Linking Client Assessment Profiles to O*NET® Occupational Profiles Within the O*NET Ability Profiler

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Introduction

The **O*NET® Career Exploration Tools** are a set of assessment tools used for career counseling, exploration, and planning purposes. These tools are designed to help clients learn work-related information about themselves to focus their career search activities. The **O*NET Career Exploration Tools** assist clients in planning and identifying occupations for which they (a) have (or can learn) the required abilities, (b) have the basic interests that characterize people in those occupations, and/or (c) have a strong need for the work values that the occupations will provide. That is, workers, students, and individuals new to the labor market can use **O*NET Career Exploration Tools** to identify occupations that are linked to their attributes.

To achieve this focused career exploration, clients use the **O*NET Career Exploration Tools** to accurately and reliably identify their abilities, interests, and/or work values. Once clients identify their work-related attributes, they are directed to O*NET-SOC occupations that are linked to the individualized assessment information they provided. The purpose of this report is to describe how client ability assessment profiles are linked to O*NET-SOC occupational profiles by means of the **O*NET Ability Profiler**, one of the **O*NET Career Exploration Tools**.

O*NET Career Exploration Tools

The O*NET Program has developed six career exploration tools designed to help clients assess important pieces of personal and career information:

(1) **O*NET Ability Profiler**—measures nine abilities related to job performance. The assessment is group-administered via paper-and-pencil and may be scored electronically or by hand.

(2) **O*NET Interest Profiler**—measures six vocational interests (i.e., Realistic, Investigative, Artistic, Social, Enterprising, and Conventional: R-I-A-S-E-C; cf. Holland, 1985, 1997). The assessment is self-administered via paper-and-pencil and is self-scored.

(3) **O*NET Computerized Interest Profiler**—measures six vocational interests (i.e., R-I-A-S-E-C interests). The assessment is self-administered via computer and uses automated scoring.

(4) **O*NET Interest Profiler Short Form**—measures six vocational interests (i.e., R-I-A-S-E-C interests). The assessment is self-administered via the web and uses automated scoring.

(5) **O*NET Work Importance Locator**—measures six important work values (Achievement, Independence, Recognition, Relationships, Support, and Working Conditions) identified in the Theory of Work Adjustment (cf. Dawis & Lofquist, 1984; Dawis, Lofquist, & Weiss, 1968; Lofquist & Dawis, 1969; Weiss,

Dawis, England, & Lofquist, 1964).[1] The assessment is self-administered via paper-and-pencil and is self-scored.

(6) **O*NET Work Importance Profiler**—measures 21 important work needs related to six work values (see above). The assessment is self-administered via computer and uses automated scoring.

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[1]In the Theory of Work Adjustment, the six work values were labeled Achievement, Autonomy, Status, Altruism, Safety, and Comfort, respectively.

Each of the assessment tools described above yields several scores for the client. These scores define the client's score profile. Clients can identify occupations to explore using the score profile generated for them from a single **O*NET Career Exploration Tool** or they can combine score profiles generated from multiple **O*NET Career Exploration Tools** (McCloy, Campbell, Oswald, Lewis, & Rivkin, 1999b). This paper solely focuses on linking client assessment profiles to O*NET-SOC occupational profiles using the **O*NET Ability Profiler.**

O*NET-SOC Occupations

The O*NET-SOC occupational taxonomy is based on the Standard Occupational Classification [(SOC); Office of Management and Budget, 2000] system. In some cases, the O*NET-SOC describes occupations at a more detailed level than does the SOC to reflect needed occupational specificity. The O*NET-SOC 2009 taxonomy includes 1,102 occupational titles, 965 of which represent O*NET data-level occupations. (National Center for O*NET Development, 2009). Data-level occupations are those occupations for which the O*NET Program collects data. Data and occupational information are collected on a wide variety of variables and scales, such as occupational characteristics and worker requirements drawn from the O*NET Content Model. Data are gathered from job incumbents and occupation experts for domains such as knowledges, work activities, work context, tasks, and educational requirements. Additionally, trained occupational analysts, following standardized procedures, independently conduct an analysis of occupational information provided by job incumbents to develop occupational ability and skills information.

For career exploration purposes, O*NET-SOC occupations are categorized into five Job Zones on the basis of the amount of education, training, and/or experience each occupation requires. Job Zones are ordered according to increasing levels of education, training, and/or experience, such that Job Zone 1 contains occupations requiring the least preparation and Job Zone 5 contains those occupations requiring the most preparation (National Center for O*NET Development, 2008; Oswald, Campbell, McCloy, Rivkin, & Lewis, 1999).

Each O*NET-SOC occupation has an occupational score profile that enables direct linkage of the occupation with score profiles generated from the **O*NET Career Exploration Tools**. For the **O*NET Ability Profiler**, each occupation has a specific ability score profile that corresponds to ability information measured by the assessment. For a description of the development of this occupational information, see *Updating Occupational Ability Profiles with O*NET Content Model Descriptors* (Allen, Tsacoumis, & McCloy, 2009), *Linking Client Assessment Profiles to O*NET Occupational Profiles* (McCloy et al., 1999a), *Generation and Use of Occupational Ability Profiles for Exploring O*NET Occupational Units, Vols. I-II* (McCloy et al., 1999b), *Procedures for O*NET Job Zone Assignment* (National Center for O*NET Development, 2008), and *Determining the Occupational Reinforcer Patterns for O*NET Occupational Units, Vols. I-II* (McCloy, Waugh, Medsker, Wall, Rivkin, & Lewis, 1999a).

Linking Assessment Results to Occupations

The primary goal of the **O*NET Career Exploration Tools** is to identify the set of O*NET-SOC occupations that best correspond to a client's abilities, interests, and/or work values. To meet this goal, a linking procedure compares a client's assessment results from one or more of the O*NET tools (e.g., **O*NET Ability Profiler**, **O*NET Computerized Interest Profiler**) to O*NET occupational information related to the tool(s) the client elects to use. The O*NET-SOC occupations with score profiles that most closely correspond to the client's score profile qualify as suggested candidates for the client's career exploration. **O*NET Career Exploration Tools** also can be used in conjunction with other available assessment instruments, if needed, to meet program objectives or individual assessment needs. The following sections discuss how client/O*NET-SOC occupational profile correspondence was characterized for the purposes of identifying an algorithm for determining profile similarity using the **O*NET Ability Profiler**.

O*NET Ability Profiler

Scores on the **O*NET Ability Profiler** are calculated by a computer program—the O*NET Ability Profiler Scoring Program (National Center for O*NET Development, 1999a; Silva, 1999; Silva, Lewis, Rivkin, & Koritko, 1999). When determining the correspondence between a client score profile from the **O*NET Ability Profiler** and the corresponding O*NET-SOC occupational score profiles, the O*NET Ability Profiler Scoring Program uses the correlation coefficient and a second index, the Euclidian distance (see below), to refine the profile correspondence. The correlation between a client's profile (*X*) and an occupational profile (*Y*) is given mathematically as follows:

$$ r_{XY} = \frac{\Sigma(X - \overline{X})(Y - \overline{Y})}{N\sigma_X\sigma_Y} $$

where $\overline{X}$ and $\overline{Y}$ and σ_X and σ_Y are the means and standard deviations of *X* and *Y*, respectively, and *N* is the number of scores to be correlated (i.e., the number of scores constituting the client's profile).[2] The correlation indexes the similarity of the shape (but not the level) between the client and occupational profiles and is the correspondence index most vocational counselors prefer. The correlation can range from -1.0 to +1.0. A correlation of +1.0 indicates that the rank orders of client and O*NET-SOC occupational

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[2]Note that σ represents variability of the *sample* at hand and uses a divisor of *N*.

profile scores are identical, whereas a correlation of -1.0 indicates that the rank order of client scores is opposite the rank order of O*NET-SOC occupational profile scores. A value of 0.0 indicates no correspondence between the client score profile and the O*NET-SOC occupational score profile.

The second index of correspondence, the Euclidian distance, introduces level into the linking program. Specifically, if a client's **O*NET Ability Profiler** score profile correlates equally with two or more O*NET-SOC occupations, the occupations are ordered from lowest to highest on *d*, the Euclidean distance. The Euclidean distance between two measures *X* and *Y* is given mathematically as follows:

$$d = \sqrt{\sum_{i=1}^{k}(X_i - Y_i)^2}$$

where X and Y are scores from the client and occupational profiles, respectively, and *k* is the number of scores in a given score profile. The *d* value indexes the proximity of the client profile to the occupational profile. Thus, Euclidean distance introduces level to the matching process. For occupations exhibiting equal correlations with the client profile, the occupation(s) having the most proximal profile(s) will be listed ahead of those having profiles less similar in level. The matching program uses *d* with the **O*NET Ability Profiler** because the goal is to increase the face validity of the selected occupations by guiding the client to occupations for which they are more likely to be qualified rather than to occupations for which they may be under- or over-qualified.

An Example
To illustrate the use of both the correlation and Euclidean distance, consider the hypothetical client and O*NET-SOC occupational score profiles for the **O*NET Ability Profiler** appearing in Figures 1 and 2. The nine ability scores given in the figures are as follows:

- Verbal (V)
- Spatial (S)
- Form Perception (P)
- Clerical (Q)
- Motor Coordination (K)
- Finger Dexterity (F)
- Manual Dexterity (M)
- Arithmetic Reasoning (AR)
- Computation (CMP; corresponds to usual CM abbreviation)
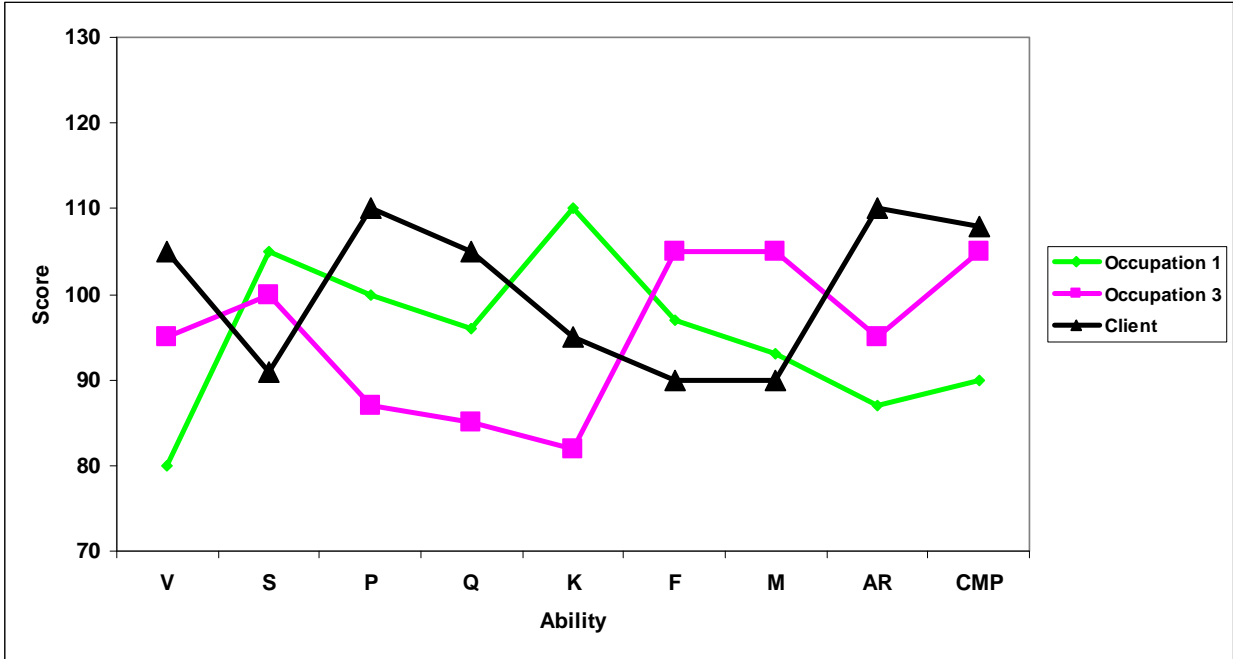
Figure 1. Sample Client and O*NET-SOC Occupational Profiles for the O*NET Ability Profiler: Low Correlations
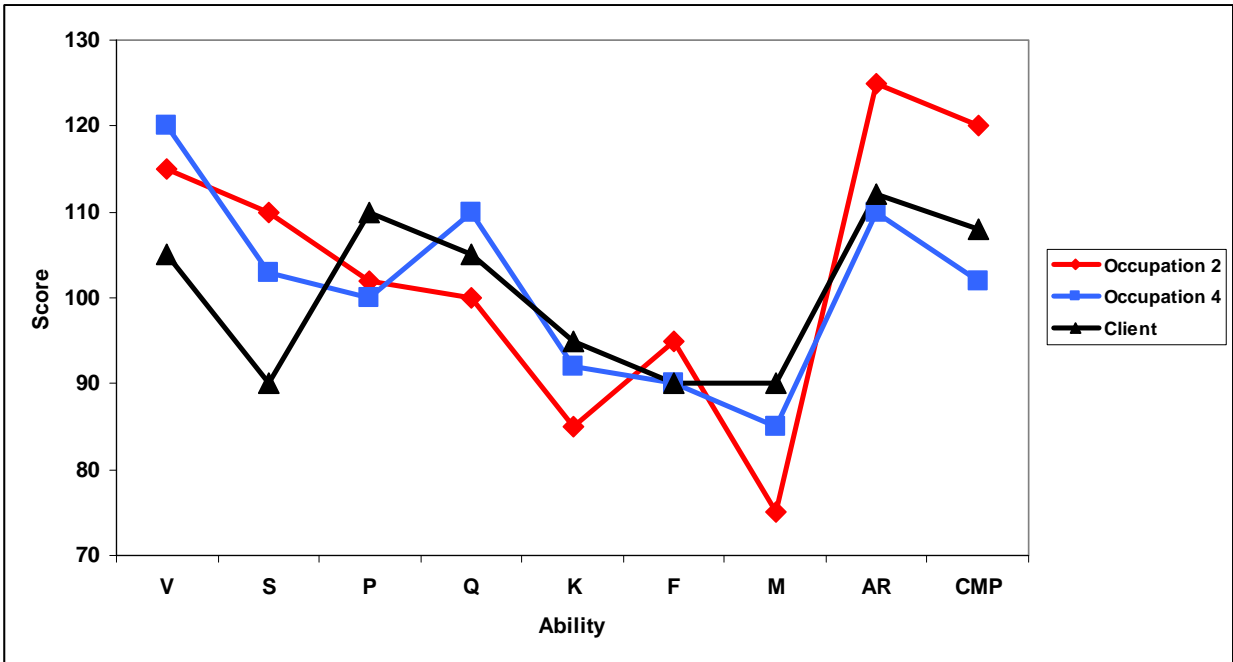

Figure 2. Sample Client and O*NET-SOC Occupational Profiles for the O*NET Ability Profiler: High Correlations

The correspondence indices between the client profile and four O*NET-SOC occupational profiles are given in Table 1. The values of the correlation coefficient in Table 1 indicate that the client's profile has a dissimilar shape to the score profiles for O*NET-SOC occupation 1 and O*NET-SOC occupation 3 (see Figure 1) and a similar shape to O*NET-SOC occupation 2 and O*NET-SOC occupation 4 (see Figure 2). In addition, the client profile correlates equally with the score profiles for occupation 2 and occupation 4. The Euclidean distance values for occupation 2 and occupation 4 indicate that the client's profile corresponds more closely with the score profile for occupation 4 than for occupation 2; that is, the client profile is less distant from the occupation 4 profile ($d = 23.24$) than from the occupation 2 profile ($d = 34.75$). Thus, given the choice of the two O*NET-SOC occupations, the client might wish to explore occupation 4 first.

Table 1
Correspondence Indices for Hypothetical Client and O*NET-SOC Occupational Profiles from the O*NET Ability Profiler

O*NET-SOC Occupation	Correlation Coefficient	Euclidean Distance
Occupation 1	-.46	45.06
Occupation 2	.68	34.75
Occupation 3	-.36	44.96
Occupation 4	.68	23.24

In sum, using both the correlation and the Euclidean distance provides a refined determination of the correspondence between a client profile and various O*NET-SOC occupational profiles. Using the distance index only in the event of ties preserves the preeminence of profile shape (as vocational counselors suggest).

Occupations Listed on the O*NET Ability Score Report

By comparing the client's ability profile to those of O*NET-SOC occupations, the scoring program selects and presents occupations considered most promising for career exploration. For the **O*NET Ability Profiler**, the client score profile will contain six to nine ability scores, depending on whether the client elects to take the optional psychomotor portions of the assessment. The client can choose to take one, two, or three psychomotor sub-tests. After calculating the correlation coefficient between the client score profile and each O*NET-SOC occupational score profile, the scoring program applies a series of decision rules to the results. O*NET-SOC occupations that satisfy the decision rules appear on the client's score report. These decision rules are described below.

1. Occupations are presented in descending order of the correlation, within Job Zone.
2. The correlation between a client's and an O*NET-SOC occupational profile must be positive for an occupation to appear on the Ability Profiler score report (i.e., no occupations with negative correlations are reported).
3. O*NET-SOC occupations for which the client/O*NET-SOC occupational profile correlation is notably high are identified as "very strong" matches. The "very strong" match cutoff denotes the value for which the statistical significance of the correlation is $p < .05$ as derived from a one-tailed significance test. See Table 2 for a description of the "very strong" match correlation criteria for each of the score profile types (e.g., six, seven, eight, or nine scores).
4. O*NET-SOC occupations for which the client/ O*NET-SOC occupation profile correlation is high are identified as "strong" matches. The "strong" match cutoff represents the value for which the statistical significance of the correlation is $p < .10$, as derived from a one-tailed significance test. See Table 2 below for a description of the "strong" match correlation criteria for each of the score profile types (e.g., six, seven, eight, or nine scores).

Table 2

Correlation Values for an O*NET-SOC Occupation to Appear on the Profiler Score Report and to be Labeled "Strong" or "Very Strong" Matches

# of Ability Scores in the Client/O*NET-SOC Profile	Strong Match Correlation	Very Strong Match Correlation
Six	.608	.729
Seven	.550	.669
Eight	.506	.621
Nine	.475	.582

5. The goal of the scoring program is to list a minimum of 10 "very strong" or "strong" occupations displayed per Job Zone. If there are not 10 "very strong" or "strong" matches to the client's ability profile available, the scoring program displays the occupations with the next highest available positive correlations. These occupations are labeled "good matches."

6. The Euclidian distance (d) is used to break ties among equally correlated scores. When two correlations are tied, the Euclidian distance orders the occupations by calculating the proximity of the client's score profile to the occupational score profile. Scores that are closer in distance to each other are ranked higher.

7. A maximum number of 25 O*NET-SOC occupations may be presented within a Job Zone.

8. Clients have the option of taking any or all of the three voluntary Ability Profiler sub-tests which measure psychomotor abilities (i.e., motor coordination, finger dexterity, and manual dexterity). All clients take six Ability Profiler sub-tests that measure a set of cognitive abilities (i.e., verbal, spatial, form perception, clerical, arithmetic reasoning, and computation). If less than 10 occupations are displayed within a given Job Zone based on the above decision rules 1-7, and the client has taken the psychomotor sub-test(s), the correlation between the client's cognitive portion of their profile (see six cognitive sub-tests above) and the O*NET-SOC occupations is re-calculated without including the psychomotor sub-test(s). These new correlations are then used to potentially populate the required number of occupations on the score report to reach a display of 10 occupations per Job Zone. Occupations listed on the report generated from this second tier analysis are identified with the following language:

   "+ This occupation is presented based on its link to your Verbal Ability,

Arithmetic Reasoning, Computation, Spatial Ability, Form Perception and Clerical Perception results."

9. There may be some instances where fewer than 10 occupations are displayed per Job Zone, as only a small number of occupations are linked to the client's score profile. If fewer than 7 occupations are presented per Job Zone, the following language is displayed on the score report:

   "There are only a few occupations in this job zone that link to your ability profile. Look in other job zones to find occupations that match your ability profile."

10. Additionally, there may be occasions where no occupations are linked to a client's ability profile within a Job Zone. If this occurs, the following language is displayed on the score report:

   "There are no occupations linked to your ability profile in this job zone. Look in other job zones to find occupations that match your ability profile."

The decision rules used in the scoring algorithm help ensure that users of the **O*NET Ability Profiler** receive appropriate, meaningful occupations based on their ability results.

Summary

To facilitate client career exploration, a diverse set of **O*NET Career Exploration Tools** have been developed that clients can use to assess their abilities, interests, and work values. Except for the **O*NET Ability Profiler**, the assessment tools are offered in both computerized and paper-and-pencil formats. Clients can score the paper-and-pencil versions, while the computerized assessments have automated scoring. Given a set of scores on one or more of the Profilers, clients are directed to O*NET-SOC occupations that are deemed most promising for career exploration. The occupations are based on the 965 data-level O*NET-SOC occupational titles.

The O*NET-SOC occupations targeted for further exploration are those with score profiles that correspond most with the client's score profile. This report described two statistical indices used to determine profile correspondence within the **O*NET Ability Profiler**: the correlation coefficient and the Euclidian distance. The correlation provides a numerical index of the similarity of the shapes (but not the levels) of the client and occupation profiles and is the approach most vocational counselors prefer for describing profile correspondence. The Euclidian distance introduces level into the profile correspondence process and is used to break ties among equally correlated scores.

The **O*NET Ability Profiler** helps clients identify their work-related abilities and links their ability profile to occupations for career exploration purposes, especially focusing client career exploration on those occupations that are "very strong," "strong," and "good" matches to their abilities. By linking clients' abilities with occupations that are "very strong," "strong," and "good" matches to their abilities, the Ability Profiler can help workers consider career options, think about career education and training, and transition into new occupations more smoothly. Additionally, the Ability Profiler can help students and individuals new to the labor market explore career areas that relate to their abilities.

The modified and enhanced client/O*NET-SOC occupation linkage procedures just described provide another component to a flexible, dynamic career exploration system that corresponds to today's rapidly changing world of work.

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