second, based on past research (e.g., Harvey, 1987) it was hypothesized that oblique first-order factors would be indicated (i.e., that a number of nontrivial correlations would be seen among the first-order dimensions), and that factor analyses of the first-order GWA correlations would lead to the identification of meaningful second-order GWA dimensions.

Third, with respect to the desire to take a confirmatory, hypothesis-testing approach to the task of developing and evaluating GWA taxonomies, the second-order factor analyses were conducted in two phases. After developing hypotheses regarding the dimensionality of the first-order factor space via exploratory analysis, factor scores were estimated and the database was split in half. Exploratory second-order factor analyses were then conducted on the first (derivation) half for the purpose of producing solutions that could be tested via confirmatory methods, and the fit of each second-order factor model was evaluated using confirmatory analysis in the holdout sample. Given the sizable and diverse sample of CMQ positions available, it was hypothesized that strong indices of model fit would be found in the holdout sample.

A final question concerned the substantive interpretation of the second-order GWA constructs; in particular, whether they would more closely match the 3-factor TDP taxonomy of FJA or the 4- or 9-factor versions of the SOR model favored by the O*NET's developers (Jeanneret et al., 1999). Based on the Harvey (1987) and Lynskey and Harvey (1988) analyses of the PAQ and JEI (which revealed second-order solutions that were similar to TDP), as well as the strongly TDP-like 3-factor solutions reported for the O*NET by Jeanneret et al. (1999) and Gibson, Harvey, and Quintela (2004), it was hypothesized that a low-dimensionality second-order solution for the CMQ would be most similar to the TDP taxonomy. This hypothesis was evaluated using qualitative assessments of the factor loading patterns. Although it would of course be desirable to conduct confirmatory factor analyses comparing second-order models based on TDP versus SOR, in this study confirmatory analyses were conducted only on models identified from the exploratory second-order analyses. Although it would be possible to form hypothesized factor loading matrices by rationally sorting the first-order CMQ work dimensions into the categories defined by the TDP and SOR taxonomies, such a task would be highly subjective, and it would be impossible to determine the degree to which differential model fit reflected inadequacies in the taxonomy versus the author's inability to sort the dimensions into the correct categories implied by a given taxonomy.

Method

Participants and Instrument

A sample of N = 6,743 position-level profiles (classified into 2,128 job titles) was drawn from a larger database of CMQ administrations from 1990 through 2001; profiles that contained questionable responses (e.g., low item endorsement rates) were excluded. Of respondents who provided demographic data, 58% were male, 77% indicated White/non-Hispanic ethnicity, the average job tenure was 3.3 years, and the average age was 39.3 years. Although the precise breakdown of positions classified as FLSA-exempt was not available, the sample was diverse, being drawn from several dozen public and private sector organizations of varying sizes, with occupations ranging from Custodian and Laborer through Vice President and CEO.

Out of a desire to enhance verifiability, the CMQ's items were written at a higher level of behavioral specificity (and lower reading level) than the typical items seen in earlier instruments (e.g., Ash & Edgell, 1975); in a further departure from instruments like the PAQ and JEI, the CMQ adopted a matrix structure (see Figure 2) in which each characteristic is rated on multiple scales. Consequently, the CMQ provides considerably more item-level data than previous job analysis instruments (e.g., the web-based Third Edition of the CMQ contains 475 rating screens that produce 2,897 data points).

Responses were collected using the paper-and-pencil CMQ Standardization and First Editions, as well as the computer-based Second Edition (for details of the CMQ's development, see Harvey, 1991b, 1993; Harvey & Lozada-Larsen,1993). The main differences between these forms centered on the items contained in the Job Knowledge section; given that the focus of this study was to examine the latent structure of *work activities*, and not required job *knowledge*, these differences were deemed unimportant. Items viewed as being either potentially subjective, within-job relative, or reflective of personal or situational factors that would not be useful for identifying GWAs (e.g., those contained in the Other Job Characteristics and Knowledge sections, as well as ratings on *Criticality, Essentiality, Required-To-Possess, Could-Perform, Damage*, and *When-Acquired* rating scales) were not included. Although such ratings are useful for many purposes (e.g., identifying essential functions; setting selection standards), they are tangential to the goal of describing the verifiable *activities* performed on the job. The resulting profile of 1,222 item responses for each position consisted primarily of *Frequency* and *Do-You-Perform* ratings.

Analyses

First-order factors. The item correlation matrix of the 1,222 CMQ items was analyzed using exploratory factor analysis, with principal-axis factor extraction, maximum-r estimates of communalities, oblique rotation via the Harris-Kaiser orthoblique method (p = 0.5), and the regression method for computing factor score estimates. The first-order analyses were designed to identify factors that could function as general dimensions of work activity, striking a balance between not being too small (and abstract) in number, versus too numerous (and molecular) to be useful for the intended purpose of allowing meaningful comparisons between task-dissimilar jobs. Although the CMQ has used an 80-factor scoring system since its initial development (see Harvey, 1991b), that scoring system was not used, nor were attempts made to conduct confirmatory analyses at the first-order level. That is, on purely practical grounds the large number of items precluded any attempt to test any first-order confirmatory factor models. Additionally, as was the case for the "division" factors of the PAQ, the 80-factor CMQ scoring system was developed by separately analyzing each of the logical *subsections* and then aggregating the factors; because the goal of this study was to identify factors from the entire item pool, such fractional factors were not of interest.

The number-of-factors decision was driven primarily by a criterion of interpretability; however, information was also provided by scree plots of eigenvalues, inspection of the amount of total common variance, as well as parallel analysis (i.e., comparison of the obtained eigenvalues against those computed using same-sized matrices composed of random numbers; see Montanelli & Humphreys, 1976). For the parallel analysis, because job analysis ratings tend to exhibit a positive skew, the random item ratings were sampled from a truncated Normal (0,1) distribution (using only values falling above –0.5).

Second-order factors. After making a determination regarding which exploratory first-order factor solution would be most desirable given the stated goal of identifying GWAs, factor score estimates were computed for each position for each of the first-order factors, the sample was split in half, and the second-order analyses were then conducted in two phases. In the derivation phase, exploratory second-order factor analyses were conducted on the correlation matrix of the first-order factor score estimates. Confirmatory factor analyses were then conducted in the holdout sample, analyzing the correlation matrix of the first-order factor score estimates (the CALIS procedure of SAS was used to estimate parameters and assess model fit). Given that the factor score estimates were expected to exhibit strongly non-Normal distributions (i.e., job analysis ratings tend to have a strong positive skew), unweighted least squares estimation was used, with model fit indices including the goodness of fit index (GFI), the GFI adjusted for degrees of freedom (AGFI), root mean square residual (RMSR), and the Parsimonious GFI (PGFI).

Results

Exploratory Factor Analyses

First-order factors. Figure 3 presents the scree plot of eigenvalues (excluding the first two, which were approximately 130 and 42, respectively, to allow an expanded scale) and the parallel analysis values; Table 2 presents summary statistics on the 78-factor first-order solution. For the number-of-factors decision, an examination of the full scree plot suggests that perhaps as few as 20-30 first-order factors might be sufficient; however, the Figure 3 results (especially the parallel analysis) suggest solutions in higher dimensionalities. Because parallel analysis eigenvalues may vary considerably depending on the communality estimation method (and the maximum-*r* method would likely produce very small values in random data), three methods for computing parallel analysis communalities were examined: maximum-*r*, random estimates from 0-1, and values of 1.0 (as in components analysis). Results from maximum-*r* estimates were expected to be potentially biased toward suggesting too many factors, whereas those based on 1.0s were expected to be potentially biased toward too few.

The parallel analysis results in Figure 3 indicate that solutions with as many as 100 (1.0 estimates), 140 (random estimates), and 250 factors (max-*r*) should be considered, given its logic that factors with eigenvalues from real data that exceed those for that factor from random data are candidates for retention. Rotated solutions in from 2 to 150 factors were examined, judging solutions based on a criterion of interpretability as general categories of work activity, and striking a balance between too-abstract versus too-molecular GWAs. The rotated solutions were all deemed interpretable, with factors in higher dimensionalities typically being formed by splitting item pools that loaded on a single factor in lower dimensionalities; thus, the main issue was specificity. The 78-factor solution (which explained 77.4% of the total common variance) was selected as offering the best balance between parsimony of factors and avoiding overly-abstract factors. To conserve space, first-order factor labels are presented in Tables 1-2 (an appendix listing items having significant loadings on each factor is available for download; see author notes).

As hypothesized, although correlations between the first-order factors were generally low, a number of nontrivial – but easily interpretable – correlations were seen in the rotated solution; for example, r = .34 for Factors 6 (*External Contacts: Regulators*) and 11 (*External Contacts: Government Officials*), r = .33 for Factors 9 (*Physical Activities*) and 25 (*Information from Senses*). In terms of the makeup of the factors, an inspection of Table 1 shows that, as hypothesized, the CMQ first-order dimensions provide coverage of both MSEP and non-MSEP occupations, as well as considerably more differentiation among interpersonal and decision-making GWAs than was seen in the PAQ. Although subsequent convergent-discriminant validation studies that compute dimension scores for jobs using both the CMQ and other instruments are needed to conclusively answer this question, at least at a qualitative level the Table 1 results suggest that the GWA dimensions in the 78-factor first-order CMQ solution match-up relatively well with the major GWAs identified in various prior MSEP and non-MSEP factor analyses (although a number of points of divergence are evident, especially vis a vis the taxonomy of GWAs specified in the O*NET system; this issue is discussed further below).

Second-order factors. Using the first half of the total sample, exploratory factor analyses were then conducted on the score estimates for the first-order factors to identify potential second-order factor models to be evaluated via confirmatory factor analysis. The scree plot of eigenvalues of the 78 first-order factor score correlation matrix is presented in Figure 4. As with the first-order factors, the scree plot and parallel analysis results suggest a number of possible solutions, ranging from 3 through 25 factors; after examining rotated solutions in this range of dimensionalities, 3- and 7-factor second-order solutions were selected (explaining 64% and 99% of the estimated total common variance, respectively) as offering easily interpretable ways to organize the first-order GWAs (see Tables 3-4).

Regarding the interpretation of the second-order factors, as hypothesized an inspection of Tables 3-4 reveals results that appear to be much more consistent with Fine's TDP taxonomy than with either of the two SOR models favored by the O*NET's developers (Jeanneret et al., 1999). That is, although a number of the first-order GWAs exhibit only marginal loadings on the second-order factors, the 3-factor second-order solution in Table 3 conforms well with FJA's view of the structure of work when the higher-loading GWAs are used to name the factors: that is, Factor 1 corresponds with the FJA *People* function (with strongly loading GWAs dealing with information exchange, external contacts, and lower-level internal contacts); Factor 2 corresponds with FJA's *Data* (particularly, involving managerial decision making); and Factor 3 corresponds with *Things* (machine and tool use, associated physical activities, unpleasant/dangerous aspects of the work environment). The r = .25 correlation between factors 1 and 2 is consistent with past research (Gibson et al., 2004; Harvey, 1987), and reflects the fact that jobs that tend to be higher in decision-making also tend to have higher levels of interpersonal activities.

The 7-factor second-order solution (Table 4) is also more consistent with TDP than SOR, as it essentially represents a subdivision of the overall TDP dimensions in the 3-factor solution into subfactors: that is, several reflect the FJA *People* function (i.e., factors 1, 2, and 6), others reflect more *Data* activities (3, 7), and the rest are relevant to *Things* (4, 5). As in the 3-factor solution, factor correlations are generally low, and the few nontrivial correlations are easily interpretable (e.g., r = .23 between Factors 1 and 2, which both deal with interpersonal contacts and information exchange).

Interestingly, the estimated total common variance (i.e., the sum of the eigenvalues of the reduced correlation matrix) in the

78-scale matrix represents a much smaller percentage of the total variance than for the 1,222 item matrix (i.e., 14.0% versus 63.4% for second- and first-order data, respectively), suggesting that although it is possible to identify easily interpretable second-order GWA factors to explain the *common* variance present among the first-order GWA dimensions, the first-order GWAs are largely composed of *unique* variance. Such a finding might represent cause for concern if one's research goals were focused on *data reduction* (i.e., condensing as much of the information as possible in the first-order factors into a small number of second-order factors). However, that was *not* the goal of the present study; here, the fact that the first-order factors measure largely independent sources of work variance can be viewed as a highly positive finding. In short, although the second-order factors provide a theoretically useful "big picture" perspective, and they offer empirical support for the rationally derived TDP taxonomy, a sizable amount of the variance contained in the first-order CMQ GWAs is independent of the higher-order TDP constructs (see below for further discussion).

Confirmatory Factor Analyses

Table 5 reports the fit indices obtained from the confirmatory factor analyses of the 78 first-order CMQ GWA dimensions. In addition to orthogonal and oblique versions of the factor models identified from the exploratory analyses (Tables 3-4), for purposes of comparison models involving a single general factor on which all first-order scales loaded, and a null model with no common factors (i.e., each first-order scale was viewed as being composed of 100% unique variance), were also evaluated in addition to, for each substantive model, a model based on free factor loadings for only the primary loading for each item, as well as an augmented model that added a number of secondary loadings suggested by the exploratory results. The free loadings are indicated by italics in Tables 3-4.

In view of the low level of common variance seen in the second-order exploratory analyses, an especially poor level of fit for the null model was *not* expected. On the contrary, finding that a null model produces at least moderate fit would indicate that the elements of the first-order GWA profile provide descriptions of largely non-redundant aspects of work (i.e., *discriminant validity*, a highly desirable property for a profile of GWAs). As Table 5 indicates, the confirmatory factor analyses support this conclusion, with the null model producing GFI and AGFI values in the mid .70's (by way of comparison, the null model values reported by Gibson et al., 2004, when analyzing the first-order O*NET GWAs were only .11 and .07, respectively, indicating that O*NET GWAs provide *much* less of the highly desirable unique variance component at the first-order level than the CMQ GWAs).

The fit indices for the 3- and 7-factor models show that the second-order factor patterns identified in the derivation sample cross-validate reasonably well (especially given the inherent difficulty in obtaining fit indices in the upper .90's when high numbers of overidentifying restrictions are present, as in the oblique 3-factor model, where only 159 free parameters are estimated in an attempt to reproduce a data matrix containing 3,081 unique elements). However, it is notable that even the best-fitting models in Table 5 offer only modest improvements beyond the level of fit provided by the null model, which provides surprisingly strong fit by typical standards.

Thus, in this job analysis context, the expected fit for the null model is essentially reversed from the usual situation – i.e., we seek first-order GWAs composed largely of dimension-specific, *unique* variance (and hence, a well-fitting null model). As the results in Tables 2 and 5 indicate, this is precisely what was found (e.g., in the 3- and 7-factor second-order solutions, the median final communalities for the first-order CMQ GWAs are only 8% and 13%, respectively); when combined with the low first-order factor score correlations (median r = .02, range of only -.14 – .36), these findings offer strong evidence supporting an inference of discriminant validity.

Discussion

Toward a Comprehensive First-Order Taxonomy

In addition to offering insights regarding the higher-order dimensionality of work, the factor analytic results reported above contribute to the literature by virtue of providing a new first-order taxonomic alternative for viewing the latent structure of work. By integrating these results with past research and attempting to identify GWAs that are not covered by the CMQ taxonomy (but that are measured by other surveys), and/or identifying GWAs that have yet to be measured by a standardized survey, subsequent research can continue our evolutionary progress toward the goal of developing a first-order taxonomy that is widely accepted as being comprehensive.

These results have direct implications for the O*NET, a system that aspires to the goal of defining "an occupational information system for the 21st century" (Peterson et al., 1999, p. i) that, according to Dye and Silver (1999), "replaces the *Dictionary of Occupational Titles*" (p. 9) and "is becoming the nation's new primary source of occupational information" (p. 9) that will "be able to help all Americans make informed employment decisions" (p. 18). Given these objectives, the salient question is: Are the results of this study consistent with the inference that the O*NET GWA system provides a suitably comprehensive first-order taxonomy?

Two lines of evidence can be offered to argue against such a conclusion. First, a relatively substantial degree of divergence is evident in Table 1 when comparing the rationally identified GWAs defined by the O*NET versus the empirically derived GWAs of the CMQ. For example, the O*NET system has only a single first-order GWA (27) that seems to directly addresses non-sales, business-related external contacts. In contrast, the CMQ produces 15 GWAs relevant to this category, and of considerable importance, there is little redundancy among these dimensions (of the 105 correlations among the CMQ GWAs, the median r = .05, interquartile range = .02 – .09, and range is only -.06 – .25), a finding that suggests that general work activities of this type cannot be collapsed and described comprehensively using a single GWA. Furthermore, some CMQ first-order GWAs (e.g., dealing with environmental hazards, using weapons) have no apparent analog in the O*NET taxonomy.

One might counter that this lack of comparability between O*NET versus CMQ is an artifact caused by the different numbers of GWA constructs in each system. However, as part of a study to compare JCV models linking CMQ versus O*NET GWAs to O*NET ability-trait requirement ratings, Wagner and

Harvey (2004) computed a CMQ factor solution designed to match the number of scales in the original O*NET system; in that study, a rotated 42-factor solution was used for CMQ. As with many of the lower-dimensional CMQ solutions examined in the present study, the 42-GWA solution was quite similar to the 78-factor solution, with the main differences involving GWAs that are separate in the higher-dimensional solution being combined in the lower-dimensional one. Table 1 lists the 42 GWAs from Wagner and Harvey (2004), and an inspection of these results again suggests that, on a substantive basis, there are many points of difference between the GWAs obtained from the CMQ versus O*NET.

Of course, it must be stressed that different researchers might well have produced a different sorting of GWAs than the integrative taxonomy that was advanced in Table 1, even when operating from identical data. This is especially true in the present situation, given the ambiguity inherent in the rationally derived O*NET GWAs due to their brief, behaviorally vague definitions, and the lack of more-specific, *item-level* indicators of each GWA (i.e., data that would be available in an empirically derived taxonomy). To conclusively answer this question, *empirical* comparisons of the degree to which the O*NET GWA taxonomy is capable of subsuming the information contained in the GWAs in alternative taxonomies will be required (e.g., correlations showing that ratings of the O*NET GWAs – either individually, or in combination – are capable of capturing the majority of the variance measured by each of the 78 CMQ GWAs).

Second, the O*NET GWA taxonomy arguably comes up short when evaluated using the taxonomic criteria advanced by its developers. Specifically, Jeanneret et al. (1999) offered several standards by which a GWA taxonomy should be judged: (a) the first-level GWAs should "act as *stand-alone sources* of occupational information;" (b) a small number of second-order GWAs should underlie them, and be "expressed at a very broad level of generality" (p. 112, emphasis added) to provide a big-picture view of work; and (c) first-level GWAs should "have *definitive underlying content*," "the constructs as a set should be comprehensive," and "the constructs should provide *unique descriptive information*" (pp. 111-112, emphasis added).

Although the O*NET GWA taxonomy performs well in terms of the second criterion, major concerns can be identified with respect to the remaining criteria, all of which revolve around the question of *discriminant validity*. That is, in contrast to the results of the present study, which showed that the 78 CMQ GWAs performed well in terms of all of the Jeanneret et al. (1999) criteria, the communalities reported by Jeanneret et al. (1999) and Gibson et al. (2004) indicated that the O*NET GWAs suffer from significant concerns regarding a lack of unique variance (i.e., exhibiting high degrees of redundancy between ratings of supposedly distinct GWAs, and low levels of unique variance among the first-order GWAs).

The Unanswered Question of Convergent Validity

An equally troublesome issue concerns the level of convergent validity between ratings collected using the *holistic* rating process used to quantify the O*NET dimensions (i.e., one in which a single-item rating scale is used to directly rate the level of an abstract *construct* for the job as a whole) versus a more traditional *decomposed-judgment* rating strategy (i.e., one that involves combining ratings of multiple, more-specific work activities to estimate a score for each GWA, as in instruments such as the PAQ and CMQ); for background, see Harvey (1991a, pp. 100-104, 115-116). The major O*NET data-collection surveys (e.g., see Figure 1) all rely on single-item holistic rating scales as a means for allowing the system to achieve its developers' goal of dramatically reducing the cost and effort involved in data-collection (e.g., Peterson et al,. 1999, p. 487), relative to the DOT.

Although holistic rating methods are clearly successful with respect to the goal of simplifying the rating process, research suggests that they may suffer from difficulties with respect to being able to produce the levels of convergent validity that would be desired in a national occupational information system. In short, for precisely the same reasons clinical psychologists tend not to rely on single-item holistic rating scales to measure constructs such as *Conscientiousness*, *Verbal Ability*, or *Neuroticism* when assessing clients – e.g., reliability, accuracy, verifiability – questions can be raised regarding the advisability of using holistic scales to assess similarly abstract GWA constructs such as *Analyzing Data, Making Decisions and Solving Problems,* and *Controlling Machines and Processes*. Studies involving ratings of both job activities and worker-trait constructs (e.g., Butler & Harvey, 1988; DeNisi & Shaw, 1977; Gibson et al., 2004; Harvey, Wilson, & Blunt, 1994) have demonstrated that holistic judgment strategies often produce ratings that exhibit low (in some cases, effectively zero) levels of convergence with data collected using traditional decomposed-judgment methods, and that holistic ratings often show questionable levels of interrater agreement (e.g., Gibson et al., 2004; Harvey & Hollander, 2004).

For example, using actual GWA ratings from the national O*NET database, Harvey & Hollander (2004) reported that the median cross-rater correlation (i.e., comparing rating profiles for pairs of analysts rating the same occupation) across occupations was only $r = .63$, with over 75% of occupations showing values less than .70 (a value often cited as representing a minimum-acceptable level of agreement). To put these values into perspective, Harvey and Hollander (2004) used Monte Carlo methods to determine benchmark levels of agreement that would be produced from ratings having a given amount of rating error; results indicated that for the O*NET GWA scales, an observed agreement level of $r = .63$ would be expected when each analyst produced item ratings composed of approximately 50% *random* variance.

It is important to note that questions regarding the psychometric quality of holistic job ratings are hardly new, with similar issues having been raised – and subsequently largely ignored – with respect to the DOT (e.g., Boling & Fine, 1959; Cain & Green, 1983; Webb et al., 1981), which also used a number of single-item holistic scales to rate abstract work- and worker-trait requirements. For example, Bolling and Fine (1959) examined several strategies for collecting holistic ratings of worker-trait requirements, finding that an approach based on describing traits in theoretical, conceptual terms produced unacceptable performance. They concluded that rather than defining the dimensions in terms of clinical concepts regarding the traits themselves, they should be defined in terms of actual job-relevant situations. Unfortunately, as Figure 1 indicates, the holistic scales used in the O*NET tend to follow the clinical-definition approach; although some work behaviors are indeed used to anchor the scales, other than by chance these behaviors will typically *not* demonstrate any overlap with the actual behaviors performed on the job being rated.

In sum, the O*NET's GWAs were intended to provide a comprehensive taxonomy of work that would form the foundation for an economy-wide occupational system providing "the most comprehensive standard source of occupational information" available (Hubbard et al., 2000, p. v). Given this ambitious goal, as well as the research results noted above regarding discriminant and convergent validity, it seems somewhat premature to conclude – as did the developers of the O*NET – that "the proposed GWA taxonomy received considerable support," its GWA scales "provided reliable, coherent, and useful occupational information," and that its GWA taxonomy represents "a viable system for describing similarities and differences between occupations" (Jeanneret et al., 1999, p. 125). Before concluding that the O*NET's GWA taxonomy has indeed met its ambitious design goals, large-scale empirical studies are needed to further examine the question of whether its GWA elements define comprehensive and unique aspects of work that can be rated accurately and reliably, as well as determine whether holistic ratings of these abstract constructs exhibit adequate convergent validity with GWA scores obtained using traditional, independently verifiable job analysis methods. Although ultimately an empirical question, a review of the available research suggests ample basis for hypothesizing that serious problems regarding discriminant and convergent validity will be further documented by subsequent research.

The Role of FJA in a Post-DOT Environment

Since its inception, one of the most striking aspects of the O*NET project has been the *revolutionary* nature of the goals and methods surrounding it. Not content to simply find ways to streamline the process of revising the DOT or making it more accessible (e.g., APDOT, 1992; Dye & Silver, 1999), the O*NET project's goal became one of achieving a fundamental paradigm shift in occupational analysis that involved junking virtually every major aspect of the DOT: (a) field occupational analysts were replaced by non-field analysts working in small teams and rating using archival information (with the ultimate goal of relying on *job incumbents* to maintain the database; e.g., Hubbard et al., 2000); (b) the DOT occupational title taxonomy was replaced with a radically simpler system containing less than one-tenth the number of titles listed in the DOT; and (c) the content of the system was changed to describe a broad "content model" that emphasized holistic ratings of abstract work- and worker-trait constructs. As Peterson et al. (2001) noted, the goal was to produce a system that "provides a *highly usable* and *inexpensive* methodology for analyzing jobs… [that] is *much easier to use* than the analyst-based and largely narrative format of the DOT" (p. 487, emphasis added).

This desire to make a radical break with all technologies associated with the system it sought to replace (Dye & Silver, 1999, p. 9) was evident during the construction of O*NET's primary job analysis tool, the *General Work Activity* survey, and its GWA taxonomy (Jeanneret et al, 1999). Without question, FJA and its TDP taxonomy had exerted a major impact on occupational analysis – and the DOT trait-rating and title-code system in particular (e.g., Fine, 1955, 1968; Fine & Heinz, 1957, 1958) – during the half-century prior to the advent of O*NET. Even researchers working on other aspects of the O*NET (Mumford, Peterson, & Childs, 1999) acknowledged FJA's "*now-classic taxonomy* of data, people, and things as a way of structuring the major domains of people's work performance" (pp. 50-51, emphasis added).

However, no citation of FJA's theory, or Fine's TDP taxonomy, is to be found in the lengthy chapter describing the development of the O*NET's GWA taxonomy (Jeanneret et al., 1999) contained in the primary reference document for this project (Peterson et al., 1999). This omission is made all the more notable by virtue of the fact that when Jeanneret et al. (1999) factor analyzed their first-order GWAs, rather than finding the hypothesized 4- or 9-factor SOR model they predicted on theoretical grounds, their results instead indicated a 3-factor solution with factors they named *Working with Information*, *Working With and Directing the Activities of Others*; and *Manual and Physical Activities*. In other words, FJA's *Data, People,* and *Things.*

Three-factor solutions that are consistent with FJA's TDP taxonomy have now been documented in job analysis instruments ranging from the holistic O*NET *GWA* survey (Gibson et al., 2004; Jeanneret et al., 1999) through the highly detailed CMQ. Given the consistency of results found from instruments that vary dramatically in terms of numbers of items, item specificity, rating scale metric, and degree of content coverage of MSEP jobs, Fine's FJA theory clearly deserves consideration when a theory-based explanation of the latent structure of work is needed in the current post-DOT environment. Rather than trying to reinvent the wheel (giving it a new name in the process), it is time that researchers involved in developing an occupational analysis system for the 21st century adopted an *evolutionary* approach that recognizes, and builds upon, the large amount of prior research and theory that exists. Although for many personnel functions it may well be preferable to employ GWAs that are phrased at the higher level of specificity seen at the first-order level, there are other functions (e.g., developing a meaningful occupational title-code system) for which the macro-level view provided by FJA's *Things-Data-People* constructs will represent the preferred level of analysis.

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Table 1. *Rational Taxonomy of Work Dimensions*

PAQ System II	PMPQ	PDQ	EXCEL	ONET	CMQ-78	CMQ-42
(1) Advising, Negotiating, Persuading, Info Exchange, Plan, Decision Making, IC, EC, Demanding Situations, Supervision, Training, Math, Writing	(-) Communicate, Instructing (-) Interpersonal activities	(-) Supervising (-) Coordinating (-) Controlling (-) Consulting	(-) Employee Relations: Supervise,Lead,Instruct (-) HRM: Policy, Programs (-) IC: Consult, Communications	(25) Interpreting the Meaning of Information for Others (26) Comm. with Supervisors, Peers, or Subordinates (28) Establishing & Maintaining Interpersonal Relationships (31) Resolving Conflicts & Negotiating with Others (33) Coordinating the Work & Activities of Others (34) Developing & Building Teams (35) Teaching Others (36) Guiding, Directing, & Motivating Subordinates (37) Coaching & Developing Others (38) Providing Consultation & Advice to Others	(1) Negotiation (4) IC: Nonarea Mid, Nonsup - Give, Exchng, Solve, Decide (5) IC: Area Prof/Tech - Give, Exchng, Solve, Decide (10) IC: Execs - Chair to Decide, Solve, Resolve, Exchng (19) Meetings Attend: Persuade/Sell (49) IC: Techs - Supervise, Delegate (67) IC: Entertaining (61) IC: Treatment/Therapy (20) IC: Area Nonsupervisory (22) IC: Area Supervisory/Midmanager (29) IC: Area Nonsupervisory (40) IC: Sup/Manager - Inform, Interview, Take Orders (51) IC: Attend Execs - Exchange, Solve, Give (53) IC: Attend - Resolve Conflicts (54) IC: Sales - Inform, Supv, Resolve, Info (58) Attend - Train,Instruct (59) Attend Sup/Mgr/Prof/Tech - Coordinate, Schedule (44) IC/EC: Mgr, Exec, Tech, Nonbusiness - Sell/Persuade (71) IC: Unions - Supervise, Resolve, Info (72) IC: Managerial - Supervise, Delegate, Schedule (42) Meet Sup/Prof-Tech: Set Policy/Procedures	(13) Negotiation (16) Persuade/sell (19) IC: mid-level info/decide (35) IC: lower-level supervision (36) IC: middle-level supervision (37) IC: sales/service supervision (6) High-level: info/decide/resolve (7) Prof/tech: info/decide/resolve (8) Lower-level: info/decide/resolve
	(-) Second-language usage	(-) External contacts	(-) Customer Relations (-) Contract Management (-) EC: Legal, Government (-) EC: Prof.. Industrial	(27) Communicating with Persons Outside the Organization	(27) Language: Foreign (3) EC: Nonsupervisory - Give, Exchng, Solve, Decide (7) EC: Execs/Mgrs - Give, Exchng, Solve, Decide (21) EC: Business, Informal Info Exchange (32) EC: Mgr/Non - Inform, Interview, Exchange (46) Chair Meetings: Press/Media - Solve, Resolve, Exch (48) EC: Chair Prof/Tech - Info, Solve (50) EC: Attend Prof/Tech - Solve, Decide, Evaluate (52) EC: Unions - Info, Inform, Resolve + (64) EC: Serve as Consultant (65) EC: Contractors (66) EC: Mgr/Exec - Resolve Conflicts (74) EC: Mgr, Exec, Non - Train, Instruct (75) Suppliers, Purchasing (76) EC: Exec/Mgr – Schedule	(39) Language use/foreign (3) EC: Regulators, Govt (5) EC: mid-level, info/decide/supervise (21) EC: Entertain/persuade (23) EC: mid-level exchange info (40) EC: PT/mid-level conflicts (41) EC: projects/people supervising (33) EC: delegating/supervising
	(-) Processing Information, Data (-) Planning, Decision Making (-)Technical activities (-) Spec Training (-) Experience (-) Job Requirements	(-) Monitor Business Indicators (-) Strategic Long Range Planning (-) Products, Services	(-) Products, Services: R&D, Tech Support (-) Production Mgmt (-) Assets, Cash (-) HRM: Hiring (-) Finance, Admin. (-) Planning, Goals, Budgeting	(1) Getting Information Needed To Do The Job (7) Evaluating Information for Compliance to Standards (10) Making Decisions & Solving Problems (11) Thinking Creatively (12) Updating & Using Job-Relevant Knowledge (13) Developing Objectives & Strategies (14) Scheduling Work & Activities (15) Organizing, Planning, & Prioritizing Work (39) Performing Administrative Activities (40) Staffing Organizational Units (41) Monitoring & Controlling Resources	(57) Language: Computer (13) Language: English (12) MDM: POM (lower level) (14) MDM: HR,Budgets (mid level) (18) MDM: Delegated (26) MDM: Products/Services/Ops (upper level) (33) MDM: POM, Finance (upper level) (35) Evaluate Projects/People (68) MDM - Operations, Goals (upper level) (43) MDM: Start/Stop Businesses (upper level) (78) MDM - Investments	(38) Language use/programming (1) MDM: implementing (9) MDM: POM/HR, lower-impact (17) MDM: Acquire/start/sell businesses (25) MDM: products/services, lower-impact (27) MDM: POM/HR higher-level (28) MDM: prods/services, higher impact (34) MDM: financial (42) MDM: strat planning, entire org

(3) Keyboard Devices; Clerical information Processing				(8) Processing Information (9) Analyzing Data (24) Documenting/Recording Information	(73) Machines: Keyboard Equip, PC, Office – Operate (41) Machines: Office, Computer, Keyboard - Direct, Fix	(29) Tech/scientific/computers-machines (32) Office equipment
(4) Graphic Info; Measuring Devices; Input from Environment; Math				(21) Drafting, Laying-Out & Specifying Technical Devices, Parts, or Equipment (3) Monitoring Processes, Materials, or Surroundings (2) Identifying Objects, Actions, & Events (4) Inspecting Equipment, Structures, or Materials (5) Est. Chars. of Materials, Products, Events, or Info (6) Judging the Qualities of Objects, Services, or Persons	(36) Math (25) Information from Senses	(14) Take info, orders, interview
(10) Supervising People, Processes; Using Powered Mobile Equipment				(18) Controlling Machines & Processes	(62) IC: Laborers - Supervise, Direct, Inform (60) IC: Machine Workers - Inform, Supv, Delegate, Train (47) Machines/Tools: Direct, Correct, Train	(15) Powered tools/equipment
(11) Public, Sales, Customer Contact		(-) Customer Relations, Marketing	(-) EC: Public Relations (-) Products, Services: Marketing, Sales, Advertising	(30) Selling or Influencing Others	(2) EC: Customer/Client - Give, Exchng, Solve, Decide (6) EC: Regulators (11) EC: Government Officials (16) EC: Public - Info, Solve, Decide (17) EC: Children/Students (28) EC: Treatment/Therapy (31) Persuade/Sell (37) EC: Press/Media (63) EC: Media, Civic, Unions, Public - Supervise, Delegate (77) EC: Clients - Take Orders, Info	(18) EC: public/customers/clients info (24) EC: press/media (26) EC: students/children/civic (11) Treatment/therapy/safety
(5) Personal Service Work; Entertaining				(29) Assisting & Caring for Others (32) Performing For or Working Directly With the Public	(55) IC: Personal Service (70) EC: Entertaining	
(2) Machine, Equipment Operation, Setup; Measuring; Dirty Environment; Info From Work Environment				(19) Interacting with Computers (22) Repairing & Maintaining Mechanical Equipment (23) Repairing & Maintaining Electronic Equipment	(8) Vehicles: Operate, Repair, Fix (38) Tools: Repair/Diagnose (30) Tools: Operate/Control (34) Stationary Machines: Repair/Assemble (45) Machines: Tech/Scientific - Operate, Fix	
(8) Machines w/Continuous Controls; Powered Vehicles				(20) Operating Vehicles, Mechanized Devices, or Equipment	(15) Machines: Stationary Drill, Grind, Cut, Form, Mill (24) Machines: Moving/Processing (69) Machines: Print, Can, Bottle - Operate, Direct	(10) Stationary machines (30) Processing/moving machines (31) Stationary machines (20) Heavy/offroad vehicles
(9) Physical Activities				(17) Handling & Moving Objects (16) Performing General Physical Activities	(9) Physical Activities	(4) Physical activity
(12) Unpleasant, Hazardous Work Environment					(39) Tools: Weapons (56) Environmental Hazards/Unpleasant (23) Responsible For Safety of Others	(12) Enforcement/demanding conditions (2) Hazardous/unpleasant work environment (22) Safety/damage to others
(7) Specified Pace; Repetitive						
(13) Nontypical Schedule						
(6) Regular Day Schedule						

Table 2. *Simple Statistics for 78 First-Order Factor Score Estimates*

#	Label	Mean	SD	Skew	Kurtosis	3-factor h^2	7-factor h^2
1	Negotiation	-0.002	0.98	3.7	17.8	0.0909	0.1207
2	EC: Customer/Client - Give, Exchng, Solve, Decide	-0.011	0.97	3.1	11.3	0.0802	0.1052
3	EC: Nonsupervisory - Give, Exchng, Solve, Decide	0.022	1.01	3.0	11.2	0.2380	0.3140
4	IC: Nonarea Mid, Nonsup - Give, Exchng, Solve, Decide	0.008	0.97	1.5	3.4	0.2592	0.2588
5	IC: Area Prof/Tech - Give, Exchng, Solve, Decide	0.007	0.97	1.1	1.5	0.1636	0.2350
6	EC: Regulators	-0.006	0.95	5.5	38.2	0.2207	0.4044
7	EC: Execs/Mgrs - Give, Exchng, Solve, Decide	0.015	0.98	2.9	11.1	0.3291	0.2948
8	Vehicles: Operate, Repair, Fix	0.014	1.01	5.9	45.3	0.2094	0.2499
9	Physical Activities	0.008	0.98	1.5	2.9	0.2516	0.3551
10	IC: Execs - Chair to Decide, Solve, Resolve, Exchng	0.0008	0.95	2.7	10.1	0.2122	0.2226
11	EC: Government Officials	-0.011	0.96	5.2	34.3	0.2121	0.3650
12	MDM: POM (lower level)	-0.021	0.97	0.9	0.1	0.2077	0.1763
13	Language: English	0.001	0.97	0.2	-0.8	0.0004	0.2072
14	MDM: HR,Budgets (mid level)	-0.003	0.98	2.2	6.1	0.2830	0.2782
15	Machines: Stationary Drill, Grind, Cut, Form, Mill	0.011	1.01	3.6	13.9	0.2881	0.3712
16	EC: Public - Info, Solve, Decide	-0.001	0.95	3.9	19.2	0.0827	0.1556
17	EC: Children/Students	-0.005	0.97	3.1	14.6	0.0364	0.1500
18	MDM: Delegated	0.005	0.98	5.3	36.8	0.1053	0.1482
19	Meetings Attend: Persuade/Sell	-0.014	0.97	2.9	12.6	0.0822	0.2161
20	IC: Area Nonsupervisory	0.003	0.96	1.2	1.6	0.1868	0.1692
21	EC: Business, Informal Info Exchange	0.0008	0.97	1.5	3.4	0.1709	0.2012
22	IC: Area Supervisory/Midmanager	0.0004	0.96	1.2	2.2	0.1358	0.1382
23	Responsible For Safety of Others	-0.001	0.93	5.5	38.2	0.0768	0.0599
24	Machines: Moving/Processing	0.001	0.99	4.6	24.0	0.1027	0.1074
25	Information from Senses	-0.007	0.97	0.8	0.5	0.1530	0.2493
26	MDM: Products/Services/Ops (upper level)	-0.013	0.93	5.6	44.3	0.1124	0.1480
27	Language: Foreign	-0.015	0.93	7.0	56.4	0.0000	0.0147
28	EC: Treatment/Therapy	-0.006	0.87	11.8	175.0	0.0717	0.0238
29	IC: Area Nonsupervisory	0.004	0.96	0.5	0.1	0.0191	0.0952
30	Tools: Operate/Control	0.023	0.98	1.7	3.5	0.2046	0.1972
31	Persuade/Sell	-0.003	0.96	3.2	18.2	0.0439	0.1678
32	EC: Mgr/Non - Inform, Interview, Exchange	0.004	0.98	0.7	-0.0	0.0528	0.2000
33	MDM: POM, Finance (upper level)	-0.014	0.94	3.1	13.5	0.1377	0.1583
34	Stationary Machines: Repair/Assemble	0.001	0.96	10.6	134.1	0.0847	0.1291
35	Evaluate Projects/People	0.004	0.98	1.7	5.3	0.1437	0.1669
36	Math	0.002	0.98	2.4	7.2	0.0266	0.1099
37	EC: Press/Media	-0.006	0.95	7.1	82.9	0.0418	0.0580
38	Tools: Repair/Diagnose	0.017	0.99	5.0	37.0	0.0883	0.0915
39	Tools: Weapons	-0.008	0.94	3.0	12.1	0.0257	0.2350
40	IC: Sup/Manager - Inform, Interview, Take Orders	-0.004	0.96	0.0	-0.7	0.0373	0.1630
41	Machines: Office, Computer, Keyboard - Direct, Fix	-0.018	0.94	2.0	6.2	0.0116	0.0680
42	Meet Sup/Prof-Tech: Set Policy/Procedures	-0.020	0.94	1.6	6.5	0.1580	0.1512
43	MDM: Start/Stop Businesses (upper level)	-0.015	0.86	18.9	455.6	0.0362	0.0942
44	IC/EC: Mgr, Exec, Tech, Nonbusiness - Sell/Persuade	0.009	0.99	3.4	17.2	0.0547	0.2788
45	Machines: Tech/Scientific - Operate, Fix	-0.014	0.95	2.5	7.9	0.0139	0.0262
46	Chair Meetings: Press/Media - Solve, Resolve, Exch	-0.023	0.78	10.8	176.8	0.0096	0.0434
+7	Machines/Tools: Direct, Correct, Train	-0.008	0.94	3.9	20.7	0.1198	0.1334
48	EC: Chair Prof/Tech - Info, Solve	0.015	0.97	1.7	5.9	0.1847	0.1748
49	IC: Techs - Supervise, Delegate	-0.020	0.95	1.9	5.2	0.1063	0.0691
50	EC: Attend Prof/Tech - Solve, Decide, Evaluate	-0.006	0.96	1.4	5.5	0.1518	0.1575
51	IC: Attend Execs - Exchange, Solve, Give	0.009	0.97	1.4	2.7	0.1519	0.1353
52	EC: Unions - Info, Inform, Resolve	0.00011	0.98	2.1	7.1	0.0286	0.1618
53	IC: Attend - Resolve Conflicts	-0.023	0.95	1.1	3.8	0.0914	0.1046
54	IC: Sales - Inform, Supv, Resolve, Info	0.021	0.99	3.1	12.8	0.0447	0.1340
55	IC: Personal Service	0.003	0.96	6.9	59.2	0.0008	0.0042
56	Environmental Hazards/Unpleasant	0.018	0.99	2.1	8.8	0.2004	0.1668
57	Language: Computer	-0.009	0.93	3.9	19.7	0.0057	0.0537
58	Attend - Train,Instruct	0.016	0.97	0.9	1.5	0.0850	0.1308
59	Attend Sup/Mgr/Prof/Tech - Coordinate, Schedule	0.002	0.96	1.4	3.9	0.1465	0.1275
60	IC: Machine Workers - Inform, Supv, Delegate, Train	0.0004	0.95	1.9	5.1	0.0428	0.0531
61	IC: Treatment/Therapy	0.005	1.03	10.9	146.6	0.0263	0.0090
62	IC: Laborers - Supervise, Direct, Inform	-0.006	0.96	1.9	4.3	0.0783	0.0847
63	EC: Media, Civic, Unions, Public - Supervise, Delegate	0.023	1.08	11.9	244.6	0.0083	0.0235
64	EC: Serve as Consultant	0.003	0.94	1.0	2.6	0.0668	0.0582
65	EC: Contractors	-0.008	0.95	1.2	2.7	0.0598	0.0938
66	EC: Mgr/Exec - Resolve Conflicts	-0.012	0.95	1.6	5.8	0.0161	0.0451
67	IC: Entertaining	-0.002	0.94	7.2	76.0	0.0085	0.0551
68	MDM - Operations, Goals (upper level)	0.012	0.96	3.4	19.7	0.0461	0.0542
69	Machines: Print, Can, Bottle - Operate, Direct	-0.015	0.92	2.9	18.1	0.0013	0.0014

70	EC: Entertaining	-0.007	0.96	7.6	87.8	0.0117	0.0847
71	IC: Unions - Supervise, Resolve, Info	0.003	0.95	6.1	53.4	0.0078	0.0353
72	IC: Managerial - Supervise, Delegate, Schedule	-0.008	0.93	2.4	12.8	0.0804	0.0804
73	Machines: Keyboard Equip, PC, Office - Operate	-0.022	0.95	-0.3	-0.3	0.0053	0.0850
74	EC: Mgr, Exec, Non - Train, Instruct	0.002	0.97	1.4	7.5	0.0477	0.0970
75	Suppliers, Purchasing	-0.016	0.94	0.3	0.1	0.0604	0.0797
76	EC: Exec/Mgr - Schedule	-0.005	0.96	1.7	10.1	0.0240	0.0111
77	EC: Clients - Take Orders, Info	-0.001	0.92	0.5	3.8	0.0008	0.0310
78	MDM - Investments	0.038	0.99	2.6	21.1	0.0826	0.1101

Note. Simple statistics are for the first-order factor score estimates computed using the regression method for the holdout sample (N = 3,372); the 3- and 7-factor h^2 values represent the final communalities from the confirmatory factor models that included secondary loadings.

Table 3. *3-Factor Second-Order Factor Solution, 78 First-Order Factors*

		1	2	3
Factor Correlations				
Factor1		1.00	0.31	-0.03
Factor2		0.25	1.00	-0.04
Factor3		0.03	0.02	1.00
Second Order Factor 1 – Interpersonal Activities, External Contacts				
Fact7	EC: Execs/Mgrs - Give,Exchng,Solve,Decide	***0.44***	0.05	-0.08
Fact11	EC: Government Officials	***0.43***	-0.05	-0.00
Fact3	EC: Nonsupervisory - Give,Exchng,Solve,Decide	***0.40***	-0.08	0.02
Fact6	EC: Regulators	***0.40***	-0.03	-0.00
Fact21	EC: Business, Informal Info Exchange	***0.39***	0.06	0.04
Fact48	EC: Chair Prof/Tech - Info,Solve	***0.37***	-0.03	-0.01
Fact35	Evaluate Projects/People	***0.34***	***0.14***	0.02
Fact16	EC: Public - Info,Solve,Decide	***0.34***	-0.06	***0.12***
Fact2	EC: Customer/Client - Give,Exchng,Solve,Decide	***0.33***	0.05	0.00
Fact50	EC: Attend Prof/Tech - Solve,Decide,Evaluate	***0.33***	0.00	0.01
Fact4	IC: Nonarea Mid,Nonsup - Give,Exchng,Solve,Decide	***0.31***	***0.23***	-0.10
Fact59	Attend Sup/Mgr/Prof/Tech - Coordinate,Schedule	***0.30***	0.07	-0.00
Fact1	Negotiation	***0.28***	***0.13***	-0.07
Fact19	Meetings Attend: Persuade/Sell	***0.28***	***0.12***	0.00
Fact53	IC: Attend - Resolve Conflicts	***0.27***	***0.13***	0.04
Fact5	IC: Area Prof/Tech - Give,Exchng,Solve,Decide	***0.27***	***0.21***	-0.03
Fact42	Meet Sup/Prof-Tech: Set Policy/Procedures	***0.26***	***0.17***	-0.05
Fact58	Attend - Train,Instruct	***0.24***	0.10	***0.11***
Fact37	EC: Press/Media	***0.23***	-0.05	0.05
Fact31	Persuade/Sell	***0.23***	0.06	-0.03
Fact74	EC: Mgr,Exec,Non - Train,Instruct	***0.21***	0.06	0.01
Fact46	Chair Meetings: Press/Media - Solve,Resolve,Exch	***0.19***	-0.05	0.01
Fact66	EC: Mgr/Exec - Resolve Conflicts	***0.14***	0.10	0.06
Fact76	EC: Exec/Mgr - Schedule	***0.06***	-0.00	-0.01
Fact63	EC: Media,Civic,Unions,Public - Supervise,Delegate	***0.05***	0.03	0.04
Second Order Factor 2 – Managerial Decision Making, Internal Contacts				
Fact12	MDM: POM (lower level)	0.01	***0.48***	0.01
Fact14	MDM: HR,Budgets (mid level)	-0.01	***0.46***	-0.10
Fact49	IC: Techs - Supervise,Delegate	0.05	***0.35***	0.01
Fact22	IC: Area Supervisory/Midmanager	***0.13***	***0.32***	0.00
Fact33	MDM: POM,Finance (upper level)	-0.02	***0.31***	-0.06
Fact51	IC: Attend Execs - Exchange,Solve,Give	***0.11***	***0.30***	-0.03
Fact26	MDM: Products/Services/Ops (upper level)	-0.01	***0.29***	-0.00
Fact20	IC: Area Nonsupervisory	0.12	***0.27***	0.06
Fact72	IC: Managerial - Supervise,Delegate,Schedule	-0.00	***0.27***	0.02
Fact75	Suppliers,Purchasing	-0.08	***0.27***	-0.04
Fact10	IC: Execs - Chair to Decide,Solve,Resolve,Exchng	***0.20***	***0.25***	***-0.13***
Fact40	IC: Sup/Manager - Inform,Interview,Take Orders	0.04	***0.24***	0.03
Fact18	MDM: Delegated	0.02	***0.24***	0.03
Fact65	EC: Contractors	***0.11***	***0.24***	***0.13***
Fact54	IC: Sales - Inform,Supv,Resolve,Info	-0.02	***0.23***	-0.07
Fact44	IC/EC: Mgr,Exec,Tech,Nonbusiness - Sell/Persuade	0.07	***0.23***	0.00
Fact64	EC: Serve as Consultant	0.07	***0.22***	0.00
Fact32	EC: Mgr/Non - Inform,Interview,Exchange	***0.18***	***0.19***	0.08
Fact78	MDM - Investments	0.04	***0.18***	-0.00

Fact60	IC: Machine Workers - Inform,Supv,Delegate,Train	-0.06	***0.18***	***0.14***
Fact68	MDM - Operations,Goals (upper level)	-0.03	***0.16***	0.00
Fact41	Machines: Office,Computer,Keyboard - Direct,Fix	-0.01	***0.16***	0.04
Fact43	MDM: Start/Stop Businesses (upper level)	-0.06	***0.15***	-0.03
Fact67	IC: Entertaining	-0.03	***0.13***	0.03
Fact73	Machines: Keyboard Equip,PC,Office - Operate	0.04	***0.13***	0.01
Fact57	Language: Computer	0.00	***0.12***	0.00
Fact29	IC: Area Nonsupervisory	0.06	***0.11***	0.10
Fact69	Machines: Print,Can,Bottle - Operate,Direct	-0.01	***-0.05***	0.00
Second Order Factor 3 – Tool/Equipment Use, Physical Activities, Work Environment				
Fact9	Physical Activities	0.02	-0.09	***0.47***
Fact56	Environmental Hazards/Unpleasant	0.03	-0.07	***0.40***
Fact30	Tools: Operate/Control	-0.04	-0.02	***0.39***
Fact25	Information from Senses	0.06	0.01	***0.38***
Fact8	Vehicles: Operate,Repair,Fix	-0.05	0.00	***0.37***
Fact15	Machines: Stationary Drill,Grind,Cut,Form,Mill	-0.07	-0.02	***0.36***
Fact47	Machines/Tools: Direct,Correct,Train	-0.07	***0.11***	***0.32***
Fact38	Tools: Repair/Diagnose	-0.02	0.01	***0.28***
Fact62	IC: Laborers - Supervise,Direct,Inform	-0.02	***0.17***	***0.27***
Fact23	Responsible For Safety of Others	0.04	0.02	***0.26***
Fact24	Machines: Moving/Processing	-0.05	0.01	***0.25***
Fact17	EC: Children/Students	***0.11***	0.01	***0.23***
Fact39	Toos: Weapons	0.07	-0.06	***0.21***
Fact28	EC: Treatment/Therapy	0.02	-0.00	***0.21***
Fact52	EC: Unions - Info,Inform,Resolve	***0.16***	0.06	***0.19***
Fact36	Math	0.05	0.08	***0.17***
Fact34	Stationary Machines: Repair/Assemble	-0.03	-0.00	***0.16***
Fact71	IC: Unions - Supervise,Resolve,Info	0.00	0.08	***0.14***
Fact61	IC: Treatment/Therapy	-0.00	0.08	***0.13***
Fact45	Machines: Tech/Scientific - Operate,Fix	-0.01	0.05	***0.12***
Fact77	EC: Clients - Take Orders,Info	0.04	-0.06	***0.11***
Fact13	Language: English	0.04	0.09	***0.09***
Fact55	IC: Personal Service	-0.00	0.07	***0.08***
Fact70	EC: Entertaining	0.01	0.06	***0.07***
Fact27	Language: Foreign	0.00	0.01	***0.02***

Note. EC = External Contacts; IC = Internal Contacts; MDM = Managerial Decision Making. Loadings are Harris-Kaiser ($p = 0.5$) rotated primary factor pattern loadings of the first-order factor score estimates on the second-order factors, using the derivation sample ($N = 3{,}371$). Italicized loadings defined the hypothesized pattern of free loadings for the confirmatory factor analysis. Factor correlations that lie below the diagonal are from exploratory solution, those above are from the confirmatory model including secondary loadings.

Table 4. *7-Factor Second-Order Factor Solution, 78 First-Order Factors*

	1	2	3	4	5	6	7
Factor Correlations							
Factor1	1.00	0.40	0.27	-0.01	0.08	0.22	0.31
Factor2	0.23	1.00	0.13	-0.07	0.03	0.12	0.11
Factor3	0.19	0.09	1.00	-0.05	0.02	0.33	0.22
Factor4	0.00	-0.03	-0.02	1.00	-0.06	-0.03	0.14
Factor5	0.02	0.04	-0.01	0.13	1.00	-0.04	-0.08
Factor6	0.13	0.12	0.15	-0.01	0.07	1.00	0.20
Factor7	0.15	0.05	0.08	0.03	0.10	0.11	1.00
Second-Order Factor 1 – Interpersonal Contacts: Work Information Exchange							
4 IC: Nonarea Mid,Nonsup - Give,Exchng,Solve,Decide	***0.45***	0.06	***0.11***	-0.04	-0.03	0.04	-0.10
5 IC: Area Prof/Tech - Give,Exchng,Solve,Decide	***0.44***	0.01	0.07	-0.03	-0.00	-0.02	0.02
3 EC: Nonsupervisory - Give,Exchng,Solve,Decide	***0.35***	***0.18***	***-0.18***	0.00	0.02	0.04	-0.04
20 IC: Area Nonsupervisory	***0.33***	-0.09	***0.14***	-0.01	***0.11***	0.06	-0.01
59 Attend Sup/Mgr/Prof/Tech - Coordinate,Schedule	***0.31***	***0.14***	-0.00	0.04	-0.06	-0.04	0.06
29 IC: Area Nonsupervisory	***0.30***	***-0.17***	-0.08	0.01	0.03	0.01	***0.14***
21 EC: Business, Informal Info Exchange	***0.30***	***0.19***	-0.04	-0.04	0.05	-0.03	***0.17***
22 IC: Area Supervisory/Midmanager	***0.30***	-0.02	***0.22***	0.00	0.02	0.02	0.02
50 EC: Attend Prof/Tech - Solve,Decide,Evaluate	***0.29***	***0.16***	-0.08	0.01	-0.02	-0.01	0.06
35 Evaluate Projects/People	***0.28***	***0.20***	0.07	0.04	-0.00	0.01	0.03
42 Meet Sup/Prof-Tech: Set Policy/Procedures	***0.28***	***0.12***	***0.12***	-0.01	-0.01	0.02	-0.05
58 Attend - Train,Instruct	***0.27***	0.07	-0.01	0.04	0.04	-0.01	***0.15***

53 IC: Attend - Resolve Conflicts	***0.23***	***0.13***	0.05	0.01	0.04	0.08	0.03
64 EC: Serve as Consultant	***0.19***	-0.08	0.08	-0.08	0.07	***0.18***	-0.02
45 Machines: Tech/Scientific - Operate,Fix	***0.13***	-0.10	0.01	0.02	***0.11***	***-0.12***	0.09
Second-Order Factor 2 – External Contacts							
6 EC: Regulators	0.00	***0.45***	0.05	0.01	0.01	0.00	0.03
11 EC: Government Officials	0.06	***0.44***	0.02	-0.01	0.03	-0.05	0.04
7 EC: Execs/Mgrs - Give,Exchng,Solve,Decide	***0.12***	***0.44***	***0.11***	0.00	-0.05	0.02	-0.04
16 EC: Public - Info,Solve,Decide	-0.02	***0.32***	-0.04	-0.06	***0.21***	0.07	***0.11***
37 EC: Press/Media	-0.06	***0.27***	0.00	-0.04	***0.13***	0.00	0.06
48 EC: Chair Prof/Tech - Info,Solve	***0.26***	***0.26***	-0.05	0.07	-0.06	-0.02	-0.03
2 EC: Customer/Client - Give,Exchng,Solve,Decide	***0.14***	***0.24***	-0.03	0.00	-0.02	***0.13***	0.07
46 Chair Meetings: Press/Media - Solve,Resolve,Exch	-0.06	***0.24***	-0.00	-0.01	0.05	0.04	0.01
1 Negotiation	***0.14***	***0.21***	0.06	0.00	-0.07	***0.20***	-0.07
74 EC: Mgr,Exec,Non - Train,Instruct	0.07	***0.15***	-0.01	-0.04	0.00	0.10	***0.13***
Second-Order Factor 3 – Mangerial Decisions							
14 MDM: HR,Budgets (mid level)	-0.00	0.05	***0.53***	-0.02	-0.01	0.04	-0.04
12 MDM: POM (lower level)	***0.19***	-0.05	***0.43***	0.00	0.04	-0.02	0.09
33 MDM: POM,Finance (upper level)	-0.00	0.02	***0.36***	-0.00	-0.00	0.03	-0.03
26 MDM: Products/Services/Ops (upper level)	-0.07	0.08	***0.32***	0.06	-0.07	-0.00	***0.14***
10 IC: Execs - Chair to Decide,Solve,Resolve,Exchng	0.09	***0.21***	***0.29***	-0.01	-0.07	0.08	***-0.12***
18 MDM: Delegated	-0.08	***0.12***	***0.29***	0.06	-0.02	-0.02	0.13
51 IC: Attend Execs - Exchange,Solve,Give	***0.12***	0.06	***0.27***	-0.03	0.01	0.04	0.05
49 IC: Techs - Supervise,Delegate	***0.16***	-0.04	***0.26***	-0.00	0.01	0.07	0.08
72 IC: Managerial - Supervise,Delegate,Schedule	-0.00	-0.02	***0.22***	-0.03	0.07	***0.19***	0.00
78 MDM - Investments	-0.02	0.07	***0.21***	-0.01	0.05	0.04	-0.00
43 MDM: Start/Stop Businesses (upper level)	***-0.12***	0.04	***0.18***	0.02	-0.05	0.08	0.01
68 MDM - Operations,Goals (upper level)	-0.01	-0.04	***0.15***	-0.06	0.06	0.01	0.07
77 EC: Clients - Take Orders,Info	0.01	-0.04	***-0.22***	0.02	0.00	0.13	***0.18***
Second-Order Factor 4 – Mechanical Activities							
15 Machines: Stationary Drill,Grind,Cut,Form,Mill	-0.02	0.00	-0.01	***0.49***	0.01	0.00	-0.04
8 Vehicles: Operate,Repair,Fix	-0.03	0.01	-0.01	***0.45***	0.02	0.03	0.02
30 Tools: Operate/Control	-0.01	0.00	-0.01	***0.42***	0.10	-0.04	0.01
47 Machines/Tools: Direct,Correct,Train	0.01	-0.03	0.08	***0.37***	0.04	0.00	0.05
24 Machines: Moving/Processing	0.02	-0.02	0.00	***0.32***	-0.01	-0.07	0.06
38 Tools: Repair/Diagnose	0.03	-0.02	-0.04	***0.31***	0.02	0.02	0.07
34 Stationary Machines: Repair/Assemble	-0.01	0.01	-0.00	***0.26***	-0.03	0.03	-0.03
60 IC: Machine Workers - Inform,Supv,Delegate,Train	0.08	***-0.12***	0.06	***0.18***	-0.01	***0.15***	0.00
62 IC: Laborers - Supervise,Direct,Inform	0.03	-0.07	0.09	***0.17***	***0.16***	***0.15***	0.02
Second-Order Factor 5 – Physical Activities, Work Environment							
9 Physical Activities	0.02	-0.01	-0.01	***0.21***	***0.48***	-0.08	-0.08
39 Toos: Weapons	-0.03	0.01	0.00	-0.10	***0.44***	-0.00	-0.06
25 Information from Senses	0.09	-0.01	0.03	***0.14***	***0.40***	-0.08	-0.00
52 EC: Unions - Info,Inform,Resolve	-0.05	0.09	0.03	***-0.12***	***0.35***	***0.16***	***0.12***
17 EC: Children/Students	-0.04	0.03	-0.05	-0.07	***0.30***	***0.14***	***0.17***
56 Environmental Hazards/Unpleasant	0.01	0.01	-0.04	***0.27***	***0.29***	-0.03	-0.03
23 Responsible For Safety of Others	-0.01	0.00	-0.04	0.10	***0.18***	0.09	***0.13***
71 IC: Unions - Supervise,Resolve,Info	0.00	-0.03	0.03	0.03	***0.15***	***0.12***	-0.00
76 EC: Exec/Mgr - Schedule	0.03	0.03	-0.10	0.04	***-0.12***	***0.11***	0.09
75 Suppliers,Purchasing	0.08	***-0.11***	***0.17***	0.06	***-0.17***	0.02	***0.14***
Second-Order Factor 6 – Interpersonal Activities: Sales, Marketing							
44 IC/EC: Mgr,Exec,Tech,Nonbusiness - Sell/Persuade	-0.01	0.01	0.05	-0.01	-0.02	***0.45***	0.01
54 IC: Sales - Inform,Supv,Resolve,Info	0.04	-0.09	0.08	-0.02	-0.09	***0.31***	-0.01
70 EC: Entertaining	-0.05	-0.00	-0.04	0.05	-0.00	***0.30***	0.01
31 Persuade/Sell	0.09	***0.16***	-0.00	0.00	-0.01	***0.28***	***-0.13***
67 IC: Entertaining	0.01	-0.09	0.00	0.00	-0.01	***0.27***	0.00
19 Meetings Attend: Persuade/Sell	***0.16***	***0.15***	0.00	-0.00	0.01	***0.26***	-0.03
66 EC: Mgr/Exec - Resolve Conflicts	0.01	0.10	0.00	-0.00	0.02	***0.17***	***0.14***
63 EC: Media,Civic,Unions,Public - Supervise,Delegate	-0.07	0.06	-0.02	0.00	-0.01	***0.15***	0.10
55 IC: Personal Service	-0.00	-0.05	0.00	-0.00	0.09	***0.13***	0.02
28 EC: Treatment/Therapy	-0.04	-0.00	-0.08	0.08	0.13	***0.13***	***0.11***
61 IC: Treatment/Therapy	0.01	-0.05	-0.00	0.06	0.07	***0.13***	0.05
Second-Order Factor 7 – Language Use, Information Procesing							
13 Language: English	-0.06	0.08	0.00	0.08	***-0.12***	-0.06	***0.43***

32 EC: Mgr/Non - Inform,Interview,Exchange	0.10	0.04	0.07	***-0.14***	***0.15***	0.06	***0.29***
40 IC: Sup/Manager - Inform,Interview,Take Orders	***0.21***	***-0.11***	0.05	-0.00	-0.06	0.03	***0.26***
36 Math	-0.05	0.04	0.02	0.03	***0.11***	0.04	***0.25***
41 Machines: Office,Computer,Keyboard - Direct,Fix	0.08	-0.09	0.02	-0.00	-0.04	0.03	***0.24***
73 Machines: Keyboard Equip,PC,Office - Operate	***0.13***	-0.08	0.02	***-0.11***	0.05	-0.05	***0.23***
57 Language: Computer	0.03	-0.01	0.06	-0.00	-0.06	-0.03	***0.21***
65 EC: Contractors	0.09	0.04	***0.12***	0.05	0.05	***0.11***	***0.17***
27 Language: Foreign	-0.05	0.00	-0.03	-0.02	-0.01	0.05	***0.14***
69 Machines: Print,Can,Bottle - Operate,Direct	-0.02	0.02	-0.03	0.05	-0.02	0.01	***-0.07***

Note. EC = External Contacts; IC = Internal Contacts; MDM = Managerial Decision Making. Entries are Harris-Kaiser (p = 0.5) rotated primary factor pattern loadings of the first-order factor score estimates on the second-order factors, using the derivation sample (N = 3,371). Italicized loadings defined the hypothesized pattern of free loadings for the confirmatory factor analysis. Factor correlations that lie below the diagonal are from exploratory solution, those above are from the confirmatory model including secondary loadings.

Table 5. *Fit Indices from Confirmatory Factor Analyses of 78 First-Order Factor Score Estimates*

Model	*Df*	Fit	GFI	AGFI	RMSR	PFI
0-factor (null) model	3003	14.2640	0.7322	0.7252	0.0680	0.7322
1-factor model	2925	6.8233	0.8719	0.8651	0.0471	0.8492
3-factor using only primary free loadings, orthogonal	2925	7.5147	0.8589	0.8514	0.0494	0.8366
3-factor using only primary free loadings, oblique	2922	5.5155	0.8964	0.8908	0.0423	0.8723
3-factor with secondary loadings, orthogonal	2904	5.4799	0.8971	0.8908	0.0422	0.8675
3-factor with secondary loadings, oblique	2901	5.0141	0.9059	0.9000	0.0403	0.8751
7-factor using only primary free loadings, orthogonal	2925	8.3076	0.8219	0.8124	0.0519	0.8005
7-factor using only primary free loadings, oblique	2904	4.4072	0.9055	0.8997	0.0378	0.8757
7-factor with secondary loadings, orthogonal	2852	4.7948	0.9100	0.9028	0.0394	0.8642
7-factor with secondary loadings, oblique	2831	3.5774	0.9328	0.9269	0.0341	0.8794

Note. Fit indices are for confirmatory factor models estimated using unweighted least squares estimation, with scores on the 78 first-order factor score estimates serving as the manifest variables, using the holdout sample (N = 3,372). GFI = goodness of fit index; AGFI = adjusted GFI; RMSR= root-mean-square residual; PFI = Parsimonious GFI.

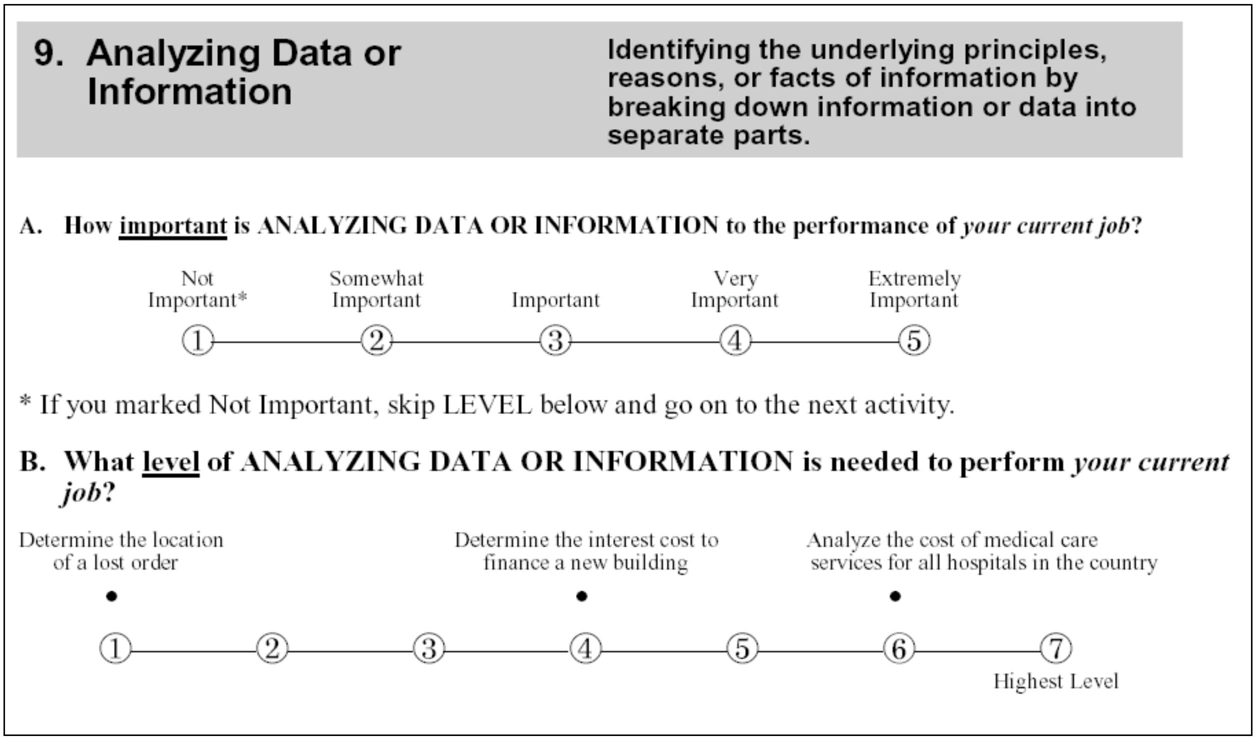

Figure 1. Sample holistic rating scale from the O*NET GWA survey.

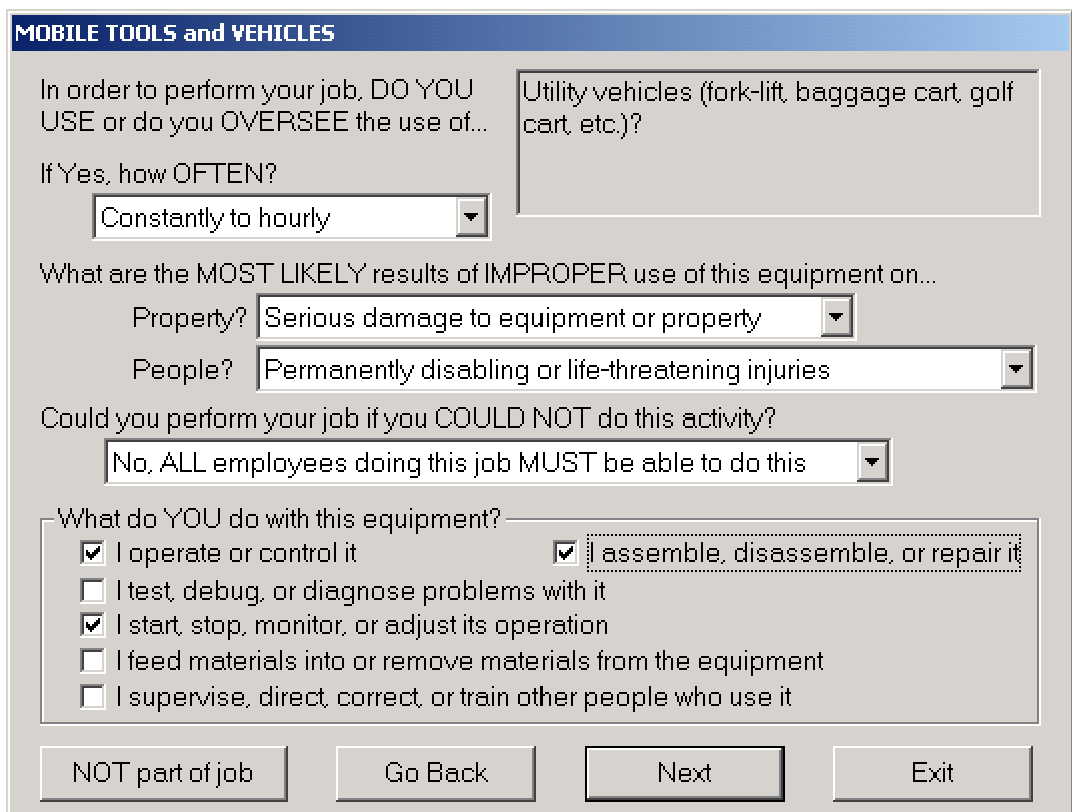

Figure 2. Sample rating screens from the PC-based CMQ data collection program.

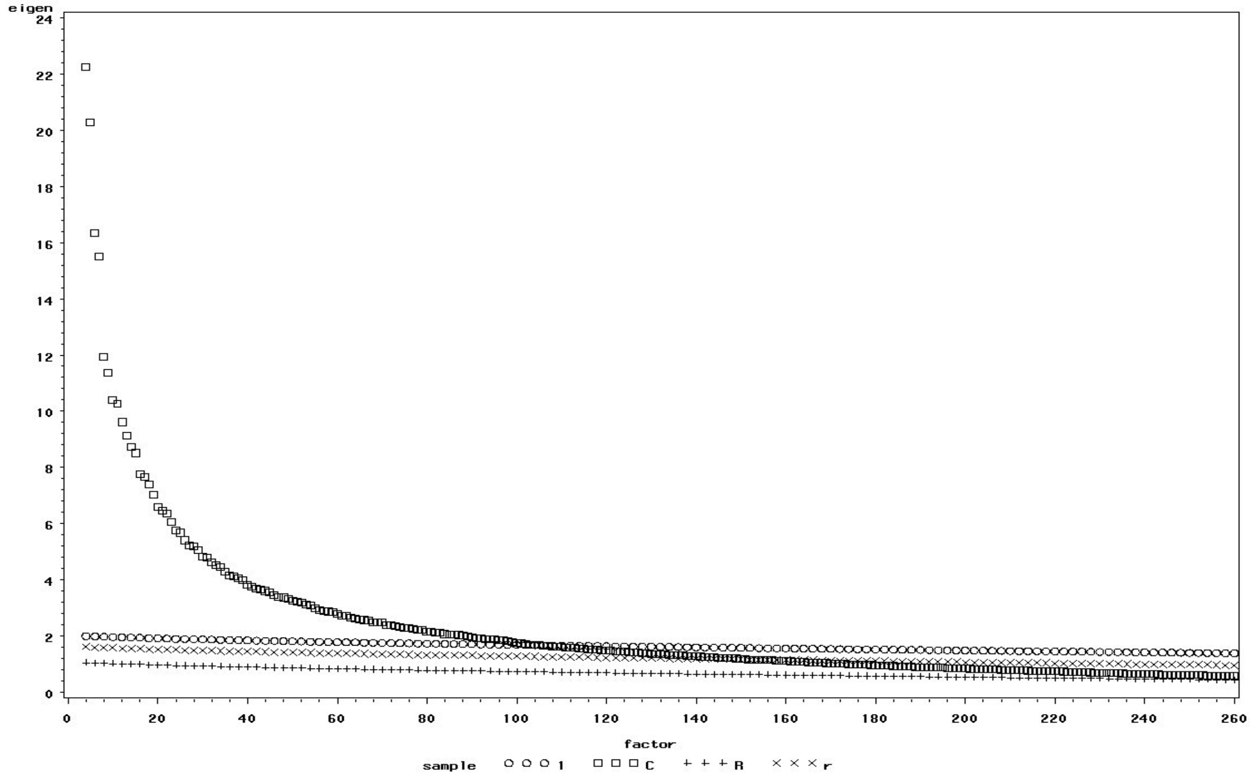

Figure 3. Scree plot of eigenvalues for factors 3-200 of 1,222 item correlation matrix of $N = 6,743$ responses from actual CMQ positions (squares), as well as parallel-analysis (random data) responses using communality estimates of maximum-r ('+'), random estimates ('X'), and 1.0 ('1').

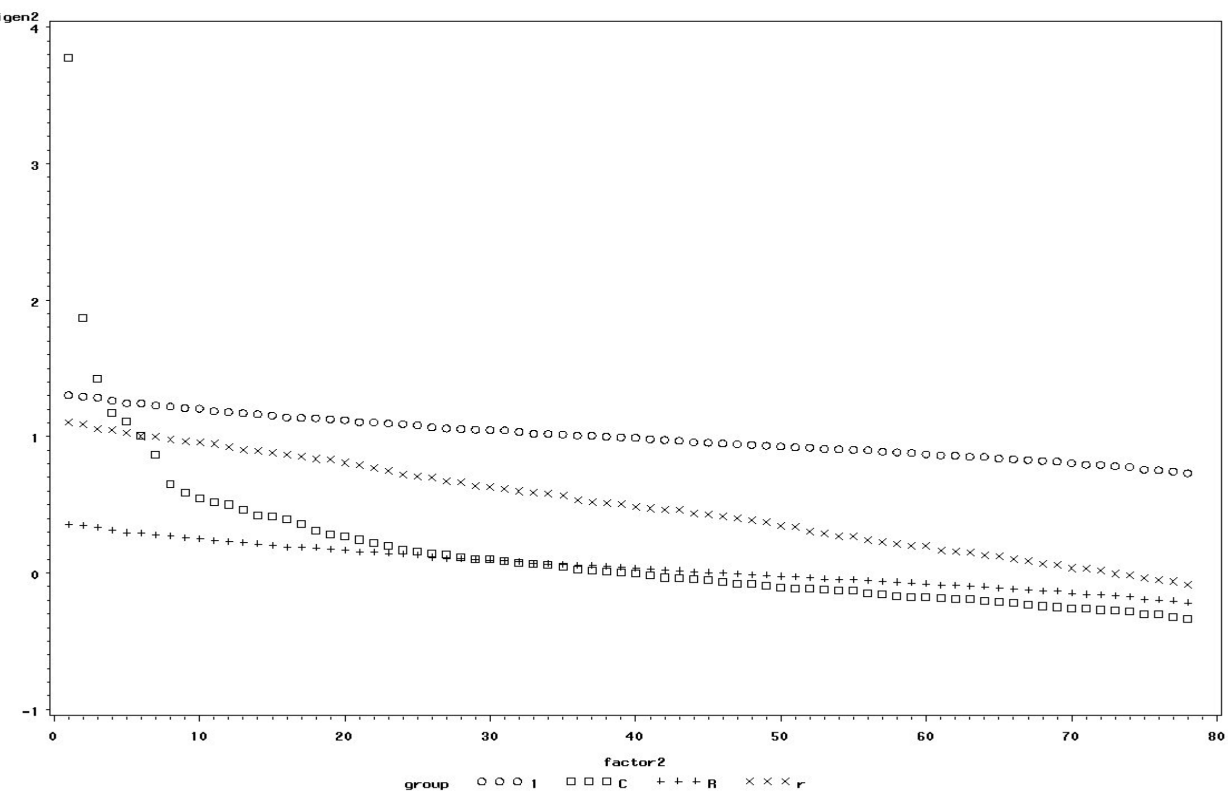

Figure 4. Scree plot of eigenvalues (squares) of the correlation matrix computed on $N = 3,371$ factor score estimates for the 78-factor first-order CMQ solution, as well as parallel-analysis (random data) responses using communality estimates of maximum-r ('+'), random estimates ('X'), and 1.0 ('1').