

A Comparison of Incumbent and Analyst Ratings of O*NET Skills

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April 26, 2006

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Background

The Occupational Information Network (O*NET) is a comprehensive system, developed by the U.S. Department of Labor, that provides information about occupations within the U.S. economy. The National O*NET Consortium's National Center for O*NET development is currently collecting various types of data on over 950 Standard Occupational Classifications (hereafter referred to as "SOCs"). One type of data being collected is the skills importance to performance in each SOC. To date, O*NET has relied on job incumbents to indicate the skills required by the work in their respective occupation. However, trained analysts have also provided skill ratings on a subset of these SOCs.

O*NET contracted with the Human Resources Research Organization (HumRRO) to conduct a study to help determine whether job incumbents or analysts should provide skill information in future data collections. Several considerations are relevant to this decision. First, there are theoretical or philosophical reasons for preferring one rater group to the other. For example, analysts, who have advanced research degrees and experience in job analysis, may understand the skill constructs better than incumbents. Conversely, incumbents are generally more familiar with the day-to-day duties of their jobs, and thus may be better able to judge the relative importance of various skills to their work. In addition, some O*NET users might perceive skill information based on incumbent ratings to have higher face validity than information based on analyst ratings. Although such theoretical issues are important, thinking about them exclusively does not lend to a clear choice between incumbent and analyst ratings.

Practical factors, such as time, cost, and convenience are also important to consider when deciding between incumbents and analysts. For example, it is costly and time-consuming to train analysts to evaluate the requirements of O*NET occupations. There also are costs associated with obtaining quality ratings from a representative group of incumbents, such as the effort required to draw a sample and the follow-up steps needed to ensure high response rates. Such considerations of relative practicality should be taken into account when trying to determine the preferred source of ratings.

A final issue to consider is whether there are differences in the psychometric "quality" of incumbent and analyst ratings. For example, ratings from one group may be more reliable and/or better represent the intended skill constructs than ratings from the other group. It is also important to determine whether such differences, should they exist, have practical implications for the use of O*NET skill information. For instance, the online reporting of skills data might differ depending on whether incumbent or analyst ratings are used to populate the O*NET database.

The goal of this study was to compare the psychometric quality of incumbent and analyst skills ratings across a large sample of O*NET SOCs. In the pages that follow, we describe (a) the analysis sample and study methodology, (b) the results of the data analyses, and (c) the implications of the results for collecting and reporting occupational skill information. However,

we begin with a brief review of prior research that has compared job analysis information from incumbent and analyst raters.

Previous Research on Incumbent-Analyst Differences

Numerous studies have examined job analysis information provided by raters from different perspectives. Most of this research has compared ratings of job incumbents and supervisors (e.g., Manson, Levine, & Brannick, 2000; Van Iddekinge, Putka, Raymark, & Eidson, 2005; Wilson, 1997). In contrast, very few published studies have compared incumbent and analyst job ratings. One such study was a meta-analysis of the reliability of job analysis ratings (Dierdorff & Wilson, 2003). The researchers applied Spearman-Brown corrections to observed reliability coefficients to estimate interrater reliability for scenarios that differed in number of job analysis raters and questionnaire items. Results revealed that although the interrater reliability of task ratings was much higher for analysts than for incumbents, the reliability estimates for generalized work activity (GWA) ratings were comparable. For example, for 15 raters and a 100-item job analysis survey, the mean interrater estimates for the two groups were .87 and .54 for tasks ratings and .47 and .44 for GWA ratings.

Other research has directly compared incumbent and analyst ratings of the same jobs or occupations. Smith and Hakel (1979) examined incumbent and analyst Position Analysis Questionnaire (PAQ; McCormick, Jeanneret, & Mecham, 1972) ratings across 25 state government jobs. The mean (single-rater) interrater reliability estimates for incumbents and analysts (.59 and .63, respectively) were comparable, and the average correlation between the two sets of ratings was very high ($r = .93$). Nevertheless, the researchers discovered that incumbent ratings of “socially desirable” PAQ items were significantly higher than analyst ratings of such items.

More recently, Mumford, Peterson, and Childs (1999) compared incumbent and analyst importance ratings of O*NET skills from 35 SOCs. They found that incumbent ratings were over one-half of a standard deviation higher than analyst ratings ($d = 0.58$) across skills and SOCs. Despite this, the median correlation between ratings of the two groups—.75—was quite high ($r = .87$ after correcting for unreliability in both sets of ratings).

Johnson, Dorsey, and Carter (2000) also compared O*NET skill ratings of incumbents and analysts and reported similar results. Across 17 occupations, they found single-rater reliability estimates of .37 and .57 for incumbents and analysts, respectively. The mean skill ratings of the two groups correlated .67. The researchers also examined the means of incumbent and analyst ratings (for 31 skills and 59 occupations for which they had sufficient data) and found that incumbent ratings tended to be higher (mean $d = 0.63$).

In sum, there is preliminary evidence to suggest that differences exist between job analysis ratings of incumbents and analysts. For one, interrater reliability appears to be higher among analysts than incumbents, although the magnitude of reliability differences may vary across descriptors (Dierdorff & Wilson, 2003). Results of the above research also suggest that job incumbents typically provide higher ratings than analysts. The prevailing theory for this finding is that incumbents tend to believe their jobs are more complex and/or desirable than do other types of raters (Morgeson & Campion, 1997; Smith & Hakel, 1979). It has also been

suggested that some incumbents deliberately inflate their ratings to influence policy decisions regarding, for example, compensation and training (Harvey, 1991; Morgeson, Delaney-Klinger, Mayfield, Ferrara, & Campion, 2004). Skill ratings may be particularly vulnerable to such effects given that they are more abstract and thus more difficult to verify than more observable descriptors such as job tasks (Morgeson & Campion, 1997; Morgeson et al., 2004). Despite the interrater reliability and mean differences between incumbents and analysts, the results of these studies suggest that the two groups have very similar perceptions about the relative importance of job/occupational descriptors.

Although the results of these prior studies are informative, there are several reasons why additional research is needed to help identify the preferred sources of O*NET skill information. First, the two O*NET studies (Johnson et al., 2000; Mumford et al., 1999) compared incumbent and analyst ratings across the 46 skills that comprised the original O*NET skills taxonomy. Since then, the taxonomy has been refined (i.e., it now includes only 35 skills), and thus it is important to reassess the nature and degree of incumbent-applicant rating differences. Second, the results of these two studies are based on a relatively small number of O*NET SOCs. As such, it is unclear whether their results generalize to the wide range of SOCs that comprise the current O*NET database. In the present study, we examined incumbent-applicant differences in a much larger sample, representing nearly 30% of all O*NET SOCs. Taken together, we believe the current study will provide a more complete assessment of the nature and potential implications of differences between incumbent and analyst ratings.

Method

Standard Occupational Classifications

Incumbent and analyst skill ratings were compared using 289 SOCs from the first three cycles of the O*NET Data Collection Program. A list of these SOCs, organized by the SOC major groups of the Bureau of Labor Statistics, is provided in Appendix A. Table 1 shows how the SOCs are distributed across the 23 major groups. For comparison, we also show the distribution of all O*NET SOCs across major groups. In general, the sample SOCs are fairly representative of O*NET overall. However, the analysis sample did not include any SOCs from 2 of the 23 Major Groups (i.e., Building and Grounds Cleaning and Maintenance and Farming, Fishery, and Forestry). The sample also comprised a smaller percentage of Production SOCs relative to O*NET in general (i.e., 2.1% vs. 20.3%). Although it would have been nice to have more Production SOCs, similar types of occupations (e.g., Installation, Maintenance, and Repair) were well represented within the analysis sample.

Table 1. Distribution of O*NET-SOCs across BLS Major Groups in Sample versus O*NET Overall

| Major Group | Sample O*NET-SOCs | | All O*NET-SOCs | |
|--|----------------------|-------|-------------------|-------|
| | <i>k</i> | % | <i>k</i> | % |
| 11-0000 Management | 21 | 7.3 | 44 | 3.8 |
| 13-0000 Business and Financial Operations | 16 | 5.5 | 44 | 3.8 |
| 15-0000 Computer and Mathematical | 9 | 3.1 | 17 | 1.5 |
| 17-0000 Architecture and Engineering | 22 | 7.6 | 49 | 4.2 |
| 19-0000 Life, Physical, and Social Science | 14 | 4.8 | 65 | 5.6 |
| 21-0000 Community and Social Services | 6 | 2.1 | 17 | 1.5 |
| 23-0000 Legal | 3 | 1.0 | 11 | 0.9 |
| 25-0000 Education, Training, and Library | 5 | 1.7 | 61 | 5.2 |
| 27-0000 Arts, Design, Entertainment, Sports, and Media | 19 | 6.6 | 63 | 5.4 |
| 29-0000 Healthcare Practitioners and Technical | 31 | 10.7 | 55 | 4.7 |
| 31-0000 Healthcare Support | 11 | 3.8 | 15 | 1.3 |
| 33-0000 Protective Service | 13 | 4.5 | 35 | 3.0 |
| 35-0000 Food Preparation and Serving Related | 10 | 3.5 | 18 | 1.5 |
| 37-0000 Building and Grounds Cleaning and Maintenance | 0 | 0.0 | 14 | 1.2 |
| 39-0000 Personal Care and Service | 18 | 6.2 | 35 | 3.0 |
| 41-0000 Sales and Related | 11 | 3.8 | 30 | 2.6 |
| 43-0000 Office and Administrative Support | 36 | 12.5 | 82 | 7.0 |
| 45-0000 Farming, Fishing, and Forestry | 0 | 0.0 | 25 | 2.1 |
| 47-0000 Construction and Extraction | 15 | 5.2 | 77 | 6.6 |
| 49-0000 Installation, Maintenance, and Repair | 13 | 4.5 | 81 | 6.9 |
| 51-0000 Production | 6 | 2.1 | 237 | 20.3 |
| 53-0000 Transportation and Material Moving | 10 | 3.5 | 72 | 6.2 |
| 55-0000 Military Specific Occupations | 0 | 0.0 | 20 | 1.7 |
| Total | 289 | 100.0 | 1,167 | 100.0 |

Note. SOC = Standard Occupational Classification. *k* = number of SOC.

Raters

Incumbents

As discussed, two sets of raters provided data for this study. A total of 10,017 job incumbents rated the skills required by their SOC. Incumbents were selected using one of the sampling approaches of the O*NET Data Collection Program¹ and were provided with a standard questionnaire for making their skill ratings. The number of incumbents for each SOC ranged from 15 to 196, with a mean of 34.66 (*mdn* = 25) incumbents per SOC. The vast majority of incumbents (88.4%) had been in their current job for at least one year, and more than one-third (35.3%) had occupied their job for 10 years or more. Incumbents had a wide range of

¹ See 2000 U.S. Department of Labor, Employment and Training Administration report for a description of incumbent sampling procedures.

educational backgrounds, from having less than a high school diploma to having post-doctoral training. Over one-third of the sample (38.0%) had a bachelor's degree or more.

Analysts

The second set of raters was trained job analysts. All analysts had a strong background in industrial and organizational (I-O) psychology. The three main selection criteria were that analysts needed to have (a) a minimum of two years of work experience, (b) at least two years of graduate training in I-O psychology or a closely related field, and (c) completed courses in job analysis and research methods or comparable topics. Two groups of eight analysts (16 total) participated in each data collection cycle, and each group rated about one-half of the SOCs in that cycle. Approximately one-half of the analysts participated in multiple data collection cycles, and as such the total number of unique analysts who provided data across the three cycles was actually only 31.

Analysts were provided a variety of occupational information on which to base their skill ratings, including the title and definition of the SOC and the results of ratings made for various other descriptors, such as tasks, GWAs, and work context variables. Analysts were extensively trained in how to use the occupational data to help make their skill ratings. Once trained, analysts followed a highly standardized process for making their ratings, which were continuously monitored and evaluated by HumRRO project staff.²

At this point it is worth noting that this study does not involve a simple comparison of two types of raters but rather two types of “systems” for collecting skill information. On the one hand, incumbent raters represented a variety of jobs within a given SOC and varied on potentially relevant background characteristics such as tenure and education. In addition, incumbent ratings were based on their individual experiences in the SOC and they did not receive any training prior to making their ratings. In contrast, analysts had very similar backgrounds in terms of age, job experience, and education and were unlikely to have direct experience working in most of the SOCs they evaluated. Rather, they were extensively trained to use a common set of stimulus materials as the basis for their skill ratings. It is also noteworthy that on average, four times more incumbents provided skill ratings for a each SOC than did analysts (i.e., a mean of 35 incumbents versus eight analysts).

Skills

A skill is a set of procedures for acquiring and working with knowledge (Mumford et al., 1999). Skills, along with general knowledge and education, comprise the *Worker Requirements* domain of the O*NET *Content Model* (Peterson et al., 1997). The O*NET model includes 35 skills that can be used to describe performance across occupations. The skills are organized around five higher-order skill categories called *Content Skills* (e.g., Writing, Speaking), *Process Skills* (e.g., Critical Thinking, Active Learning), *Service Orientation Skills* (e.g., Negotiation, Instructing), *System Skills* (e.g., Systems Analysis, Management of Personnel Resources), and

² Donsbach, Tsacoumis, Sager, and Updegraff (2003) provide a detailed description of the process by which analysts rated the abilities required by workers in O*NET SOCs. The same process was used for analyst skill ratings.

Technical Skills (e.g., Equipment Maintenance, Troubleshooting). Brief definitions of each skill are provided in Appendix B.

Incumbents and analysts rated each skill on its importance to the SOC using a 5-point Likert scale with anchors that ranged from *not at all important* (1) to *extremely important* (5). They also rated the level of each skill workers in the SOC should possess (on a 7-point scale with unique anchors for each skill). However, analyses revealed that importance and level ratings were virtually indistinguishable. For example, the observed correlation between the two sets of mean ratings was .96 for both rater groups. Given this, we chose to focus on only importance ratings in this study.

Analyses

We conducted two main sets of analyses to compare incumbent and analyst skill ratings. The first set was within-group whereby we examined the characteristics of skill ratings separately within each rater group. For example, we assessed the level of interrater reliability and interrater agreement for incumbents and analysts. The second set of analyses was between-group whereby incumbent and analyst ratings were directly compared within the same analysis. Example analyses included examination of mean differences and correlations between the two sets of ratings. For each analysis, we examined ratings at the rater, skill, and SOC levels of analysis, as appropriate.

Results

Data Cleaning

Prior to conducting the analyses, we investigated the quality of the incumbent and analyst data. Everything appeared to be in order. For instance, all skill ratings were within the required range of 1-5. As for missing data, no data were missing from the analyst ratings, whereas there was some missing data among incumbents. Of the 10,017 incumbents who provided data, 1,008 (or 10.1%) had at least one missing skill rating. However, the average incumbent had less than one missing rating ($M = 0.28$ ratings), and the total amount of missing data (0.82%) represents a very small portion of the overall data set. In addition, there did not appear to be any systematic reason for the missing data (e.g., missing values were not concentrated in certain skills or SOCs). Taken together, such a small amount of missing data is unlikely to affect the study results (Switzer & Roth, 2002), and thus we decided not to impute missing values.

Within Group Analyses

Interrater Reliability

We began by examining the characteristics of ratings within each group. The first within-group analysis was to estimate the interrater reliability of incumbent and analyst ratings. We treated interrater reliability as the consistency with which raters within each group order the skills (in terms of their importance) within a given SOC. Intraclass correlation coefficients (McGraw & Wong, 1996; Shrout & Fleiss, 1979) were used to estimate reliability.

Table 2 presents the median single-rater and k -rater reliability estimates organized by SOC major group and overall. The single-rater estimates (ICC,C,1) represent the mean correlation between the ratings of any two raters, whereas the k -rater estimates (ICC,C, k) represent the reliability of the mean skill ratings based on the number of incumbents (analysts) who provided ratings. The overall median single-rater estimate was notably higher for analysts (.72) than for incumbents (.44). Reliability estimates across major groups ranged from .27 to .67 for incumbents and .53 to .87 for analysts. This variation suggests that the general type of SOC may influence the level of reliability for both sets of raters. Interestingly, the zero-order correlation between incumbent and analyst single-rater coefficients was .72. This indicates that the SOCs for which incumbents demonstrated the highest level of interrater reliability tended to be the same ones for which analysts had the highest reliability, and vice versa. For example, some of the smallest single-rater estimates for both groups were for the three “blue collar” major groups—Production; Construction and Extraction; and Installation, Maintenance, and Repair.

Table 2. Interrater Reliability Estimates for Incumbent and Analyst Ratings by SOC Major Group

| Major Group | Incumbents | | Analysts | |
|--|------------|-------|----------|-------|
| | r | r_k | r | r_k |
| Management | .47 | .96 | .81 | .97 |
| Business and Financial Operations | .53 | .96 | .80 | .97 |
| Computer and Mathematical | .31 | .93 | .56 | .91 |
| Architecture and Engineering | .33 | .92 | .62 | .93 |
| Life, Physical, and Social Science | .42 | .95 | .68 | .94 |
| Community and Social Services | .67 | .98 | .87 | .98 |
| Legal | .64 | .98 | .86 | .98 |
| Education, Training, and Library | .47 | .97 | .69 | .95 |
| Arts, Design, Entertainment, Sports, and Media | .45 | .95 | .77 | .96 |
| Healthcare Practitioners and Technical | .45 | .96 | .72 | .95 |
| Healthcare Support | .46 | .96 | .71 | .95 |
| Protective Service | .43 | .96 | .74 | .96 |
| Food Preparation and Serving Related | .35 | .98 | .70 | .95 |
| Personal Care and Service | .47 | .97 | .76 | .96 |
| Sales and Related | .47 | .96 | .80 | .97 |
| Office and Administrative Support | .49 | .98 | .74 | .96 |
| Construction and Extraction | .33 | .92 | .53 | .90 |
| Installation, Maintenance, and Repair | .34 | .93 | .56 | .91 |
| Production | .27 | .91 | .59 | .92 |
| Transportation and Material Moving | .37 | .94 | .63 | .94 |
| Mean Overall | .44 | .96 | .72 | .95 |

Note. r = median interrater reliability for a single rater, ICC(C,1). r_k = median interrater reliability for k raters, ICC(C, k). Reliability estimates for incumbent ratings are based on only raters with complete data and were corrected for the total number of raters (with complete and incomplete data) using the Spearman-Brown formula.

Despite the difference in single-rater reliability estimates, the k -rater estimates for incumbents and analysts were virtually identical (.96 vs. .95). This is because the mean skill ratings for any given SOC are based on ratings from over four times as many incumbents as analysts. These results indicate that the mean skill ratings for both incumbents and analysts are very reliable.

Interrater Agreement

Next, we estimated the level of interrater agreement within the two sets of ratings. The standard deviation (SD) of ratings within each group is perhaps the most straightforward index of agreement. It represents the extent to which a group of raters agree on the specific rating for a given skill whereby smaller values indicate higher interrater agreement. Table 3 displays the mean SD s for incumbent and analyst ratings within each skill/category and across SOCs. There was almost twice as much variability among incumbent ratings than among analysts (mean $SD = 1.04$ vs. 0.56). There was some variation in SD s across skill categories for incumbents ($SD = 0.87$ to 1.16), but not for analysts ($SD = 0.56$ to 0.58). Conversely, there was variation across individual skills for both groups, particularly analysts. Mean SD s ranged from 0.75 (Active Listening) to 1.24 (Management of Personnel Resources) for incumbents and from 0.22 (Installation) to 0.82 (Quality Control Analysis) for analysts. It is interesting to note that unlike the interrater reliability estimates discussed above, there was little relationship ($r = .18$) between the specific skills for which incumbents and analysts demonstrated the highest/lowest level of agreement (although this low correlation is likely due, in part, to the relative lack of variation in SD s across skills within each rater group).

Also shown in Table 3 are the standard error of the mean (SE_M) statistics for each rater group. In this context, the SE_M represents the average deviation of a mean skill rating that would be expected if one repeatedly drew samples of this size from the population of incumbents or analysts. In other words, this statistic indicates how confident we can be that an observed mean skill rating represents the “true” importance of the skill for the work performed in a particular SOC. The SE_M is calculated by dividing the relevant SD by the square root of the number of raters who provided the ratings. As with the SD s, smaller SE_M statistics indicate higher agreement.

Although there was less agreement among incumbent ratings (of a given skill) than among analyst ratings, the SE_M statistics for the two groups were almost the same (mean $SE_M = .19$ and $.20$, respectively). These results are analogous to the interrater reliability results in that the single-rater reliability estimates and SD s suggest that analyst ratings have higher a level of interrater reliability/agreement. However, because the k -rater reliability estimates and SE_M statistics adjust the reliability/agreement index for the number of raters, the level of reliability/agreement for the mean skill ratings is comparable in the two groups. For both sets of raters, these results suggest that on average, their ratings are fairly good indicators of the “true” importance of these skills to performance in the sample SOCs.

We also estimated interrater agreement by SOC major group (see Table 4). Results revealed minimal variation in interrater agreement by major group, which suggests that raters did not demonstrate a higher/lower level of agreement on certain types of SOCs than on others.

Table 3. Interrater Agreement Estimates for Incumbent and Analyst Ratings by Skill Category and Individual Skill

| Category/Skill | Incumbents | | Analysts | |
|------------------------------|------------|-----------|----------|-----------|
| | M_{SD} | M_{SEM} | M_{SD} | M_{SEM} |
| Content Skills | 0.87 | 0.16 | 0.58 | 0.20 |
| Reading Comprehension | 0.82 | 0.15 | 0.56 | 0.20 |
| Active Listening | 0.75 | 0.14 | 0.58 | 0.20 |
| Writing | 0.89 | 0.16 | 0.58 | 0.20 |
| Speaking | 0.85 | 0.16 | 0.58 | 0.20 |
| Mathematics | 0.96 | 0.18 | 0.68 | 0.24 |
| Science | 0.96 | 0.18 | 0.36 | 0.13 |
| Process Skills | 0.93 | 0.17 | 0.59 | 0.21 |
| Critical Thinking | 0.88 | 0.16 | 0.54 | 0.19 |
| Active Learning | 0.90 | 0.16 | 0.61 | 0.22 |
| Learning Strategies | 0.95 | 0.18 | 0.62 | 0.22 |
| Monitoring | 1.04 | 0.19 | 0.57 | 0.20 |
| Service Orientation Skills | 1.04 | 0.20 | 0.58 | 0.21 |
| Social Perceptiveness | 0.98 | 0.18 | 0.58 | 0.20 |
| Coordination | 1.01 | 0.19 | 0.52 | 0.18 |
| Persuasion | 1.06 | 0.20 | 0.63 | 0.22 |
| Negotiation | 1.09 | 0.20 | 0.58 | 0.21 |
| Instructing | 1.02 | 0.19 | 0.55 | 0.19 |
| Service Orientation | 1.10 | 0.20 | 0.61 | 0.22 |
| Technical Skills | 1.11 | 0.21 | 0.58 | 0.21 |
| Complex Problem Solving | 1.04 | 0.19 | 0.57 | 0.20 |
| Operations Analysis | 1.12 | 0.21 | 0.66 | 0.23 |
| Technology Design | 1.11 | 0.21 | 0.58 | 0.21 |
| Equipment Selection | 1.12 | 0.21 | 0.60 | 0.21 |
| Installation | 1.05 | 0.20 | 0.22 | 0.08 |
| Programming | 0.91 | 0.17 | 0.53 | 0.19 |
| Quality Control Analysis | 1.23 | 0.23 | 0.82 | 0.29 |
| Operations Monitoring | 1.14 | 0.21 | 0.62 | 0.22 |
| Operation and Control | 1.10 | 0.20 | 0.63 | 0.22 |
| Equipment Maintenance | 1.11 | 0.20 | 0.35 | 0.12 |
| Troubleshooting | 1.16 | 0.21 | 0.52 | 0.18 |
| Repairing | 0.99 | 0.19 | 0.25 | 0.09 |
| Systems Skills | 1.16 | 0.21 | 0.56 | 0.20 |
| Systems Analysis | 1.12 | 0.21 | 0.70 | 0.25 |
| Systems Evaluation | 1.16 | 0.21 | 0.71 | 0.25 |
| Judgment and Decision Making | 1.13 | 0.21 | 0.55 | 0.20 |
| Time Management | 0.99 | 0.18 | 0.50 | 0.18 |
| Mgmt of Financial Resources | 1.19 | 0.22 | 0.51 | 0.18 |
| Mgmt of Material Resources | 1.18 | 0.22 | 0.65 | 0.23 |
| Mgmt of Personnel Resources | 1.24 | 0.23 | 0.56 | 0.20 |
| Mean Overall | 1.04 | 0.19 | 0.56 | 0.20 |

Note. MSD = mean standard deviation. MSEM = mean standard error of the mean. Statistics for the skill categories are median values computed from the relevant individual skills.

Table 4. Interrater Agreement Estimates for Incumbent and Analyst Ratings by SOC Major Group

| Major Group | Incumbents | | Analysts | |
|--|------------|-----------|----------|-----------|
| | M_{SD} | M_{SEM} | M_{SD} | M_{SEM} |
| Management | 0.98 | 0.20 | 0.51 | 0.18 |
| Business and Financial Operations | 0.98 | 0.21 | 0.49 | 0.17 |
| Computer and Mathematical | 0.99 | 0.19 | 0.65 | 0.23 |
| Architecture and Engineering | 1.00 | 0.21 | 0.61 | 0.22 |
| Life, Physical, and Social Science | 0.98 | 0.20 | 0.64 | 0.23 |
| Community and Social Services | 0.92 | 0.17 | 0.45 | 0.16 |
| Legal | 0.91 | 0.18 | 0.42 | 0.15 |
| Education, Training, and Library | 1.01 | 0.18 | 0.56 | 0.20 |
| Arts, Design, Entertainment, Sports, and Media | 1.04 | 0.19 | 0.52 | 0.18 |
| Healthcare Practitioners and Technical | 1.02 | 0.21 | 0.60 | 0.21 |
| Healthcare Support | 1.10 | 0.21 | 0.57 | 0.20 |
| Protective Service | 1.03 | 0.18 | 0.57 | 0.20 |
| Food Preparation and Serving Related | 1.12 | 0.15 | 0.55 | 0.19 |
| Personal Care and Service | 1.10 | 0.20 | 0.52 | 0.19 |
| Sales and Related | 1.04 | 0.21 | 0.51 | 0.18 |
| Office and Administrative Support | 1.06 | 0.17 | 0.54 | 0.19 |
| Construction and Extraction | 1.14 | 0.23 | 0.61 | 0.21 |
| Installation, Maintenance, and Repair | 1.02 | 0.20 | 0.64 | 0.23 |
| Production | 1.15 | 0.24 | 0.64 | 0.23 |
| Transportation and Material Moving | 1.13 | 0.22 | 0.56 | 0.20 |
| Mean Overall | 1.04 | 0.20 | 0.56 | 0.19 |

Intrarater Variability

The last within-group analysis concerned the amount of variance in the ratings of any given incumbent/analyst across skills and within SOCs. We refer to this as “intrarater variability.” The goal of this analysis was to determine whether raters from one group or the other appear to be more susceptible to a general impressions or “halo” effect whereby they tend to assign similar ratings (high, low, or otherwise) to most or all of the skills within a given SOC. To examine this, we calculated the *SD* of the across-skills, within-SOC ratings for each rater. We then computed the mean rater *SD* across the SOCs within each major group.

The intrarater variability results are shown in Table 5. Overall, the ratings of any given incumbent were only slightly more varied than those of any single analyst (overall mean *SD* = 1.16 vs. 1.09). In both rater groups, there was some differentiation in the amount of intrarater variability across SOC major groups. Interestingly, the overall pattern of intrarater variability differences was very similar between incumbents and analysts ($r = .87$). For example, the highest level of intrarater variability in both groups was for ratings of the Community and Social Services SOCs. This provides some preliminary evidence for convergence between the two sets of ratings.

Table 5. Intrarater Variability Indices for Incumbent and Analyst Ratings by SOC Major Group

| Major Group | Incumbents | | Analysts | |
|--|------------|-----------|----------|-----------|
| | M_{SD} | SD_{SD} | M_{SD} | SD_{SD} |
| Management | 1.18 | 0.29 | 1.22 | 0.15 |
| Business and Financial Operations | 1.25 | 0.25 | 1.23 | 0.15 |
| Computer and Mathematical | 1.10 | 0.26 | 1.04 | 0.19 |
| Architecture and Engineering | 1.07 | 0.24 | 0.99 | 0.15 |
| Life, Physical, and Social Science | 1.12 | 0.24 | 1.13 | 0.18 |
| Community and Social Services | 1.43 | 0.25 | 1.34 | 0.14 |
| Legal | 1.41 | 0.20 | 1.22 | 0.13 |
| Education, Training, and Library | 1.12 | 0.24 | 1.03 | 0.13 |
| Arts, Design, Entertainment, Sports, and Media | 1.23 | 0.25 | 1.16 | 0.17 |
| Healthcare Practitioners and Technical | 1.19 | 0.29 | 1.12 | 0.17 |
| Healthcare Support | 1.16 | 0.30 | 1.08 | 0.19 |
| Protective Service | 1.15 | 0.28 | 1.16 | 0.19 |
| Food Preparation and Serving Related | 1.08 | 0.30 | 1.04 | 0.18 |
| Personal Care and Service | 1.16 | 0.28 | 1.07 | 0.17 |
| Sales and Related | 1.23 | 0.27 | 1.17 | 0.16 |
| Office and Administrative Support | 1.18 | 0.28 | 1.10 | 0.18 |
| Construction and Extraction | 1.04 | 0.28 | 0.89 | 0.14 |
| Installation, Maintenance, and Repair | 1.02 | 0.29 | 1.00 | 0.18 |
| Production | 1.07 | 0.30 | 0.97 | 0.17 |
| Transportation and Material Moving | 1.07 | 0.30 | 0.93 | 0.16 |
| Mean Overall | 1.16 | 0.27 | 1.09 | 0.17 |

Note. M_{SD} = mean within-rater standard deviation for each occupation. SD_{SD} = standard deviation of the mean within-rater standard deviations.

Between Group Analyses

Mean Differences

We now describe the results of analyses in which data from incumbents and analysts ratings were directly compared (i.e., between group analyses). Perhaps the most basic comparison involved whether there were mean differences between the ratings of the two groups. Small and statistically nonsignificant mean differences would provide evidence that the two sets of ratings are comparable. Table 6 presents descriptive statistics and effect sizes for incumbent and analyst ratings by individual skill and skill category and across SOCs. Incumbent ratings were significantly higher ($p < .05$) than analyst ratings on 24 of the 35 individual skills and across all five categories. Analyst ratings were significantly higher than incumbent ratings on four skills (the remaining differences were nonsignificant).

To estimate the magnitude of these effects, we computed standardized mean differences (d) by dividing the difference between the incumbent and analyst mean ratings for each skill by the average SD of the two groups for that skill. Values of d around 0.20, 0.50, and 0.80 are

typically considered small, medium, and large, respectively (Cohen, 1988). On average, incumbent ratings were about 2/3 a *SD* higher (overall $d = 0.67$) than analyst ratings, which represents between a medium to large effect. However, there was wide variation in incumbent-analyst *ds* across individual skills, ranging from -0.36 for Systems Analysis to 1.93 for Learning Strategies. There was also some variation in mean differences across skill categories, with Content skills having largest effects ($mdn_d = 0.92$) and Service Orientation skills having the smallest effects ($mdn_d = 0.32$).

Table 6. Descriptive Statistics and Effect Size Differences for Incumbent and Analyst Ratings by Skill Category and Individual Skill

| Category/Skill | Incumbents | | Analysts | | <i>d</i> |
|----------------------------|------------|-----------|----------|-----------|--------------|
| | <i>M</i> | <i>SD</i> | <i>M</i> | <i>SD</i> | |
| Content Skills | | | | | 0.92 |
| Reading Comprehension | 3.99 | 0.42 | 3.44 | 0.58 | 1.10 |
| Active Listening | 4.21 | 0.32 | 3.85 | 0.47 | 0.91 |
| Writing | 3.51 | 0.59 | 3.18 | 0.57 | 0.57 |
| Speaking | 3.86 | 0.40 | 3.87 | 0.46 | -0.02 |
| Mathematics | 3.16 | 0.65 | 2.53 | 0.70 | 0.93 |
| Science | 2.31 | 0.92 | 1.34 | 0.64 | 1.24 |
| Process Skills | | | | | 0.73 |
| Critical Thinking | 3.78 | 0.45 | 3.64 | 0.49 | 0.30 |
| Active Learning | 3.65 | 0.40 | 3.12 | 0.52 | 1.15 |
| Learning Strategies | 3.40 | 0.31 | 2.53 | 0.59 | 1.93 |
| Monitoring | 3.35 | 0.42 | 3.45 | 0.45 | -0.23 |
| Service Orientation Skills | | | | | 0.32 |
| Social Perceptiveness | 3.42 | 0.53 | 3.41 | 0.54 | 0.02 |
| Coordination | 3.56 | 0.38 | 3.33 | 0.46 | 0.55 |
| Persuasion | 2.94 | 0.56 | 2.85 | 0.60 | 0.16 |
| Negotiation | 2.87 | 0.53 | 2.81 | 0.58 | 0.11 |
| Instructing | 3.44 | 0.44 | 2.71 | 0.60 | 1.40 |
| Service Orientation | 3.35 | 0.54 | 3.06 | 0.66 | 0.48 |
| Technical Skills | | | | | 0.72 |
| Complex Problem Solving | 3.20 | 0.61 | 3.31 | 0.56 | -0.19 |
| Operations Analysis | 2.53 | 0.56 | 1.50 | 0.55 | 1.86 |
| Technology Design | 2.30 | 0.64 | 1.57 | 0.53 | 1.25 |
| Equipment Selection | 2.92 | 0.70 | 1.69 | 0.70 | 1.76 |
| Installation | 2.10 | 0.80 | 1.23 | 0.56 | 1.28 |
| Programming | 1.62 | 0.49 | 1.46 | 0.57 | 0.30 |
| Quality Control Analysis | 2.60 | 0.60 | 2.43 | 0.72 | 0.26 |
| Operations Monitoring | 2.33 | 0.82 | 2.26 | 0.84 | 0.08 |
| Operation and Control | 2.47 | 0.68 | 2.07 | 0.80 | 0.54 |
| Equipment Maintenance | 2.40 | 0.84 | 1.56 | 0.83 | 1.01 |
| Troubleshooting | 2.80 | 0.77 | 1.79 | 0.81 | 1.28 |
| Repairing | 2.08 | 0.81 | 1.48 | 0.86 | 0.72 |

Table 6. (Continued)

| Category/Skill | Incumbents | | Analysts | | <i>d</i> |
|------------------------------|------------|-----------|----------|-----------|--------------|
| | <i>M</i> | <i>SD</i> | <i>M</i> | <i>SD</i> | |
| Systems Skills | | | | | 0.41 |
| Systems Analysis | 2.28 | 0.57 | 2.51 | 0.70 | -0.36 |
| Systems Evaluation | 2.35 | 0.49 | 2.44 | 0.70 | -0.15 |
| Judgment and Decision Making | 3.46 | 0.49 | 3.43 | 0.51 | 0.06 |
| Time Management | 3.71 | 0.45 | 3.24 | 0.43 | 1.07 |
| Mgmt of Financial Resources | 2.29 | 0.65 | 1.72 | 0.71 | 0.84 |
| Mgmt of Material Resources | 2.38 | 0.53 | 1.94 | 0.63 | 0.76 |
| Mgmt of Personnel Resources | 2.69 | 0.58 | 2.66 | 0.64 | 0.05 |
| Mean Overall | 2.95 | 0.57 | 2.55 | 0.62 | 0.67 |

Note. *d* = standardized mean difference between incumbent and analyst ratings, which was calculated by subtracting the analyst mean from the incumbent mean and dividing by the pooled standard deviation. Values of *d* for the skill categories are medians based on the relevant individual *ds*. Bolded *d* values indicate that the mean difference between incumbent and analyst ratings was significant ($p < .05$).

We then looked at incumbent-analyst differences within SOC and across skills. Table 7 displays results by SOC major group. Although not as large as the across-skills differences in Table 6, there were some incumbent-analyst rating differences. Incumbent ratings were significantly higher than analyst ratings on all major groups except Legal. It is interesting that the largest differences were on three previously mentioned blue collar major groups. The fact that the largest difference ($d = 0.79$) was for the Production major group is noteworthy considering that SOCs from this group were underrepresented in the analysis sample. Thus, the overall *d* of 0.67 might have been even larger if more Production SOCs were in the sample. We also examined the SOCs (across major groups) with the largest incumbent-analyst rating differences to see if there were any common themes, but not were found.

We were also interested in whether the mean rating differences between incumbents and analysts would affect the reporting of skill information. We investigated this issue in two ways. First, the *O*NET OnLine* “summary report” shows the “important” skills for each SOC (i.e., skills with mean importance ratings ≥ 3.0). As such, we wanted to know how many skills would be reported as important using incumbent and analyst ratings. The average number of skills with a mean rating of ≥ 3.0 was 18.03 for incumbent ratings ($SD = 5.41$) and 14.15 for analyst ratings ($SD = 5.34$). Thus, about four more skills would be reported as important using incumbent ratings instead of analyst ratings.

The *O*NET OnLine* summary report for each SOC lists up to only 10 skills with a mean importance rating of ≥ 3.0 . Similarly, the In Demand Occupation Description report on the *Career Voyages* website lists up to five important skills. As such, another way we compared the reporting implications of the observed incumbent-analyst mean differences was to determine the number of SOCs for which less than 10 and five skills would be reported using the two sets of ratings. Of the 289 sample SOCs, 21 (7.3%) would not show at least 10 skills as important using incumbent ratings. Likewise, only 2 SOCs (0.7%) would show less than five skills using incumbent ratings. In contrast, almost three times as many SOCs (i.e., 57, or 19.7%) would not show at least 10 skills using analyst ratings, and 14 SOCs (4.8%) would not show at least five skills as important if analysts were used.

Table 7. Descriptive Statistics and Effect Size Differences for Incumbent and Analyst Ratings by SOC Major Group

| Major Group | Incumbents | | Analysts | | <i>d</i> |
|--|------------|-----------|----------|-----------|-------------|
| | <i>M</i> | <i>SD</i> | <i>M</i> | <i>SD</i> | |
| Management | 3.22 | 0.87 | 2.95 | 1.11 | 0.27 |
| Business and Financial Operations | 2.89 | 0.95 | 2.60 | 1.13 | 0.28 |
| Computer and Mathematical | 3.29 | 0.70 | 2.87 | 0.89 | 0.52 |
| Architecture and Engineering | 3.16 | 0.69 | 2.78 | 0.82 | 0.50 |
| Life, Physical, and Social Science | 3.14 | 0.79 | 2.65 | 0.98 | 0.55 |
| Community and Social Services | 2.89 | 1.18 | 2.60 | 1.25 | 0.24 |
| Legal | 2.67 | 1.18 | 2.49 | 1.14 | 0.16 |
| Education, Training, and Library | 3.10 | 0.79 | 2.54 | 0.92 | 0.66 |
| Arts, Design, Entertainment, Sports, and Media | 2.97 | 0.89 | 2.60 | 1.09 | 0.38 |
| Healthcare Practitioners and Technical | 3.14 | 0.91 | 2.69 | 1.00 | 0.47 |
| Healthcare Support | 2.92 | 0.85 | 2.38 | 0.96 | 0.60 |
| Protective Service | 3.06 | 0.87 | 2.57 | 1.06 | 0.51 |
| Food Preparation and Serving Related | 2.52 | 0.73 | 2.19 | 0.94 | 0.40 |
| Personal Care and Service | 2.72 | 0.85 | 2.29 | 0.99 | 0.47 |
| Sales and Related | 2.71 | 0.93 | 2.40 | 1.08 | 0.30 |
| Office and Administrative Support | 2.59 | 0.85 | 2.27 | 0.98 | 0.35 |
| Construction and Extraction | 3.05 | 0.63 | 2.51 | 0.77 | 0.77 |
| Installation, Maintenance, and Repair | 3.26 | 0.65 | 2.77 | 0.83 | 0.67 |
| Production | 3.05 | 0.66 | 2.45 | 0.86 | 0.79 |
| Transportation and Material Moving | 2.61 | 0.74 | 2.29 | 0.83 | 0.42 |
| Mean Overall | 2.95 | 0.57 | 2.55 | 0.62 | 0.67 |

Note. Bolded *d* values indicate that the mean difference between incumbent and analyst ratings was significant ($p < .05$).

Relative Order Differences

In the next set of analyses, we evaluated the consistency with which incumbents and analysts ordered the importance of the 35 skills. We examined this issue in two ways. First, we investigated the extent to which ratings from the two groups ordered the sample SOCs on each skill. To do so, we computed zero-order correlations between mean incumbent and analyst ratings (within skill and across SOCs). These correlations are shown in Table 8. In general, the two groups ordered SOCs on a given skill in very similar ways (mean $r = .69$). There was some variation in correlations across skills ($r = .45$ to $.80$). However, the somewhat lower correlations for some skills (e.g., Systems Analysis) were likely due to the relative lack of variation in the importance of such skills across SOCs rather than to incumbent-analyst inconsistency.

The other way we looked at rating consistency between incumbents and analysts was to compute correlations of ratings across skills and within SOC. This analysis addressed the question of whether the two sets of raters have similar perceptions about the relative importance of the 35 skills to work in a particular SOC. Table 9 displays the results of this analysis by SOC major group. The average correlation (across SOCs) of $.80$ ($r = .85$ when corrected for unreliability in both sets of ratings) indicates that the two groups were very consistent in how they ordered the importance of skills within each SOC. Further, there was minimal variation in

correlations across major groups, with coefficients ranging from .69 for Construction and Extraction SOCs and to .93 for Community and Social Services SOCs. The fact that these within-SOC correlations are somewhat higher than the between-SOC correlations in Table 8 is not surprising because there is likely more variation in the importance of skills within a SOC than variation in a given skill across SOCs (e.g., some skills, such as Reading Comprehension, are relevant to work in almost all occupations). In addition, the across-SOC analyses are based on ratings from different sets of incumbents and analysts, and thus it is likely that rater differences may have also contributed to the somewhat lower correlations in Table 8.

Table 8. Correlations between Incumbent and Analyst Ratings (within Skill and across O*NET-SOCs)

| Category/Skill | <i>r</i> |
|----------------------------|----------|
| Content Skills | .70 |
| Reading Comprehension | .71 |
| Active Listening | .69 |
| Writing | .74 |
| Speaking | .67 |
| Mathematics | .67 |
| Science | .75 |
| Process Skills | .67 |
| Critical Thinking | .74 |
| Active Learning | .67 |
| Learning Strategies | .49 |
| Monitoring | .66 |
| Service Orientation Skills | .74 |
| Social Perceptiveness | .77 |
| Coordination | .54 |
| Persuasion | .73 |
| Negotiation | .74 |
| Instructing | .62 |
| Service Orientation | .75 |
| Technical Skills | .74 |
| Complex Problem Solving | .73 |
| Operations Analysis | .65 |
| Technology Design | .68 |
| Equipment Selection | .73 |
| Installation | .76 |
| Programming | .63 |
| Quality Control Analysis | .60 |
| Operations Monitoring | .79 |
| Operation and Control | .74 |
| Equipment Maintenance | .80 |
| Troubleshooting | .76 |
| Repairing | .84 |

Table 8. (Continued)

| Category/Skill | <i>r</i> |
|------------------------------|----------|
| Systems Skills | .60 |
| Systems Analysis | .45 |
| Systems Evaluation | .48 |
| Judgment and Decision Making | .68 |
| Time Management | .60 |
| Mgmt of Financial Resources | .70 |
| Mgmt of Material Resources | .59 |
| Mgmt of Personnel Resources | .67 |
| Mean Overall | .69 |

Note. *r* = observed zero-order correlation between incumbent and analyst ratings. Coefficients for the skill categories are median correlations computed from the relevant individual skills. All correlations are significant ($p < .01$).

Table 9. Correlations between Incumbent and Analyst Ratings (across Skills and within SOC Major Group)

| Major Group | <i>r</i> | <i>r_c</i> |
|--|----------|----------------------|
| Management | .87 | .91 |
| Business and Financial Operations | .88 | .91 |
| Computer and Mathematical | .71 | .75 |
| Architecture and Engineering | .72 | .79 |
| Life, Physical, and Social Science | .76 | .83 |
| Community and Social Services | .93 | .94 |
| Legal | .89 | .91 |
| Education, Training, and Library | .83 | .86 |
| Arts, Design, Entertainment, Sports, and | .81 | .84 |
| Healthcare Practitioners and Technical | .77 | .81 |
| Healthcare Support | .83 | .87 |
| Protective Service | .81 | .85 |
| Food Preparation and Serving Related | .82 | .85 |
| Personal Care and Service | .83 | .87 |
| Sales and Related | .85 | .89 |
| Office and Administrative Support | .87 | .89 |
| Construction and Extraction | .69 | .76 |
| Installation, Maintenance, and Repair | .72 | .78 |
| Production | .74 | .82 |
| Transportation and Material Moving | .72 | .78 |
| Mean Overall | .80 | .85 |

Note. *r* = median zero-order correlation between incumbent and analyst ratings. *r_c* = median correlation corrected for interrater reliability (ICC,C,k) in both sets of ratings. All correlations are significant ($p < .01$).

Discussion

The decision about the preferred source of O*NET skill information is an important but complex one. The study was conducted to help inform this decision by investigating the psychometric characteristics of skill ratings provided by job incumbent and trained analysts. A variety of analyses were used to compare different aspects of incumbent and analyst ratings. The overall results were fully consistent with those of prior incumbent-analyst research reviewed earlier in the paper. First, the ratings of any single incumbent were notably less reliable than those of any single analyst. The level of interrater agreement regarding the importance of a particular skill was also much higher among analysts. Nevertheless, because over four times more incumbents than analysts provided skill ratings for any given SOC, the interrater reliability for the mean skill ratings was virtually identical in the two groups, as was the amount of error around mean estimates for each skill. It is also important to note that incumbents often represent different jobs within a given SOC. Therefore, the relatively lower interrater reliability/agreement estimates we found may reflect true differences in the importance of O*NET skills across similar but different jobs.

Second, we found that incumbents tended to provide higher skill ratings than analysts. Although incumbent-analyst mean differences varied across skills and SOCs (and to a lesser extent across SOC major groups), these differences were, on average, moderate to large in magnitude. As discussed, such differences are generally attributed to incumbents overstating the importance of their jobs. However, in the absence of some external criterion or “gold standard,” we cannot conclude that the higher ratings that incumbents tend to provide necessarily represent rating “errors.” Whatever the reason for the mean differences, they would likely affect the reporting and potential use of O*NET skill information. For example, using incumbents rather than analysts to populate the O*NET database would result in more skills indicated as “important” to performance in a SOC. This, in turn, could influence decision making in organizations that use O*NET data as a basis for their human resources systems.

Although we observed differences in the reliability and means of incumbent and analyst ratings, we also found the ratings to be similar in several respects. For one, the level of variation in ratings of any given incumbent and analyst were comparable, which suggests that the two groups of raters are not differentially prone to general impression or halo effects. Also, consistent with prior research, we discovered that incumbents and analysts ordered the importance of skills, both within and across SOCs, in very similar ways. These results are particularly significant because they provide some evidence for the convergent validity of incumbent and analyst skill ratings. It is important to note, however, that a true (but perhaps unrealistic) assessment of validity would involve evaluating how incumbent and analyst ratings impact human resources systems developed on the basis of those data (Sanchez, 2000). For example, do skill data based on one source or another yield more valid selection systems or more effective training programs?

In conclusion, with the notable exception of the mean differences between incumbent and analyst ratings, the results of this study revealed minimal differences between the two systems of obtaining skill information. Given this, we found no clear evidence that one source of raters provides more valid or “accurate” than the other. Therefore, we suggest that the selection of rater source be made on the basis of other factors, including theoretical and practical considerations.

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Appendix A

Sample O*NET-SOCs and Number of Incumbents who provided Ratings for Each SOC

| Major Group/O*NET-SOC Title | SOC Code | Incumbent <i>n</i> |
|--|------------|--------------------|
| Management | | |
| 1. General/Operations Managers | 11-1021.00 | 44 |
| 2. Advertising/Promotions Managers | 11-2011.00 | 27 |
| 3. Marketing Managers | 11-2021.00 | 19 |
| 4. Sales Managers | 11-2022.00 | 27 |
| 5. Public Relations Managers | 11-2031.00 | 23 |
| 6. Admin Services Managers | 11-3011.00 | 27 |
| 7. Computer/Information Systems Managers | 11-3021.00 | 26 |
| 8. Human Resources Managers | 11-3040.00 | 25 |
| 9. Compensation/Benefits Managers | 11-3041.00 | 26 |
| 10. Training & Development Managers | 11-3042.00 | 21 |
| 11. Industrial Production Managers | 11-3051.00 | 20 |
| 12. Purchasing Managers | 11-3061.00 | 21 |
| 13. Transportation Managers | 11-3071.01 | 19 |
| 14. Storage/Distribution Managers | 11-3071.02 | 19 |
| 15. Construction Managers | 11-9021.00 | 22 |
| 16. Engineering Managers | 11-9041.00 | 22 |
| 17. Food Service Managers | 11-9051.00 | 55 |
| 18. Funeral Directors | 11-9061.00 | 91 |
| 19. Lodging Managers | 11-9081.00 | 18 |
| 20. Medical/Health Services Managers | 11-9111.00 | 16 |
| 21. Social/Community Service Managers | 11-9151.00 | 33 |
| Business and Financial Operations | | |
| 22. Wholesale/Retail Buyers | 13-1022.00 | 23 |
| 23. Purchasing Agents | 13-1023.00 | 16 |
| 24. Insurance Adjusters/Examiners/Investigators | 13-1031.02 | 21 |
| 25. Cost Estimators | 13-1051.00 | 25 |
| 26. Employment Interviewers | 13-1071.01 | 27 |
| 27. Personnel Recruiters | 13-1071.02 | 25 |
| 28. Compensation/Benefits/Job Analysis Specialists | 13-1072.00 | 26 |
| 29. Training & Development Specialists | 13-1073.00 | 16 |
| 30. Meeting/Convention Planners | 13-1121.00 | 28 |
| 31. Accountants | 13-2011.01 | 22 |
| 32. Auditors | 13-2011.02 | 21 |
| 33. Assessors | 13-2021.01 | 49 |
| 34. Budget Analysts | 13-2031.00 | 20 |
| 35. Credit Analysts | 13-2041.00 | 21 |
| 36. Insurance Underwriters | 13-2053.00 | 18 |
| 37. Loan Officers | 13-2072.00 | 20 |

| Major Group/O*NET-SOC Title | SOC Code | Incumbent <i>n</i> |
|--|------------|--------------------|
| Computer and Mathematical | | |
| 38. Computer Programmers | 15-1021.00 | 19 |
| 39. Applications Computer Software Engineers | 15-1031.00 | 27 |
| 40. Systems Software Computer Software Engineers | 15-1032.00 | 40 |
| 41. Computer Support Specialists | 15-1041.00 | 18 |
| 42. Computer Systems Analysts | 15-1051.00 | 25 |
| 43. Database Administrators | 15-1061.00 | 18 |
| 44. Network/Computer Systems Admins | 15-1071.00 | 129 |
| 45. Network Systems/Data Communications Analysts | 15-1081.00 | 20 |
| 46. Actuaries | 15-2011.00 | 31 |
| Architecture and Engineering | | |
| 47. Architects | 17-1011.00 | 17 |
| 48. Landscape Architects | 17-1012.00 | 19 |
| 49. Cartographers/Photogrammetrists | 17-1021.00 | 48 |
| 50. Surveyors | 17-1022.00 | 21 |
| 51. Aerospace Engineers | 17-2011.00 | 18 |
| 52. Chemical Engineers | 17-2041.00 | 27 |
| 53. Civil Engineers | 17-2051.00 | 21 |
| 54. Electrical Engineers | 17-2071.00 | 21 |
| 55. Environmental Engineers | 17-2081.00 | 26 |
| 56. Industrial Engineers | 17-2112.00 | 21 |
| 57. Mechanical Engineers | 17-2141.00 | 25 |
| 58. Mining/Geological Engineers | 17-2151.00 | 20 |
| 59. Petroleum Engineers | 17-2171.00 | 26 |
| 60. Architectural Drafters | 17-3011.01 | 23 |
| 61. Civil Drafters | 17-3011.02 | 19 |
| 62. Mechanical Drafters | 17-3013.00 | 20 |
| 63. Civil Engineering Technicians | 17-3022.00 | 23 |
| 64. Electronics Engineering Technicians | 17-3023.01 | 22 |
| 65. Electrical Engineering Technicians | 17-3023.03 | 23 |
| 66. Environmental Engineering Technicians | 17-3025.00 | 21 |
| 67. Industrial Engineering Technicians | 17-3026.00 | 18 |
| 68. Mechanical Engineering Technicians | 17-3027.00 | 21 |
| Life, Physical, and Social Science | | |
| 69. Biologists | 19-1020.01 | 20 |
| 70. Microbiologists | 19-1022.00 | 24 |
| 71. Zoologists/Wildlife Biologists | 19-1023.00 | 32 |
| 72. Park Naturalists | 19-1031.03 | 25 |
| 73. Foresters | 19-1032.00 | 15 |
| 74. Chemists | 19-2031.00 | 20 |
| 75. Environmental Scientists/Specialists | 19-2041.00 | 51 |
| 76. Geologists | 19-2042.01 | 42 |
| 77. Urban/Regional Planners | 19-3051.00 | 21 |
| 78. Historians | 19-3093.00 | 19 |

*A Comparison of Incumbent and Analyst Ratings of O*NET Skills*

| Major Group/O*NET-SOC Title | SOC Code | Incumbent <i>n</i> |
|---|------------|--------------------|
| 79. Biological Technicians | 19-4021.00 | 28 |
| 80. Chemical Technicians | 19-4031.00 | 34 |
| 81. Environmental Science/Protection Technicians | 19-4091.00 | 21 |
| 82. Forensic Science Technicians | 19-4092.00 | 18 |
| Community and Social Services | | |
| 83. Mental Health Counselors | 21-1014.00 | 51 |
| 84. Child/Family/School Social Workers | 21-1021.00 | 23 |
| 85. Medical/Public Health Social Workers | 21-1022.00 | 23 |
| 86. Mental Health/Substance Abuse Social Workers | 21-1023.00 | 56 |
| 87. Probation Officers/Correctional Treatment Specialists | 21-1092.00 | 27 |
| 88. Social/Human Service Assistants | 21-1093.00 | 25 |
| Legal | | |
| 89. Lawyers | 23-1011.00 | 40 |
| 90. Paralegals/Legal Assistants | 23-2011.00 | 18 |
| 91. Law Clerks | 23-2092.00 | 26 |
| Education, Training, and Library | | |
| 92. Curators | 25-4012.00 | 23 |
| 93. Museum Technicians/Conservators | 25-4013.00 | 27 |
| 94. Librarians | 25-4021.00 | 81 |
| 95. Library Technicians | 25-4031.00 | 44 |
| 96. A/V Collections Specialists | 25-9011.00 | 24 |
| Arts, Design, Entertainment, Sports, and Media | | |
| 97. Art Directors | 27-1011.00 | 18 |
| 98. Floral Designers | 27-1023.00 | 18 |
| 99. Graphic Designers | 27-1024.00 | 23 |
| 100. Interior Designers | 27-1025.00 | 17 |
| 101. Producers | 27-2012.01 | 45 |
| 102. Stage/Motion Pictures/TV/Radio Directors | 27-2012.02 | 21 |
| 103. Technical Directors/Managers | 27-2012.05 | 24 |
| 104. Coaches/Scouts | 27-2022.00 | 65 |
| 105. Umpires/Referees/Other Sports Officials | 27-2023.00 | 24 |
| 106. Radio/TV Announcers | 27-3011.00 | 85 |
| 107. Reporters/Correspondents | 27-3022.00 | 111 |
| 108. Public Relations Specialists | 27-3031.00 | 17 |
| 109. Editors | 27-3041.00 | 42 |
| 110. Technical Writers | 27-3042.00 | 23 |
| 111. Copy Writers | 27-3043.04 | 17 |
| 112. A/V Equipment Technicians | 27-4011.00 | 38 |
| 113. Broadcast Technicians | 27-4012.00 | 122 |
| 114. TV/Video/Motion Picture Camera Operators | 27-4031.00 | 97 |
| 115. Film/Video Editors | 27-4032.00 | 30 |
| Healthcare Practitioners and Technical | | |
| 116. Dietitians/Nutritionists | 29-1031.00 | 18 |
| 117. Optometrists | 29-1041.00 | 18 |

| Major Group/O*NET-SOC Title | SOC Code | Incumbent <i>n</i> |
|--|------------|--------------------|
| 118.Pharmacists | 29-1051.00 | 18 |
| 119.Psychiatrists | 29-1066.00 | 17 |
| 120.Physician Assistants | 29-1071.00 | 19 |
| 121.Registered Nurses | 29-1111.00 | 76 |
| 122.Occupational Therapists | 29-1122.00 | 20 |
| 123.Physical Therapists | 29-1123.00 | 16 |
| 124.Radiation Therapists | 29-1124.00 | 26 |
| 125.Recreational Therapists | 29-1125.00 | 22 |
| 126.Respiratory Therapists | 29-1126.00 | 23 |
| 127.Speech-Language Pathologists | 29-1127.00 | 44 |
| 128.Veterinarians | 29-1131.00 | 51 |
| 129.Medical/Clinical Laboratory Technologists | 29-2011.00 | 26 |
| 130.Medical/Clinical Laboratory Technicians | 29-2012.00 | 21 |
| 131.Dental Hygienists | 29-2021.00 | 21 |
| 132.Cardiovascular Technologists/Technicians | 29-2031.00 | 58 |
| 133.Diagnostic Medical Sonographers | 29-2032.00 | 22 |
| 134.Nuclear Medicine Technologists | 29-2033.00 | 52 |
| 135.Radiologic Technologists | 29-2034.01 | 19 |
| 136.Radiologic Technicians | 29-2034.02 | 22 |
| 137.ER Medical Technicians/Paramedics | 29-2041.00 | 23 |
| 138.Dietetic Technicians | 29-2051.00 | 28 |
| 139.Pharmacy Technicians | 29-2052.00 | 31 |
| 140.Respiratory Therapy Technicians | 29-2054.00 | 17 |
| 141.Surgical Technologists | 29-2055.00 | 20 |
| 142.Veterinary Technologists/Technicians | 29-2056.00 | 40 |
| 143.Vocational Nurses | 29-2061.00 | 16 |
| 144.Medical Records/Health Info Technicians | 29-2071.00 | 32 |
| 145.Dispensing Opticians | 29-2081.00 | 22 |
| 146.Athletic Trainers | 29-9091.00 | 23 |
| Healthcare Support | | |
| 147.Home Health Aides | 31-1011.00 | 26 |
| 148.Nursing Aides/Orderlies/Attendants | 31-1012.00 | 23 |
| 149.Psychiatric Aides | 31-1013.00 | 20 |
| 150.Occupational Therapist Assistants | 31-2011.00 | 35 |
| 151.Physical Therapist Assistants | 31-2021.00 | 18 |
| 152.Physical Therapist Aides | 31-2022.00 | 52 |
| 153.Dental Assistants | 31-9091.00 | 21 |
| 154.Medical Assistants | 31-9092.00 | 23 |
| 155.Medical Equipment Preparers | 31-9093.00 | 36 |
| 156.Pharmacy Aides | 31-9095.00 | 19 |
| 157.Veterinary Assistants/Laboratory Animal Caretakers | 31-9096.00 | 43 |
| Protective Service | | |
| 158.Police/Detective Managers | 33-1012.00 | 23 |
| 159.Municipal Fire Fighting/Prevention Supervisors | 33-1021.01 | 106 |

*A Comparison of Incumbent and Analyst Ratings of O*NET Skills*

| Major Group/O*NET-SOC Title | SOC Code | Incumbent <i>n</i> |
|--|------------|--------------------|
| 160.Municipal Fire Fighters | 33-2011.01 | 26 |
| 161.Forest Fire Fighters | 33-2011.02 | 18 |
| 162.Fire Inspectors | 33-2021.01 | 49 |
| 163.Bailiffs | 33-3011.00 | 25 |
| 164.Correctional Officers/Jailers | 33-3012.00 | 83 |
| 165.Police Detectives | 33-3021.01 | 49 |
| 166.Police Identification/Records Officers | 33-3021.02 | 29 |
| 167.Police Patrol Officers | 33-3051.01 | 73 |
| 168.Gaming Surveillance Officers/Investigators | 33-9031.00 | 33 |
| 169.Security Guards | 33-9032.00 | 21 |
| 170.Lifeguards/Ski Patrol/Other Rec Protective Svc Wrkrs | 33-9092.00 | 21 |
| Food Preparation and Serving Related | | |
| 171.Food Preparation/Serving Worker Sups/Mngrs | 35-1012.00 | 77 |
| 172.Fast Food Cooks | 35-2011.00 | 33 |
| 173.Restaurant Cooks | 35-2014.00 | 65 |
| 174.Short Order Cooks | 35-2015.00 | 33 |
| 175.Food Preparation Workers | 35-2021.00 | 100 |
| 176.Bartenders | 35-3011.00 | 91 |
| 177.Food Preparation/Serving Workers | 35-3021.00 | 62 |
| 178.Cafeteria/Concession/Coffee Shop Attendants | 35-3022.00 | 33 |
| 179.Waiters/Waitresses | 35-3031.00 | 117 |
| 180.Restaurant/Lounge/Coffee Shop Hosts/Hostesses | 35-9031.00 | 71 |
| Personal Care and Service | | |
| 181.Gaming Supervisors | 39-1011.00 | 34 |
| 182.Slot Key Persons | 39-1012.00 | 33 |
| 183.Nonfarm Animal Caretakers | 39-2021.00 | 40 |
| 184.Gaming Dealers | 39-3011.00 | 31 |
| 185.Lobby Attendant/Ticket Taker Ushers | 39-3031.00 | 37 |
| 186.Amusement/Recreation Attendants | 39-3091.00 | 27 |
| 187.Locker Room/Coatroom/Dressing Room Attendants | 39-3093.00 | 24 |
| 188.Embalmers | 39-4011.00 | 52 |
| 189.Funeral Attendants | 39-4021.00 | 95 |
| 190.Hairdressers/Hairstylists/Cosmetologists | 39-5012.00 | 18 |
| 191.Baggage Porters/Bellhops | 39-6011.00 | 19 |
| 192.Concierges | 39-6012.00 | 46 |
| 193.Tour Guides/Escorts | 39-6021.00 | 37 |
| 194.Child Care Workers | 39-9011.00 | 35 |
| 195.Nannies | 39-9011.01 | 27 |
| 196.Personal/Home Care Aides | 39-9021.00 | 23 |
| 197.Fitness Trainers/Aerobics Instructors | 39-9031.00 | 22 |
| 198.Recreation Workers | 39-9032.00 | 37 |
| Sales and Related | | |
| 199.Retail Sales Worker Managers | 41-1011.00 | 24 |
| 200.Cashiers | 41-2011.00 | 51 |

| Major Group/O*NET-SOC Title | SOC Code | Incumbent <i>n</i> |
|---|------------|--------------------|
| 201.Counter/Rental Clerks | 41-2021.00 | 20 |
| 202.Parts Salespersons | 41-2022.00 | 39 |
| 203.Retail Salespersons | 41-2031.00 | 22 |
| 204.Advertising Sales Agents | 41-3011.00 | 19 |
| 205.Insurance Sales Agents | 41-3021.00 | 31 |
| 206.Travel Agents | 41-3041.00 | 20 |
| 207.Real Estate Brokers | 41-9021.00 | 26 |
| 208.Real Estate Sales Agents | 41-9022.00 | 20 |
| 209.Telemarketers | 41-9041.00 | 24 |
| Office and Administrative Support | | |
| 210.Switchboard Operators | 43-2011.00 | 85 |
| 211.Bill/Account Collectors | 43-3011.00 | 51 |
| 212.Billing/Cost/Rate Clerks | 43-3021.02 | 54 |
| 213.Billing/Posting/Calculating Machine Operators | 43-3021.03 | 16 |
| 214.Bookkeeping/Accounting/Auditing Clerks | 43-3031.00 | 80 |
| 215.Gaming Cage Workers | 43-3041.00 | 53 |
| 216.Payroll/Timekeeping Clerks | 43-3051.00 | 98 |
| 217.Procurement Clerks | 43-3061.00 | 48 |
| 218.Tellers | 43-3071.00 | 35 |
| 219.Court Clerks | 43-4031.01 | 49 |
| 220.Municipal Clerks | 43-4031.02 | 22 |
| 221.Customer Service Representatives | 43-4051.00 | 55 |
| 222.File Clerks | 43-4071.00 | 65 |
| 223.Hotel/Motel/Resort Desk Clerks | 43-4081.00 | 42 |
| 224.Interviewers (except Eligibility and Loan) | 43-4111.00 | 22 |
| 225.Clerical Library Assistants | 43-4121.00 | 92 |
| 226.New Accounts Clerks | 43-4141.00 | 21 |
| 227.Order Clerks | 43-4151.00 | 36 |
| 228.Human Resources Assistants | 43-4161.00 | 76 |
| 229.Receptionists/Information Clerks | 43-4171.00 | 39 |
| 230.Police/Fire/Ambulance Dispatchers | 43-5031.00 | 51 |
| 231.Dispatchers (except Police/Fire/Ambulance) | 43-5032.00 | 22 |
| 232.Shipping/Receiving/Traffic Clerks | 43-5071.00 | 31 |
| 233.Sales Floor Stock Clerks | 43-5081.01 | 27 |
| 234.Stockroom/Warehouse/Storage Yard Stock Clerks | 43-5081.03 | 51 |
| 235.Wholesale/Retail Sales Order Fillers | 43-5081.04 | 18 |
| 236.Executive Secretaries/Administrative Assistants | 43-6011.00 | 196 |
| 237.Legal Secretaries | 43-6012.00 | 18 |
| 238.Medical Secretaries | 43-6013.00 | 23 |
| 239.Secretaries (except Legal/Medical/Executive) | 43-6014.00 | 188 |
| 240.Computer Operators | 43-9011.00 | 33 |
| 241.Word Processors/Typists | 43-9022.00 | 27 |
| 242.Desktop Publishers | 43-9031.00 | 16 |
| 243.Insurance Policy Processing Clerks | 43-9041.02 | 18 |

*A Comparison of Incumbent and Analyst Ratings of O*NET Skills*

| Major Group/O*NET-SOC Title | SOC Code | Incumbent <i>n</i> |
|---|------------|--------------------|
| 244.General Office Clerks | 43-9061.00 | 68 |
| 245.Proofreaders/Copy Markers | 43-9081.00 | 32 |
| Construction and Extraction | | |
| 246.Brickmasons/Blockmasons | 47-2021.00 | 22 |
| 247.Construction Carpenters | 47-2031.01 | 17 |
| 248.Rough Carpenters | 47-2031.02 | 20 |
| 249.Carpet Installers | 47-2041.00 | 24 |
| 250.Tile/Marble Setters | 47-2044.00 | 22 |
| 251.Paving/Surfacing/Tamping Equipment Operators | 47-2071.00 | 34 |
| 252.Electricians | 47-2111.00 | 29 |
| 253.Pipefitters/Steamfitters | 47-2152.01 | 28 |
| 254.Plumbers | 47-2152.02 | 20 |
| 255.Sheet Metal Workers | 47-2211.00 | 42 |
| 256.Electrician Helpers | 47-3013.00 | 20 |
| 257.Pipelayer/Plumber/Pipefitter/Steamfitter Helpers | 47-3015.00 | 18 |
| 258.Construction/Building Inspectors | 47-4011.00 | 18 |
| 259.Highway Maintenance Workers | 47-4051.00 | 65 |
| 260.Mining Roof Bolters | 47-5061.00 | 28 |
| Installation, Maintenance, and Repair | | |
| 261.Mechanic/Installer/Repairer Sups/Mngrs | 49-1011.00 | 109 |
| 262.Electrical/Electronics Repairers | 49-2094.00 | 17 |
| 263.Automotive Body and Related Repairers | 49-3021.00 | 20 |
| 264.Automotive Master Mechanics | 49-3023.01 | 30 |
| 265.Bus and Truck Mechanics/Diesel Engine Specialists | 49-3031.00 | 21 |
| 266.Mobile Heavy Equipment Mechanics | 49-3042.00 | 20 |
| 267.Bicycle Repairers | 49-3091.00 | 26 |
| 268.Heating/Air Conditioning Mechanics | 49-9021.01 | 17 |
| 269.Refrigeration Mechanics | 49-9021.02 | 23 |
| 270.General Maintenance/Repair Workers | 49-9042.00 | 94 |
| 271.Millwrights | 49-9044.00 | 21 |
| 272.Medical Equipment Repairers | 49-9062.00 | 22 |
| 273.Installation/Maintenance/Repair Workers Helpers | 49-9098.00 | 51 |
| Production | | |
| 274.Food Batchmakers | 51-3092.00 | 36 |
| 275.Food Cooking Machine Operators/Tenders | 51-3093.00 | 25 |
| 276.Machinists | 51-4041.00 | 24 |
| 277.Treatment Plant & System Operators | 51-8031.00 | 17 |
| 278.Furnace/Kiln/Oven/Drier/Kettle Operators/Tenders | 51-9051.00 | 22 |
| 279.Packaging/Filling Machine Operators/Tenders | 51-9111.00 | 17 |
| Transportation and Material Moving | | |
| 280.Transit/Intercity Bus Drivers | 53-3021.00 | 34 |
| 281.Driver/Sales Workers | 53-3031.00 | 20 |
| 282.Taxi Drivers/Chauffeurs | 53-3041.00 | 26 |
| 283.Parking Lot Attendants | 53-6021.00 | 26 |

| Major Group/O*NET-SOC Title | SOC Code | Incumbent <i>n</i> |
|--|------------|--------------------|
| 284.Hoist/Winch Operators | 53-7041.00 | 19 |
| 285.Industrial Truck/Tractor Operators | 53-7051.00 | 47 |
| 286.Vehicle and Equipment Cleaners | 53-7061.00 | 29 |
| 287.Hand Packers/Packagers | 53-7064.00 | 35 |
| 288.Wellhead Pumpers | 53-7073.00 | 24 |
| 289.Shuttle Car Operators | 53-7111.00 | 30 |

Note. SOC = Standard Occupational Classification.

Appendix B

O*NET Skills Taxonomy

A. Basic Skills

1. *Reading Comprehension*. Understanding written sentences and paragraphs in work related documents.
2. *Active Listening*. Giving full attention to what other people are saying, taking time to understand the points being made, asking questions as appropriate, and not interrupting at inappropriate times.
3. *Writing*. Communicating effectively in writing as appropriate for the needs of the audience.
4. *Speaking*. Talking to others to convey information effectively.
5. *Mathematics*. Using mathematics to solve problems.
6. *Science*. Using scientific rules and methods to solve problems.

B. Process Skills

7. *Critical Thinking*. Using logic and reasoning to identify the strengths and weaknesses of alternative solutions, conclusions or approaches to problems.
8. *Active Learning*. Understanding the implications of new information for both current and future problem-solving and decision-making.
9. *Learning Strategies*. Selecting and using training/instructional methods and procedures appropriate for the situation when learning or teaching new things.
10. *Monitoring*. Monitoring/Assessing performance of yourself, other individuals, or organizations to make improvements or take corrective action.

C. Service Orientation Skills

11. *Social Perceptiveness*. Being aware of others' reactions and understanding why they react as they do.
12. *Coordination*. Adjusting actions in relation to others' actions.
13. *Persuasion*. Persuading others to change their minds or behavior.

14. *Negotiation*. Bringing others together and trying to reconcile differences.

15. *Instructing*. Teaching others how to do something.

16. *Service Orientation*. Actively looking for ways to help people.

D. Technical Skills

17. *Complex Problem Solving*. Identifying complex problems and reviewing related information to develop and evaluate options and implement solutions.

18. *Operations Analysis*. Analyzing needs and product requirements to create a design.

19. *Technology Design*. Generating or adapting equipment and technology to serve user needs.

20. *Equipment Selection*. Determining the kind of tools and equipment needed to do a job.

21. *Installation*. Installing equipment, machines, wiring, or programs to meet specifications.

22. *Programming*. Writing computer programs for various purposes.

23. *Quality Control Analysis*. Conducting tests and inspections of products, services, or processes to evaluate quality or performance.

24. *Operation Monitoring*. Watching gauges, dials, or other indicators to make sure a machine is working properly.

25. *Operation and Control*. Controlling operations of equipment or systems.

26. *Equipment Maintenance*. Performing routine maintenance on equipment and determining when and what kind of maintenance is needed.

27. *Troubleshooting*. Determining causes of operating errors and deciding what to do about it.

28. *Repairing*. Repairing machines or systems using the needed tools.

E. Systems Skills

29. *Systems Analysis*. Determining how a system should work and how changes in conditions, operations, and the environment will affect outcomes.

30. *Systems Evaluation*. Identifying measures or indicators of system performance and the actions needed to improve or correct performance, relative to the goals of the system.

31. *Judgment and Decision Making*. Considering the relative costs and benefits of potential actions to choose the most appropriate one.
32. *Time Management*. Managing one's own time and the time of others.
33. *Management of Financial Resources*. Determining how money will be spent to get the work done, and accounting for these expenditures.
34. *Management of Material Resources*. Obtaining and seeing to the appropriate use of equipment, facilities, and materials needed to do certain work.
35. *Management of Personnel Resources*. Motivating, developing, and directing people as they work, identifying the best people for the job.