Occupations in Education

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ABSTRACT

In this report we present the aptitude patterns for examinees with occupations in education. The primary advantage of this study over past Foundation research on occupations in education is that we examine aptitude patterns using *large* samples of examinees with a wide spectrum of specialties by means of categories such as primary, secondary, and post-secondary education, as well as special education. In addition, we analyzed scores on the Self-Directed Search (SDS) to see how interests relate to occupations in education.

There are a number of interesting findings from the study. First, examinees with occupations in post-secondary and secondary education show somewhat similar patterns of aptitudes. Post-Secondary shows reasoning (Number Series and Analytical Reasoning) and verbal abilities (Silograms, English and Mathematics Vocabulary), while Secondary shows verbal (Silograms) with some reasoning (Number Series). In addition, occupations in post-secondary education showed idea production (Ideaphoria) and musical ability (Tonal Memory and Rhythm Memory). Previous research has identified many of these same aptitudes for these groups (Technical Reports 90 and 761). These patterns of aptitudes are logical because Post-Secondary includes professors who use verbal ability for teaching and reasoning ability for conducting research. Secondary teachers are not as dependent on reasoning for carrying out research but use verbal for teaching.

A second major finding from this study is that the remaining occupational codes in education such as primary education, teachers with no level specified, and special education have a pattern of aptitudes no different from the general population. The remaining group, which includes occupations in education not classified with the other codes, showed verbal ability (Silograms and both vocabulary tests).

In addition to aptitude patterns, we also examined results on the Self-Directed Search. The current results are similar to the results reported by Holland in showing the social and artistic aspects of teaching. In the current study, we see positive effect sizes for the Social subscale for all occupational groups and for the Artistic subscale for all groups, apart from Special Education. Holland's results also show the influence of Enterprising, but we did not find the same.

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INTRODUCTION

The purpose of this study is to examine the aptitude profiles of various occupations in education using large sample sizes for the first time in one report. Before discussing previous research, it is important to define key terms and describe how occupations in education are coded.

By "education" we mean a variety of occupations such as teacher, principal, support personnel, and so on. Occupations in education range across Foundation occupational codes 90 to 99, but we focus on codes 90 to 94 and 99 because these are most commonly assigned. See immediately below for a description of each code examined in this study.

- 90 – Occupations in college and university education (henceforth referred to as "Post-Secondary education," and includes faculty member or administrator at a college or university)
- 91 – Occupations in secondary school education (henceforth referred to as "Secondary education," and includes teacher or assistant principal at a high school) (Note: Secondary education ranges from Grades 9 to 12.)
- 92 – Occupations in preschool, primary school, and kindergarten education (henceforth referred to as "Primary education," and includes teachers in preschool and kindergarten) (Note: This code ranges from preschool education through Grade 8.).
- 93 – Occupations in education, level unspecified (henceforth referred to as, "Education (Teachers, Level Unspecified)," and includes persons who work in the field of education but did not specify the level of education.)
- 94 – Occupations in education of persons with disabilities (henceforth referred to as "Special Education," and includes director or teacher of children with mental or physical impairments)
- 99 – Occupations in education not elsewhere classified (henceforth referred to as "Not Elsewhere Classified," and includes athletic directors, superintendents, and teacher aides).

It is important to remember that the types of occupations within a given code can range widely; for instance, in the case of code 90, from faculty member to department head to dean. For examples of additional occupations for the codes described above, see the Foundation document "Occupational Categories and Divisions" (Johnson O'Connor Research Foundation, n.d.).

Occupations are coded by the testing staff at the time examinees are tested. The criteria for assigning a given code are based on a) job responsibilities rather than job title and b)

the examinee's *current* or *most recent* job. Therefore, in this report we will only examine data for "current or most recent job" in education.

Previous Research

There has been a great deal of research conducted on occupations in education within the Foundation stretching back to the 1940s. We will discuss research outside of the Foundation primarily from the O*NET.[1]

As a general note before the discussion of previous research, most of the Foundation studies have quite small sample sizes, which necessitate caution in interpreting the results. In addition, many of the previous Foundation studies were conducted a number of years ago, before statistical significance tests were widely used.

We will discuss previous research in order of code (i.e., code 90, Post-Secondary education, then code 91, Secondary education, and so on).

Post-secondary education. In Statistical Bulletin 460, published in 1940, Seeley examined the aptitude profile of 30 college teachers. He found that they scored high on Accounting Aptitude (i.e., Graphoria) and Creative Imagination (i.e., Ideaphoria), low on Structural Visualization, and that they had a slight tendency toward Objective personality. These results are logical when one thinks about the aptitudes needed for teaching and conducting research, such as using number checking accuracy in grading and imagination in devising research studies.

In Technical Report 761, published in 1972, Tatlock did a study of three levels of education (i.e., primary, secondary, and post-secondary) wherein each level was divided into "still teaching" and "no longer teaching" to determine the aptitudes that relate to persistence in the field. Post-secondary teachers who were "still teaching," at the time of testing, scored high on Analytical Reasoning, Foresight, and Tweezer Dexterity.

Secondary. In Technical Report 90[2], published in 1941, Seeley conducted the most extensive Foundation study of high-school teachers. Criteria for inclusion in the study were teachers with at least four years of teaching experience, which included 75 current and 26 former teachers. High school teachers scored significantly higher than the

[1] On p. 4 there is a description of the O*NET.

[2] Statistical Bulletins 422, 505, 521, and 590 (all published in 1940) also examine the aptitude profile of high-school teachers, but Technical Report 90 subsumes these earlier documents.

general testing population on Creative Imagination (i.e., Ideaphoria), Vocabulary, Inductive Reasoning, and Number Checking (i.e., Graphoria). Seeley reported that high school teachers also *may* score higher than the general testing population on Number Memory and Analytical Reasoning and lower on Observation and Wiggly Block, but a larger study would be needed to determine this.

Tatlock also looked at the aptitude profile of secondary teachers in Technical Report 761. Her results show that secondary teachers who were "still teaching" scored high on Ideaphoria, Foresight, Tweezer Dexterity, and Abstract Visualization, which was viewed as a bipolar dimension with Structural Visualization at one end and Abstract Visualization at the other end.

Primary. In Statistical Bulletin 438, published in 1940, Seeley reported on a validation study of elementary school teachers. The results showed that the only "outstanding measured characteristic" for these teachers is having low Structural Visualization. In another study, Tatlock found that primary school teachers "still teaching" only score high on Foresight (Technical Report 761).

Additional Foundation research. Two additional studies within the Foundation examined education by *major* and not occupation, but the results are still relevant. The authors of Technical Report 1981-5 conducted a discriminant analysis and showed that a cluster of examinees with majors including sociology, education, and business scored low on English Vocabulary and Structural Visualization.

In Statistical Bulletin 2005-4, Condon and Schroeder compared education majors to other majors and found that education majors scored slightly above average on Finger Dexterity (z=.13), Inductive Reasoning (z=.08), Silograms (z=.06), and Tweezer Dexterity and Observation (each z=.04).

In addition to the two studies just discussed on education majors, in Statistical Bulletin 2005-14 Condon and Schroeder reported on the aptitude profile of occupational codes 91 to 93 combined. These examinees did not have z-scores higher than 0.3 on any Foundation test (equivalent to a percentile of 62). Therefore, education majors in this study did not have mean scores on any Foundation test meaningfully different than zero, or the mean of the general testing population.

Thus far, Foundation research has primarily examined occupational codes 90-92, and so the current study will shed light on aptitudes related to codes 93, 94, and 99 for the first time.

*O*NET.* Researchers at the O*NET have also conducted research on the abilities and skills needed by individuals in occupations in education. The O*NET is maintained by the U.S. Department of Labor and is a successor to the 60-year-old *Dictionary of Occupational Titles* (DOT). The O*NET provides information concerning skills and knowledge that are needed for given occupations as well as labor market information on employment levels and occupational outlook.

The O*NET reports the following abilities as being important *across* primary, secondary, and special education: oral expression, oral comprehension, speech clarity, speech recognition, problem sensitivity, written comprehension, deductive reasoning, fluency of ideas (analogous to the Foundation's Ideaphoria test), written expression, and inductive reasoning (analogous to the Foundation's Inductive Reasoning test) (U.S. Department of Labor, n.d.). We do not administer tests for many of the abilities listed by the O*NET, and so, we will focus on how our results compare to the O*NET for like abilities.

Below we show aptitudes *unique* to each area of education based on the O*NET research. We do not show aptitudes related to post-secondary education because the O*NET has too many sub-specialties within this designation to report.

- Primary education –written expression
- Secondary education - information ordering (analogous to Analytical Reasoning)
- Special education – near vision, information ordering (Analytical Reasoning)

Conclusions from previous studies. To sum up the previous research on occupations in education, abilities such as expression and comprehension (both oral and written), reasoning, and idea production are important. The Foundation results also indicate that Vocabulary and Number Checking (i.e., Graphoria) are important, as well.

Advantages of the Current Study

The current study has a number of advantages over the previous Foundation studies. First, other than Technical Report 761, this study is the first to examine various levels (e.g., primary, secondary, and post-secondary) of occupations in education in the same report. Second, the number of examinees for each education-related occupational code is large, which allows for solid conclusions. Finally, the current study uses contemporary data. For instance, apart from Statistical Bulletin 2005-14, the other studies cited were conducted many years ago, when the abilities and skills used for occupations in education may have differed from the present day.

One disadvantage of the current study is that each education-related occupational code contains jobs with a variety of training and skills. For instance, code 92 occupations that require minimal education, such as administrative assistants, are included with occupations that require much more education, such as teachers and administrators.

METHOD

Examinees

For this report, we used bargraph data for examinees with non-0 occupational codes from 1989[3] to 2007. Of the 48,042 examinees in this time period, 2,453 examinees had education-related codes: 418 examinees were coded as Post-Secondary (code 90), 461 as Secondary (code 91), 508 as Primary (code 92), 258 as Teachers, Level Unspecified (code 93), 125 as Special Education (code 94), and 683 as Education, Not Elsewhere Classified (code 99).

Examinees with occupations in education ranged in age from 16 to 69 (M = 35.09, SD = 10.70), and 791 (32.2%) were male, while 1,662 (67.8%) were female. The proportion of males to females was quite similar across year of testing as shown by an insignificant Pearson chi-square significance test, $\chi^2(21) = 20.71$, $p = .477$.

In addition, we examined the gender distribution by occupational code. Females were represented in the three major codes (90-92) in the following percentages: 57% of Post-Secondary, 62% of Secondary, and 87% of Primary. These educators' percentages are fairly similar to previous research of the U.S. teaching population as a whole in that females are: 46% of Post-Secondary, 60% of Secondary, and 86% of Primary (Education International, n.d.). Therefore, the gender proportions in this study are similar to those in the greater population of teachers, keeping in mind that the gender distributions are in favor of females.

Measures and Procedures

Foundation standard test battery. Before being tested, all examinees gave informed written consent to be tested by us. The tests were administered by full-time, trained

[3] We used 1989 as the first year of data in this study because this was the year Foundation staff began coding occupations.

Foundation test administrators. The examinees were administered 21 aptitude tests[4] and two tests of knowledge (English and Mathematics Vocabulary).

Roughly half of the aptitude tests were administered individually by trained test administrators, while the other half were taken in group settings with administration by a computer or other audiovisual device. Table 1 provides the reliabilities and brief descriptions of the aptitudes measured by the tests.

Among the aptitude tests we administered, two tests measure reasoning aptitudes (Inductive and Analytical Reasoning), two tests measure numerical aptitudes (Number Series and Number Facility), and two tests measure dexterity (Finger Dexterity and Tweezer Dexterity). Three tests measure types of musical abilities (Tonal Memory, Pitch Discrimination, and Rhythm Memory), four tests measure memory abilities (Memory for Design, Silograms, Number Memory, and Observation), and two tests measure spatial ability (Wiggly Block and Paper Folding), which sum to form Structural Visualization.

Finally, Number Checking, or Graphoria, is a perceptual speed measure, Color Discrimination measures the ability to perceive fine differences among colors, Ideaphoria measures idea-production ability, Foresight measures the ability to see possibilities, and Visual Designs I and II measure preferences for simplicity and non-uniformity, respectively, in randomly-generated designs.

Self-Directed Search. In addition to the aptitudes tested in this study, we also administered the Self-Directed Search (SDS) to see how interests and personality styles relate to occupations in education. According to a description on the SDS website, the SDS is "a career interest test that asks questions about your aspirations, activities, skills, and interests in different jobs. From the responses, the SDS produces your personal three-letter summary code, which you can use to find occupations and fields of study that match well with your personality. The SDS is based on John Holland's theory that people and working environments can be classified according to six basic types: Realistic, Investigative, Artistic, Social, Enterprising, and Conventional" (PAR, Inc., n.d.).

Holland identified the following three letter codes for education: elementary and secondary teaching are SAE, special education is SEC, and the post-secondary code

[4] Results for Structural Visualization, which is derived using Wiggly Block and Paper Folding, are also reported therein.

depends on the given area taught, and so we do not show it here in the interest of space and because the present study does not divide the post-secondary code into areas.

Measure reliability and validity. As can be seen from Table 1, most of the tests have reliabilities greater than .80, which is often viewed as the lower bound of acceptable reliability for testing purposes (Nunnally, 1978). The tests have also shown adequate validity, as documented in various Foundation reports (e.g., Statistical Bulletin 2004-6; Technical Report 1982-6). Lastly, the six Self-Directed Search summary scales also have reliabilities greater than .80 in all cases, as shown in Table 2 (Technical Report 2012-3).

Analyses

We took two separate approaches to the analyses based on the types of scores we analyzed. For the analyses on the Foundation standard test battery, we began by obtaining examinee percentile scores for each test. The main reason we used percentiles and not raw scores is because for a number of tests, including Number Facility, forms have changed over time leading to non-equivalent raw scores. For instance, Wks. 436 IA was used from 1989 to mid-1993, and it had a different number of items from Wks. 436 JA, which was adopted in 1993.

Once we obtained the percentiles for each test, we "normalized" them, or transformed them, from a scale based on equivalent numbers of scores at each percentile to a scale with roughly a normal distribution, so that we could calculate parametric statistics such as analysis of variance (Anastasi, 1988, pp. 82-83). Finally, we did not account for age differences because age differences were already accounted for in developing the percentiles.

For the analyses on the SDS, though, we used the raw scores for analysis because raw scores on the scales are equivalent over time. Because performance on the SDS differs with age, we partialled, or removed the influence of, age from the raw test scores before performing the analyses. To do this, we conducted a regression in which age, age-squared, and age-cubed were used to predict each scale score. Then, we saved the unstandardized residuals and added the overall mean to each score to yield the raw scores partialled for age in the original scale.

To determine which aptitudes are important for each code, we used a set of Foundation criteria to discern whether a given code outperforms the general population on a given test. When a given code surpasses the criteria for a given test, we label it as reaching "Foundation significance" which is more extensive that simply reaching "statistical

significance."[5] First, the difference between the test means for the code being examined and the general Foundation testing population[6] must be statistically significant at the .05 level (either positive or negative direction) via independent-samples *t*-tests.[7] Second, the mean difference between a given code and the population must be practically significant, with an effect size of three-tenths of a standard deviation (0.3 *SD*) or greater (positive effect) or -0.3 or less (negative effect), as evidenced by Cohen's *d* (Cohen, 1988).

Finally, at least 60% of the sample for a code must score above (positive effect) or below (negative effect) the 50th percentile of the population. A code can reach Foundation significance in either a positive or negative direction depending on the value of the test statistic, *d*, and whether the percentage of the individuals in a given code are above or below the 50th percentile of the population.

RESULTS

Post-Secondary Education

Table 3 shows the mean normalized aptitude scores for examinees with occupations in education. Mean test scores in boldface indicate Foundation significance as well as *d* values greater than or equal to 0.30. The only caveat to this is that Foresight reached Foundation significance for the Post-Secondary group but its *d* value is .29.

Examinees in Post-Secondary education show a pattern of idea production, reasoning, musical ability, word learning, and vocabulary. This group reached Foundation significance for the following aptitudes – Ideaphoria, Foresight, Analytical Reasoning, Number Series, Tonal Memory, Rhythm Memory, Silograms – and the two vocabulary tests, English and Mathematics Vocabulary.[8]

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[5] The criteria we used are based on the Foundation requirements for an aptitude to be included in an occupational profile, as described in Technical Report 2003-1.

[6] The "general Foundation testing population" is everyone in this study without an education-related occupational code.

[7] Individual *t*-tests were used to compare given occupational codes and the general Foundation population, as opposed to ANOVAs comparing all occupational codes amongst each other, because we were more interested in how a given code compared to the general population rather than differences among codes.

[8] The results of the statistical significance tests for the aptitudes that meet Foundation significance are as follows: ID, $t(45448) = 9.53$, $p < .001$; FO, $t(21334) = 3.81$, $p < .001$; AR, $t(43079) = 6.58$, $p < .001$; NS, $t(45909) = 7.43$, $p < .001$; TM, $t(45792) = 6.36$, $p < .001$; RM, $t(45852) = 6.02$, $p < .001$; SI, $t(45818) = 7.94$, $p < .001$; EV, $t(45773) = 14.74$, $p < .001$; and MV, $t(8421) = 8.25$, $p < .001$.

In Figure 1 we show the effect size differences (*d*) between examinees in Post-Secondary education and the rest of the testing population. The largest differences are for the two vocabulary tests (Mathematics Vocabulary, $d = 1.13$ and English Vocabulary, $d = .73$), which are large-sized effects, while Ideaphoria ($d = .47$), Silograms ($d = .39$), and two reasoning tests, Number Series ($d = .37$) and Analytical Reasoning ($d = .33$), show small- to medium-sized effects (Cohen, 1988).

The results of this study for the Post-Secondary group are similar to past research in some respects but differ in other respects. For instance, Statistical Bulletin 460 reported high scores on Ideaphoria, which is similar to the current study. In contrast, current results also indicate that music and word learning, as well as vocabulary, are related to occupations in Post-Secondary education, which has not been shown previously.

Secondary Education

As shown in Table 3, examinees in Secondary education show a pattern of having verbal ability and indications of reasoning and seeing possibilities. Foundation significance was reached for three aptitudes in common with Post-Secondary education: Foresight, Number Series, and Silograms – as well as the two vocabulary tests, English and Mathematics Vocabulary.[9]

In Figure 2 we show the effect size differences between examinees in Secondary education and the rest of the testing population. As with the results for Post-Secondary education, we found the largest effect size differences for the two vocabulary tests (Mathematics Vocabulary, $d = .94$, and English Vocabulary, $d = .48$).

The results of the current study for Secondary education parallel previous research by Seeley (Technical Report 90) and Tatlock (Technical Report 761) in showing the importance of Ideaphoria and English Vocabulary.

Primary Education

Examinees in Primary education did not reach Foundation significance for any aptitude (Table 3). In Figure 3 we show the small effect size differences comparing examinees in Primary education with the rest of the testing population.

[9] The results of the significance tests are as follows: FO, $t(21349) = 5.45$, $p < .001$; NS, $t(45952) = 6.38$, $p < .001$; SI, $t(45861) = 8.19$, $p < .001$; EV, $t(45818) = 10.26$, $p < .001$; MV, $t(8439) = 7.97$, $p < .001$.

Foundation researchers have conducted little-to-no previous research on examinees in primary education, which makes it difficult to place the current results in context. Nevertheless, in 1940, Seeley (Statistical Bulletin 438) found that the only distinguishing characteristic for a small sample of examinees in primary education was low scores for Structural Visualization. Seeley's lack of significant results for examinees in primary education is congruent with the current study. In the current study, although there was a modest trend toward low scores on Structural Visualization, the effect did not reach Foundation significance.

Teachers (Level Unspecified) and Special Education

As with examinees in Primary education, Teachers (Level Unspecified) and in Special Education did not reach Foundation significance for any test (Table 3). Examinees in Special Education did score statistically significantly *below* the general testing population on Wiggly Block and Structural Visualization, though. In Figures 4 and 5 we show the small effect size differences in favor of Teachers (Level Unspecified) and Special Education, respectively, compared to the general testing population.

Not Elsewhere Classified

These examinees represent a "catch-all" category that includes occupations that require a great deal of schooling, such as being a principal or superintendent, as well as positions requiring less education, such as teacher aides and tutors. Table 3 shows that this group reached Foundation significance on Silograms and English and Mathematics Vocabulary. In Figure 6 we show the small effect-size differences in favor of this group compared to the general testing population.

The Relationship Between Satisfaction in Education and Aptitudes

In addition to the general aptitude profiles, we thought it would be interesting and helpful to examine whether the aptitude scores for various occupations in education differ based on whether examinees are satisfied with their occupations. In order to examine this research question, we looked at the Information Sheets on which examinees indicate their satisfaction with their current occupation on a scale where "3" equals "satisfied," "2" equals "neutral," and "1" equals "dissatisfied." For each education-related occupational code, we compared the aptitude mean scores for satisfied ("3") versus dissatisfied ("1") examinees and found very few statistically significant mean differences. Therefore, we can conclude that aptitude performance does not differ based on levels of satisfaction for occupations in education.

The Relationship Between Major Field Codes and Occupational Codes

Because examinees with occupations in Post-Secondary and Secondary education had statistically significantly higher scores on Mathematics Vocabulary than the general testing population, we posited that a sizable percentage of examinees with these codes have a background in math or sciences fields. [10] To answer this question, we examined the major field codes for examinees in Post-Secondary, Secondary, and Primary education. As expected, 17% of Post-Secondary education examinees and 18% of Secondary education examinees have majors in math or science fields, while only 4% of Primary education examinees have such majors. Also, Primary educators are much more likely to have majors in education (general or by subject) than Secondary or Post-Secondary educators. In fact, 52% of Primary educators have majors in education as compared to 34% of Secondary educators and only 8% of Post-Secondary educators.

Next, we compared the aptitude profile of Post-Secondary educators with and without math and science majors. The results are quite interesting and further reinforce the fact that math and science majors among Post-Secondary educators are related to spatial, numerical, and reasoning aptitudes. For instance, Post-Secondary educators *with* math/science majors (N=71) scored statistically significantly higher than Post-Secondary educators *without* major/science majors (N=285) as shown via one-way analysis of variance tests on the following aptitudes:

- Number Series, $F(1,353) = 8.10$, $p = .005$ (Mean for the math/science group = 0.85 vs. mean for the non-M/S group = 0.50)
- Number Facility, $F(1,335) = 7.32$, $p = .007$ (M/S = 0.69 vs. non M/S = 0.35)
- Structural Visualization, $F(1,351) = 30.72$, $p < .001$ (M/S = 0.43 vs. non M/S = -0.23)
- Wiggly Block, $F(1,351) = 13.66$, $p < .001$ (M/S = 0.18 vs. -0.23 non M/S)
- Paper Folding, $F(1,342) = 31.66$, $p < .001$ (M/S = 0.58 vs. -0.04 non M/S)
- Memory for Design $F(1,353) = 7.77$, $p = .006$ (M/S = 0.59 vs. 0.26 non M/S).

Post-Secondary educators with math/ science majors also scored statistically significantly higher than Post-Secondary educators without math/science majors on Mathematics Vocabulary, $F(1,51) = 11.97$, $p = .001$ (M/S = 1.38 vs. 0.67 non M/S) but statistically significantly lower on Foresight, $F(1,153) = -4.01$, $p = .047$ (M/S = 0.21 vs. 0.61 non M/S) .

[10] We define a background in a math or science field as having a major in Architecture/Design; Biology/Biological Sciences; Computer, Information, and Library Science; Engineering; Mathematics; Physical Sciences; Math Education; or Science Education.

Self-Directed Search

In addition to administering the standard aptitude battery of tests, Foundation staff also administered the Self-Directed Search. In Table 4 and Figure 7 we show how examinees with occupations in education scored on the six Self-Directed Search subscales (Realistic, Investigative, Artistic, Social, Enterprising, and Conventional).

Figure 7 shows pretty clearly how socially focused educators are as a whole. All occupations in education had mean scores higher than the general testing population on the Social subscale, i.e., positive effect sizes (*d*). In addition, educators, as a whole, are quite Artistic in having positive effect sizes for all groups apart from Special Education. Finally, there is some evidence for investigative tendencies, as well, especially for the Post-Secondary group.

Apart from the general pattern for education, there were many significant differences among the occupations in education for the various SDS subscales. In Table 4 we show the mean scores and the effect size differences comparing occupations in education to the general testing population. Using two of the three Foundation criteria of significance (i.e., statistically significant mean difference of $p < .05$ and $d >= .30$),[11] examinees reached Foundation significance in each occupational group as follows:

- Post-Secondary – Investigative (positive direction)
- Secondary – Enterprising (negative)
- Primary – Realistic (negative), Social (positive), Enterprising (negative)
- Teachers (Level Unspecified) – Realistic (negative), Social (positive)
- Special Education – Realistic, Investigative, Enterprising, Conventional (all negative)
- Not Elsewhere Classified – Social (positive)

[11] The third Foundation criterion, percentile differences, was not used because percentiles are not used as part of the SDS score reporting.

DISCUSSION

We started this project with the purpose of examining the aptitude profiles of various occupations in education with large sample sizes for the first time. There were many interesting findings that will provide Foundation staff with further information on aptitudes related to occupations in education as well as inform future efforts to update education-related aptitude profiles.

One major finding of this study is that the Post-Secondary and Secondary groups show a somewhat similar pattern of aptitudes. Post-Secondary shows reasoning (Number Series and Analytical Reasoning) and verbal abilities (Silograms and English Vocabulary), while Secondary shows verbal and some reasoning (Number Series). The Post-Secondary group also showed idea production (Ideaphoria) and musical abilities (Tonal Memory and Rhythm Memory).

These results are logical and parallel previous research for the most part (Technical Reports 90 and 761). Examinees in Post-Secondary education include professors who use their verbal abilities in teaching and their reasoning and idea production abilities to conduct research. Examinees in Secondary education include teachers who use their verbal abilities to teach but are not as dependent on having reasoning ability because they do not typically conduct research.

Another major finding from this study is that the remaining occupational codes, including the Primary, Teachers (Level Unspecified), and the Special Education groups have a pattern with no aptitudes different from the general population. The Not Elsewhere Classified group, though, shows associative memory for verbal material (Silograms) and vocabulary knowledge (English and Mathematics Vocabulary). These results are similar to previous research on primary educators, which also showed no pattern (Statistical Bulletin 438).

In addition to aptitude patterns, we also examined results on the Self-Directed Search. The current results are similar to the results reported by Holland in showing the social and artistic aspects of teaching. In the current study, we see positive effect sizes for the Social subscale for all occupational groups and for the Artistic subscale for all groups, apart from Special Education. Holland's results also show the influence of Enterprising, but we did not find the same.

There are a number of caveats and cautions to this study. First, we were bound by each occupational code, meaning it was not possible to get more granular and precise in describing types of occupations within each code. For instance, occupations in post-

secondary education range widely from athletic director to dean to professor. Each of these occupations necessitates different levels of training and hence, likely a different patterns of aptitudes. Our assumption is that the majority of examinees with an occupational code of 90 are professors, for instance, but this may be incorrect. Finally, we were surprised that no occupations in education showed significance for Graphoria, when grading is such an important part of the teaching profession.

There are a number of possible directions for future research on occupations in education. First, it would be interesting to divide the overall groups, e.g., Post-Secondary, Secondary, into smaller, more-homogenous groups, which would necessitate more specific coding from testing staff. For instance, it is very likely that business Post-Secondary professors have a different aptitude pattern than natural sciences Post-Secondary professors. Another direction for future research is to do a longitudinal study to examine how education, job training, and job placement relates to aptitude patterns. For example, an examinee who majored in education with a specialty in biology and who is now teaching high school biology may materially differ aptitude-wise from an examinee who received a Ph.D. in biology and is teaching high school biology.

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Table 1
Tests in the Foundation's Standard Battery

Test	Reliability	Variable measured
Number Checking	.96	"Graphoria" (clerical speed and accuracy); test involves quickly comparing pairs of numbers to see whether they are the same or different.
Ideaphoria	.92	Rate of flow of ideas (ideational fluency).
Foresight	.96	Ability to see possibilities.
Inductive Reasoning	.88	Quickness in seeing relationships among separate facts, ideas, or observations.
Analytical Reasoning	.81	Ability to arrange ideas into a logical sequence.
Number Series	.87	Ability to reason (solve problems) with numbers.
Number Facility	.86	Ability to perform arithmetic operations quickly.
Wiggly Block	.77	Ability to visualize three-dimensional forms. The task is to reconstruct three-dimensional blocks.
Paper Folding	.82	Ability to visualize three-dimensional forms. The task is to mentally rotate two-dimensional surfaces through three-dimensional space.

(*table continues*)

Table 1 (*continued*)

Test	Reliability	Variable measured
Structural Visualization	.87	Ability to visualize three-dimensional forms. Sum of scores on Wiggly Block and Paper Folding.
Tonal Memory	.91	Ability to remember sequences of tones.
Pitch Discrimination	.80	Ability to perceive fine differences in pitch.
Rhythm Memory	.73	Ability to remember complex rhythmic patterns.
Memory for Design	.80	Memory for straight-line patterns.
Silograms	.92	Associative memory for verbal material.
Number Memory	.82	Memory for numbers.
Observation	.72	Ability to retain a mental image of various objects in the mind and quickly perceive any changes in the nature or position of an object.
Color Discrimination	.86	Ability to perceive fine differences among colors.
Finger Dexterity	.86	Speed and accuracy in manipulating small objects with one's fingers.

(*table continues*)

Table 1 (*continued*)

Test	Reliability	Variable measured
Tweezer Dexterity	.93	Speed and accuracy in handling small objects with tweezers.
English Vocabulary	.96	Knowledge of the meanings of nontechnical English words.
Mathematics Vocabulary	NA	Knowledge of terms used in mathematics.
Visual Designs I	.92	Preference for simplicity in randomly-generated designs. A measure of artistic judgment.
Visual Designs II	.88	Preference for non-uniformity in randomly-generated designs. A measure of artistic judgment (but distinct from Visual Designs I).

Note. Source for reliability coefficients: Statistical Bulletin 2012-8. "NA" means that the reliability for the given test is not available.

Table 2
Six Self-Directed Search Summary Scales

Scale	Description	Reliability
Realistic	Enjoying doing concrete things that often involve mechanical processes.	.87
Investigative	Enjoying engaging in scientific work.	.83
Artistic	Liking to do artistic things.	.87
Social	Enjoying being social, friendly, and helpful.	.82
Enterprising	Enjoying being a leader, adventurous, and ambitious.	.86
Conventional	Liking to do clerical and arithmetic tasks.	.80

Note. Source for reliability coefficients: Technical Report 2012-3. *N*s for reliability coefficients = 8,679. The reliabilities were computed across the five subscale scores, partialled for age, for each of the six scales.

Table 3

Mean Normalized Aptitude Scores, Corresponding Percentiles, and Effect Sizes (d) for Examinees With Occupations in Education

	Post-Secondary (Code = 90)			Secondary (91)			Primary (92)			Teachers (Level Unspecified) (93)			Special Ed (94)			Not Elsewhere Classified (NEC) (99)			General testing population	
Test	*M*	PC	*d*	*M*	PC	*d*	*M*	PC	*d*	*M*	PC	*d*	*M*	PC	*d*	*M*	PC	*d*	*M*	PC
GR	.29	61	.09	.18	57	-.02	.17	57	-.04	.13	55	-.08	.18	57	-.03	.15	56	-.05	.21	58
ID	.56	71	**.47**	.35	64	.28	.03	51	-.03	.03	51	-.03	-.08	47	-.13	.25	60	.18	.06	52
FO	.55	71	.29	.65	74	**.40**	.42	66	.16	.42	66	.15	.45	67	.19	.50	69	.24	.27	61
IR	.18	57	.13	.24	59	.19	.22	59	.17	.25	60	.21	.23	59	.18	.16	56	.11	.06	52
AR	.37	64	**.33**	.26	60	.21	.05	52	-.02	.11	54	.04	.01	50	-.07	.15	56	.08	.07	53
NS	.55	71	**.37**	.48	68	**.30**	.19	58	.01	.15	56	-.03	-.07	47	-.26	.33	63	.14	.19	57
NF	.42	66	.29	.37	64	.23	.33	63	.19	.16	56	.02	.17	57	.02	.26	60	.12	.15	56
WB	-.17	43	.05	-.14	44	.09	-.41	34	-.21	-.39	35	-.19	-.49	31	**-.30**	-.27	39	-.06	-.21	42
PF	.06	52	.13	.12	55	.19	-.22	41	-.19	-.20	42	-.17	-.27	39	-.25	.00	50	.06	-.05	48
SV	-.11	46	.11	-.06	48	.16	-.41	34	-.22	-.39	35	-.20	-.50	31	**-.32**	-.22	41	-.01	-.21	42
WA	16.09	N/A	.07	14.67	N/A	-.11	15.55	N/A	.01	14.73	N/A	-.10	15.00	N/A	-.06	14.75	N/A	-.10	15.50	N/A
TM	.29	61	**.31**	.08	53	.10	-.05	48	-.05	.09	53	.10	-.06	48	-.06	.08	53	.09	-.01	50
PD	.22	59	.28	.05	52	.10	-.16	44	-.13	.04	51	.09	-.09	46	-.05	.04	52	.09	-.04	48
RM	.41	66	**.30**	.19	58	.07	.07	53	-.06	.09	53	-.04	.02	51	-.11	.26	60	.14	.13	55
MD	.33	63	.18	.33	63	.18	.13	55	-.03	.12	55	-.04	.01	50	-.16	.26	60	.11	.16	56
SI	.46	68	**.39**	.45	67	**.38**	.29	61	.21	.25	60	.17	.18	57	.10	.37	64	**.30**	.08	53
NM	.16	56	.09	.17	57	.11	-.02	49	-.10	-.05	48	-.13	-.18	43	-.27	.11	54	.04	.07	53
OB	.23	59	.07	.16	56	.00	.25	60	.09	.19	57	.02	.14	55	-.02	.32	63	.16	.16	56
CD	.23	59	.20	.13	55	.08	.19	57	.16	.24	59	.21	.05	52	-.01	.14	55	.10	.05	52
FD	-.20	42	.03	-.18	43	.05	-.04	48	.20	-.19	43	.03	-.12	45	.11	-.22	41	.01	-.23	41
TD	.02	51	.07	.08	53	.13	-.01	50	.04	-.07	47	-.03	-.08	47	-.04	-.11	46	-.07	-.04	48
EV	.50	69	**.73**	.28	61	**.48**	-.23	41	-.10	.04	51	.20	-.32	38	-.20	.22	59	**.41**	-.14	44
MV	.89	81	**1.13**	.73	77	**.94**	-.04	48	.07	.09	53	.21	-.33	37	-.27	.27	61	**.42**	-.10	46
VDT I	-.05	48	.01	.02	51	.08	-.13	45	-.07	-.16	44	-.11	.22	59	.28	.08	53	.14	-.06	48
VDT II	-.13	45	.01	-.11	46	.04	.00	50	.15	-.07	47	.08	-.31	38	-.17	-.22	41	-.08	-.14	44

Note.

Tests: GR = Graphoria, ID = Ideaphoria, FO = Foresight, IR = Inductive Reasoning, AR = Analytical Reasoning, NS = Number Series, NF = Number Facility, WB = Wiggly Block, PF = Paper Folding, SV = Structural Visualization, TM = Tonal Memory, PD = Pitch Discrimination, RM = Rhythm Memory, MD = Memory for Design, SI = Silograms, NM = Number Memory, OB = Observation, CD = Color Discrimination, FD = Finger Dexterity, TD = Tweezer Dexterity, EV = English Vocabulary, MV = Mathematics Vocabulary, VDT I = Visual Designs Test I, VDT II = Visual Designs Test II.

The values for Word Association are raw-score means and not *d*-values because Word Association does not yield percentiles, which were used to calculate the normalized mean scores, which were then used to calculate the *d*-values.

Column heads: *M* = mean normalized aptitude scores calculated based on percentiles, PC = conversion of mean normalized aptitude scores back to a percentile score, *d* = effect size difference between the mean normalized aptitude scores for a given occupations in education and the general Foundation testing population group (Cohen, 1988). In practical terms, the effect size is the difference between the two means divided by the pooled standard deviation which is a function of the size of the two groups being compared, e.g., Post-Secondary code compared to the general Foundation testing population. Bolded *d* values indicate effect sizes greater than or equal to .30 as well as tests that reached Foundation significance. Foresight also reached Foundation significance for the Post-Secondary group but the effect size is .29.

The overall *N* sizes for the groups being compared are as follows: Post-Secondary = 418, Secondary = 461, Primary = 508, Teachers (Level Unspecified) = 258, Special Education = 125, NEC = 683, and rest of Foundation testing population = 45,589. The *N* sizes for the groups vary across the tests but are within 15 examinees of the overall *N* just reported in most cases. The *N* sizes for Foresight, VDT I and II, and Mathematics Vocabulary are lower than for other tests because they were added to the standard battery at later dates than other tests. The ranges of the sample sizes for these tests is as follows: FO, 60-320; VDT I and II, 40-225; and MV, 20-177.

The *SD*'s for the groups across the tests are clustered near one. The ranges of the *SD*'s for each group across tests are as follows: Post-Secondary, .80-1.01; Secondary, .87-1.01; Primary, .77-1.01; Teachers (Level Unspecified), .83-1.07; Special Education, .79-1.08; NEC, .82-1.01, rest of Foundation testing population, .85-1.06. The ranges of the standard errors of the mean for the groups across tests are as follows: Post-Secondary, .04-.10; Secondary, .04-.11; Primary, .04-.08; Teachers (Level Unspecified), .06-.13; Special Education, .07-.18; NEC, .03-.07; rest of Foundation testing population, .00-.01.

Table 4

Mean Age-Partialled Self-Directed Search Scores and Effect Sizes (d) for Examinees With Occupations in Education

	Post-Secondary (90)		Secondary (91)		Primary (92)		Teachers (Level Unspecified) (93)		Special Education (94)		Not Elsewhere Classified (99)		General testing population
Sub-scale	*M*	*d*	*M*	*d*	*M*	*d*	*M*	*d*	*M*	*d*	*M*	*d*	*M*
Real	20.14	-0.19	**20.16**	-0.17	**19.95**	-0.38	**19.93**	-0.40	**19.72**	-0.61	**20.20**	-0.13	20.33
Inv	**21.95**	0.37	21.71	0.13	**21.39**	-0.19	21.57	-0.01	**21.01**	-0.57	21.62	0.04	21.58
Art	**23.75**	0.22	23.56	0.03	23.59	0.06	23.71	0.18	23.27	-0.26	**23.69**	0.16	23.53
Soc	28.44	0.13	**28.57**	0.26	**28.75**	0.44	**28.85**	0.54	28.60	0.29	**28.65**	0.34	28.31
Ent	26.47	-0.05	**26.22**	-0.30	**26.18**	-0.34	26.47	-0.05	**26.01**	-0.51	**26.34**	-0.18	26.52
Conv	20.87	-0.06	**20.67**	-0.26	**20.75**	-0.18	21.03	0.10	**20.63**	-0.30	**20.70**	-0.23	20.93

Note.

Subscales: Real = Realistic, Inv = Investigative, Art = Artistic, Soc = Social, Ent = Enterprising, Conv = Conventional.

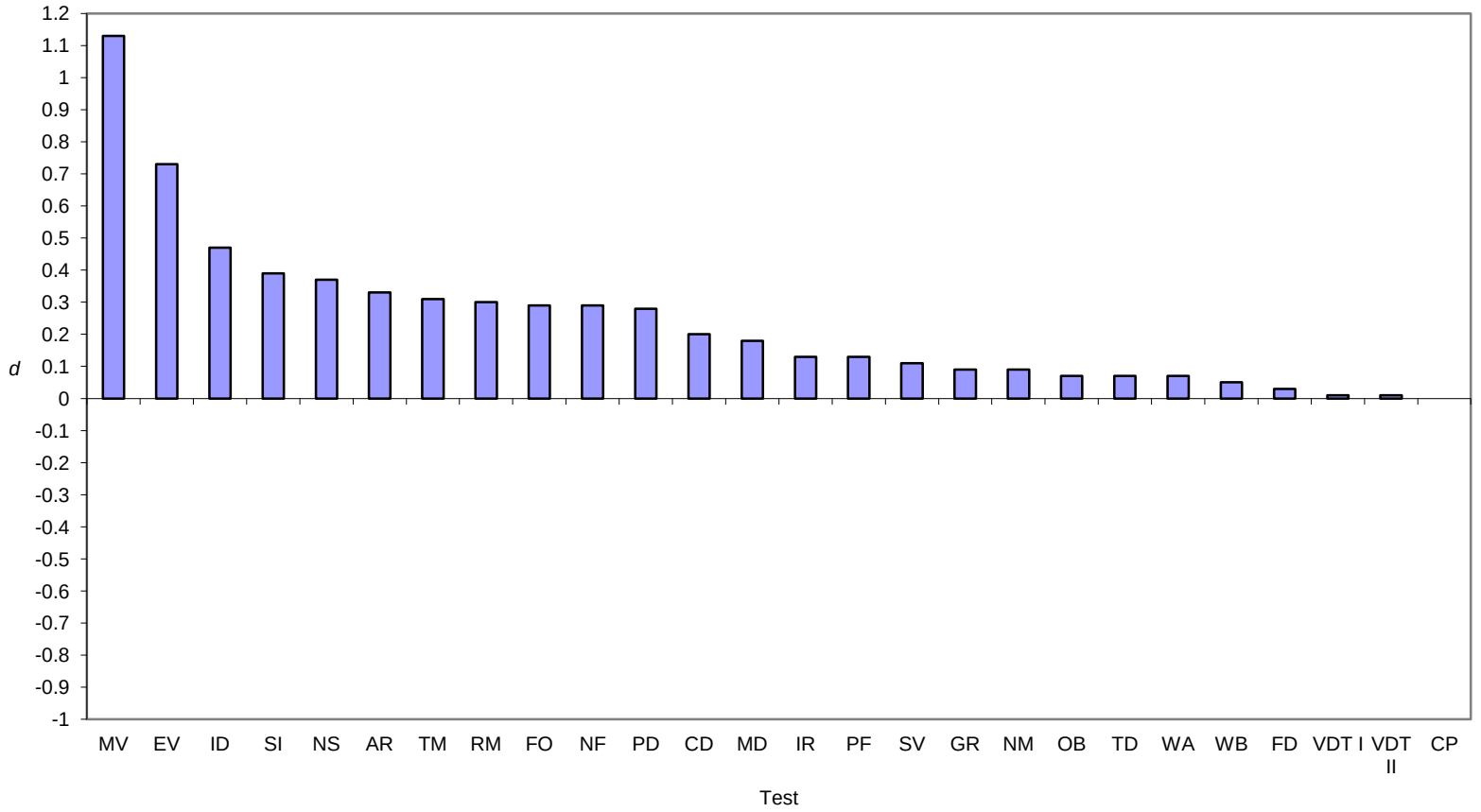
Column heads: *M* = mean age-partialled aptitude percentile scores, *PC* = percentile corresponding to mean score, *d* = effect size difference between the mean age-partialled aptitude percentile scores for a given occupations in education and the general Foundation testing population group. The mean scores reported are raw scores first partialled for age and then the non-age partialled mean was added back to each score to put the scores in a typical metric for the scales. Mean scores in bold indicate statistical significance relative to the general Foundation testing population group at the $p < .05$ level.

The overall *N* sizes for the groups being compared are as follows: Post-Secondary = 109, Secondary = 153, Primary = 151, Teachers (Level Unspecified) = 58, Special Education = 33, NEC = 211, and rest of Foundation testing population = 11,867. The *N* sizes for the groups vary across the tests but are within 7 examinees of the overall *N* in all cases.

The *SD*'s for the groups across the subscales are clustered near one. The ranges of the SD's for each group are as follows: Post-Secondary, .86-1.07; Secondary, .91-1.07; Primary, .85-1.03; Teachers (Level Unspecified), .78-1.12; Special Ed, .67-.98; NEC, .90-1.02, rest of Foundation testing population, 1.00. The ranges of the standard errors of the mean for the groups across subscales are as follows: Post-Secondary, .09-.10; Secondary, .07-.09; Primary, .07-.08; Teachers (Level Unspecified), .11-.15; Special Education, .12-.17; NEC, .06-.07; rest of Foundation testing population, .01.

Figure 1

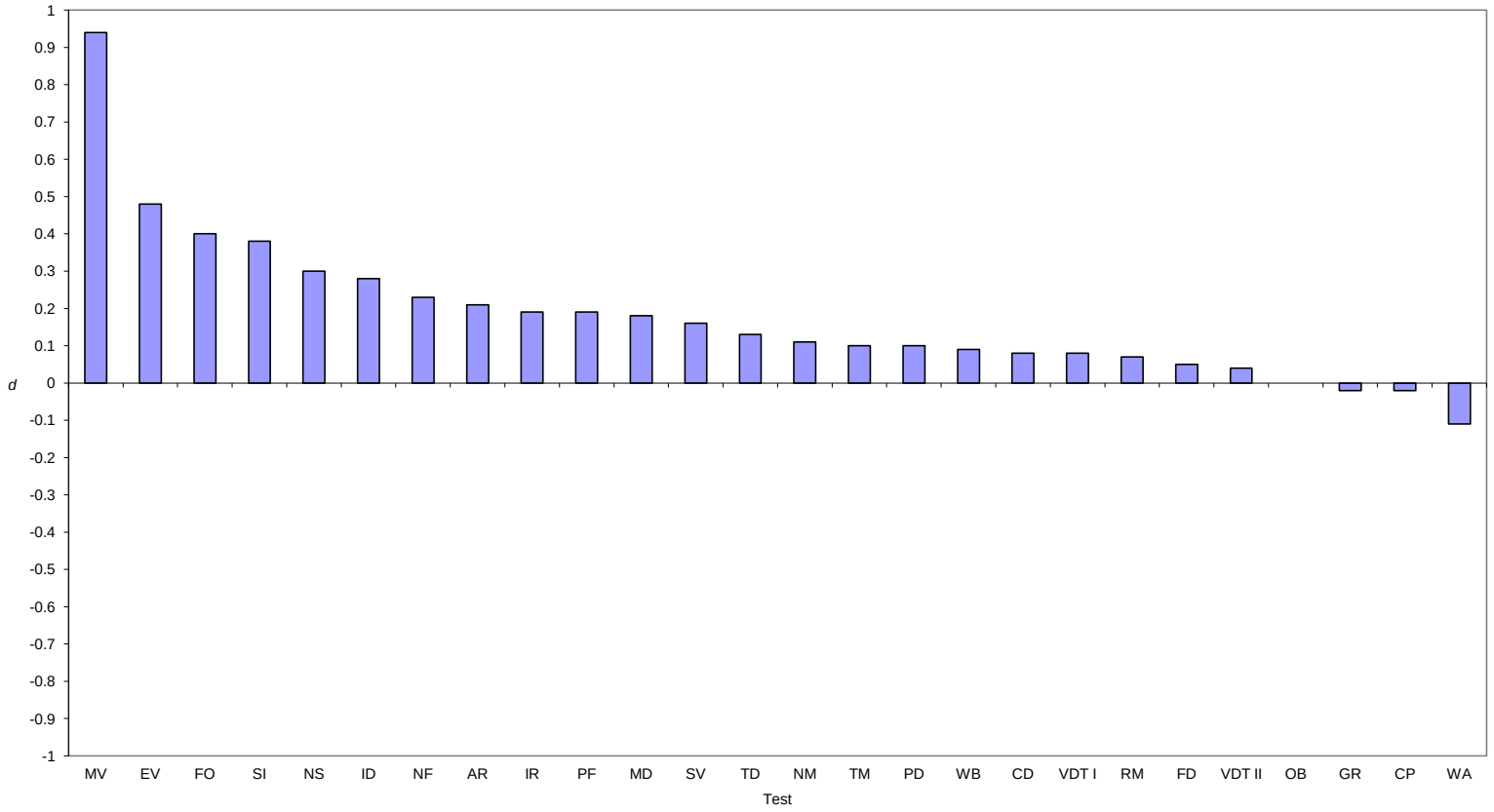
Effect Sizes for Aptitude Scores of Examinees Working in Post-Secondary Education Compared to the General Testing Population



Note. This figure shows the effect size differences (*d*) based on normalized aptitude scores on the standard battery tests for examinees with occupations in Post-Secondary education as compared to the general testing population. The normalized aptitude scores were obtained by transforming percentile scores. See the note in Table 3 for full names of the tests, *d* values, *N* sizes, standard deviations, and standard errors of the mean.

Figure 2

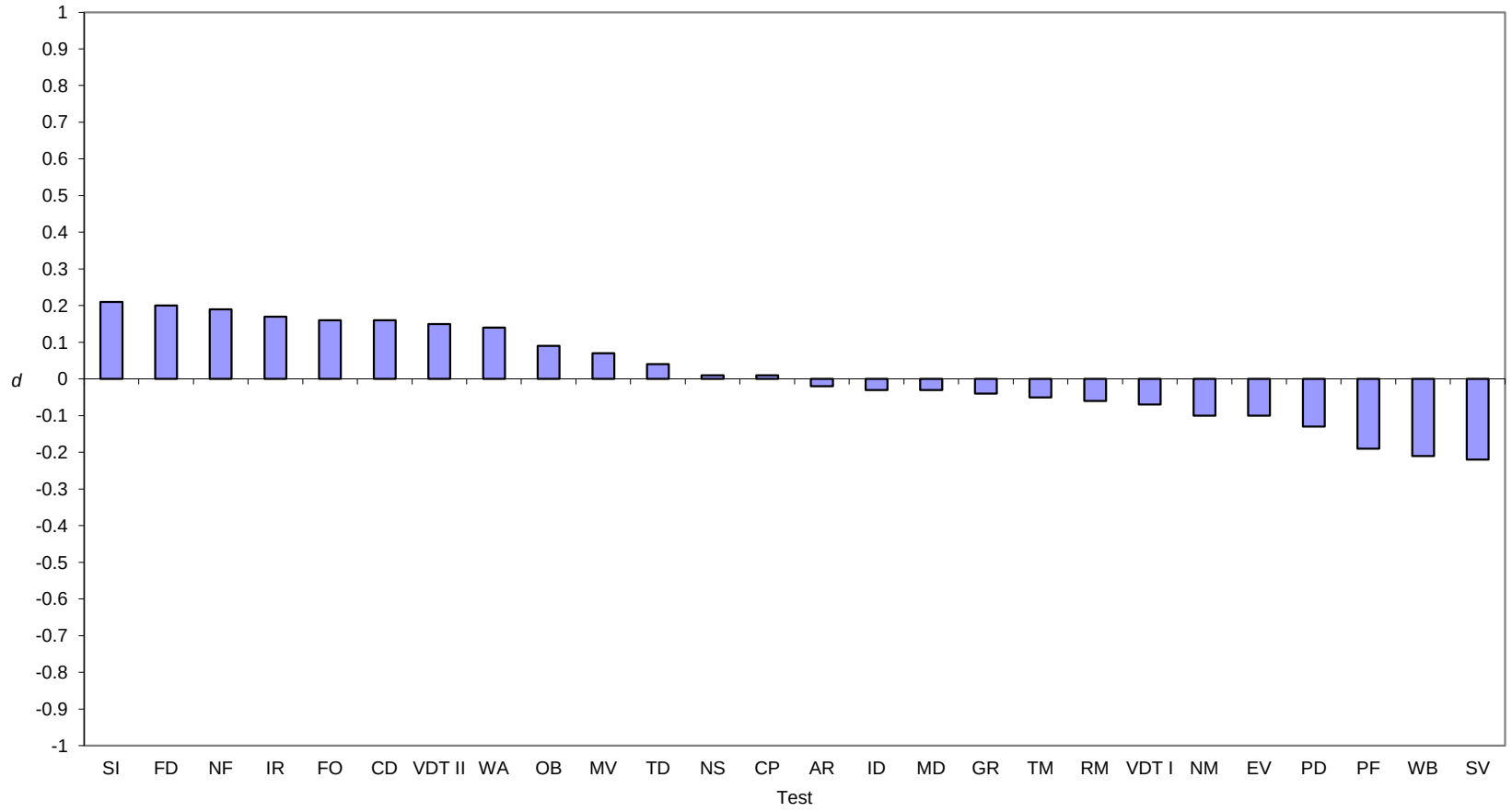
Effect Sizes for Aptitude Scores of Examinees Working in Secondary Education Compared to the General Testing Population



Note. This figure shows the effect size differences (*d*) based on normalized aptitude scores on the standard battery tests for examinees with occupations in Secondary Education as compared to the general testing population. The normalized aptitude scores were obtained by transforming percentile scores. See the note in Table 3 for full names of the tests, *d* values, *N* sizes, standard deviations, and standard errors of the mean.

Figure 3

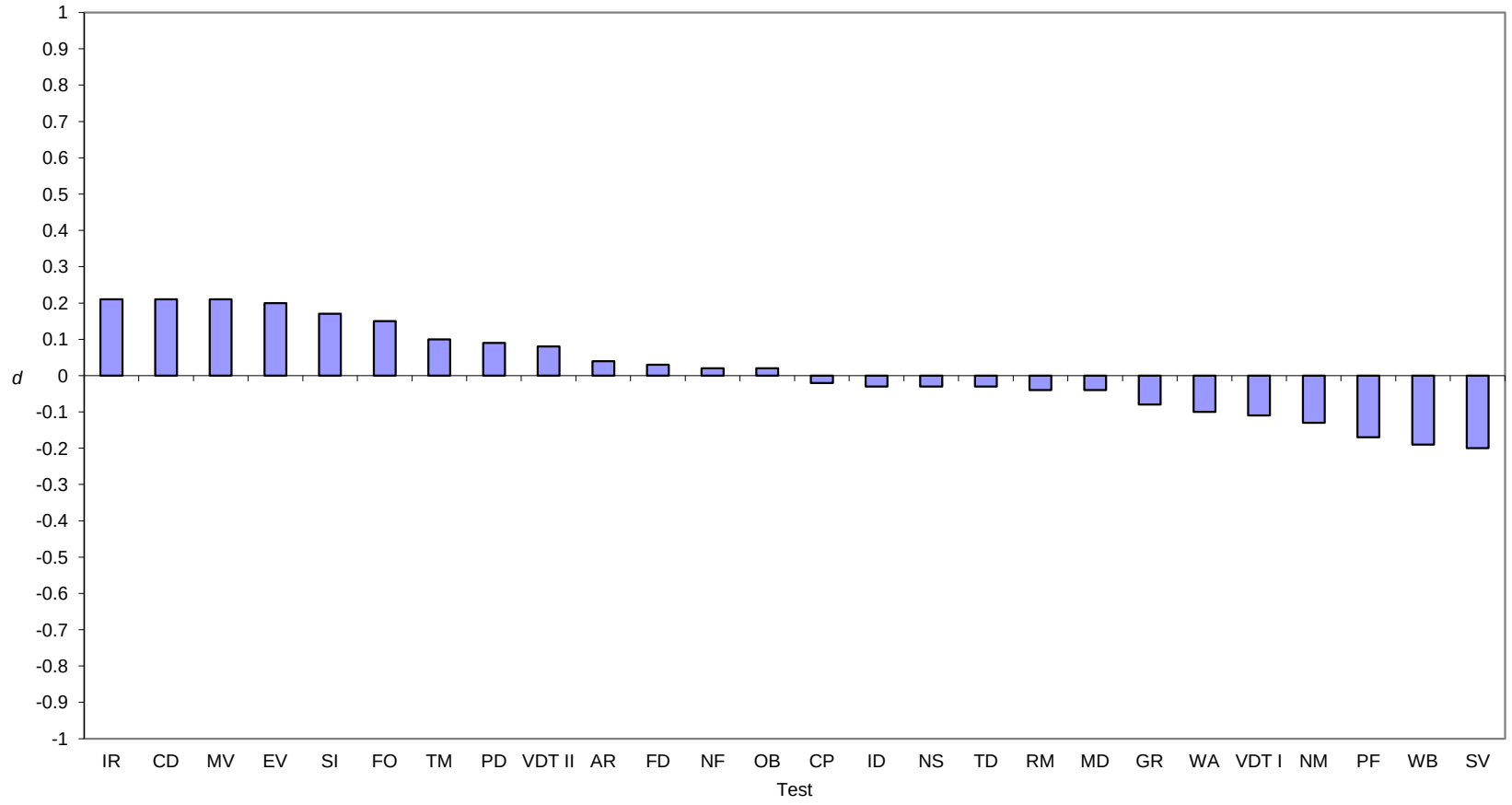
Effect Sizes for Aptitude Scores of Examinees Working in Primary Education Compared to the General Testing Population



Note. This figure shows the effect size differences (*d*) based on normalized aptitude scores on the standard battery tests for examinees with occupations in Primary Education as compared to the general testing population. The normalized aptitude scores were obtained by transforming percentile scores. See the note in Table 3 for full names of the tests, *d* values, *N* sizes, standard deviations, and standard errors of the mean.

Figure 4

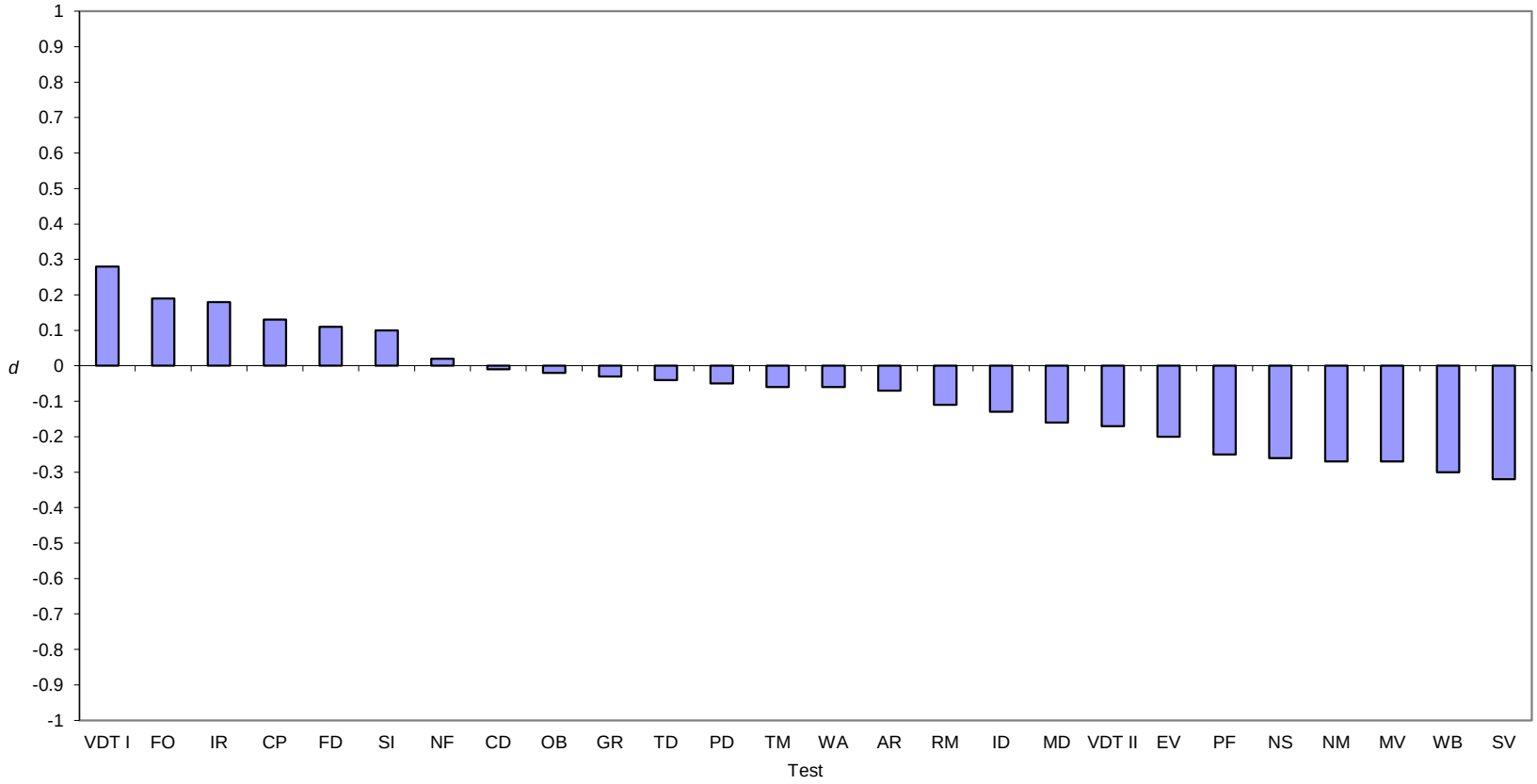
Effect Sizes for Aptitude Scores of Examinees Classified as Teacher, Level Unspecified Compared to the General Testing Population



Note. This figure shows the effect size differences (*d*) based on normalized aptitude scores on the standard battery tests for examinees with occupations as Teacher, Level Unspecified compared to the general testing population. The normalized aptitude scores were obtained by transforming percentile scores. See the note in Table 3 for full names of the tests, *d* values, *N* sizes, standard deviations, and standard errors of the mean.

Figure 5

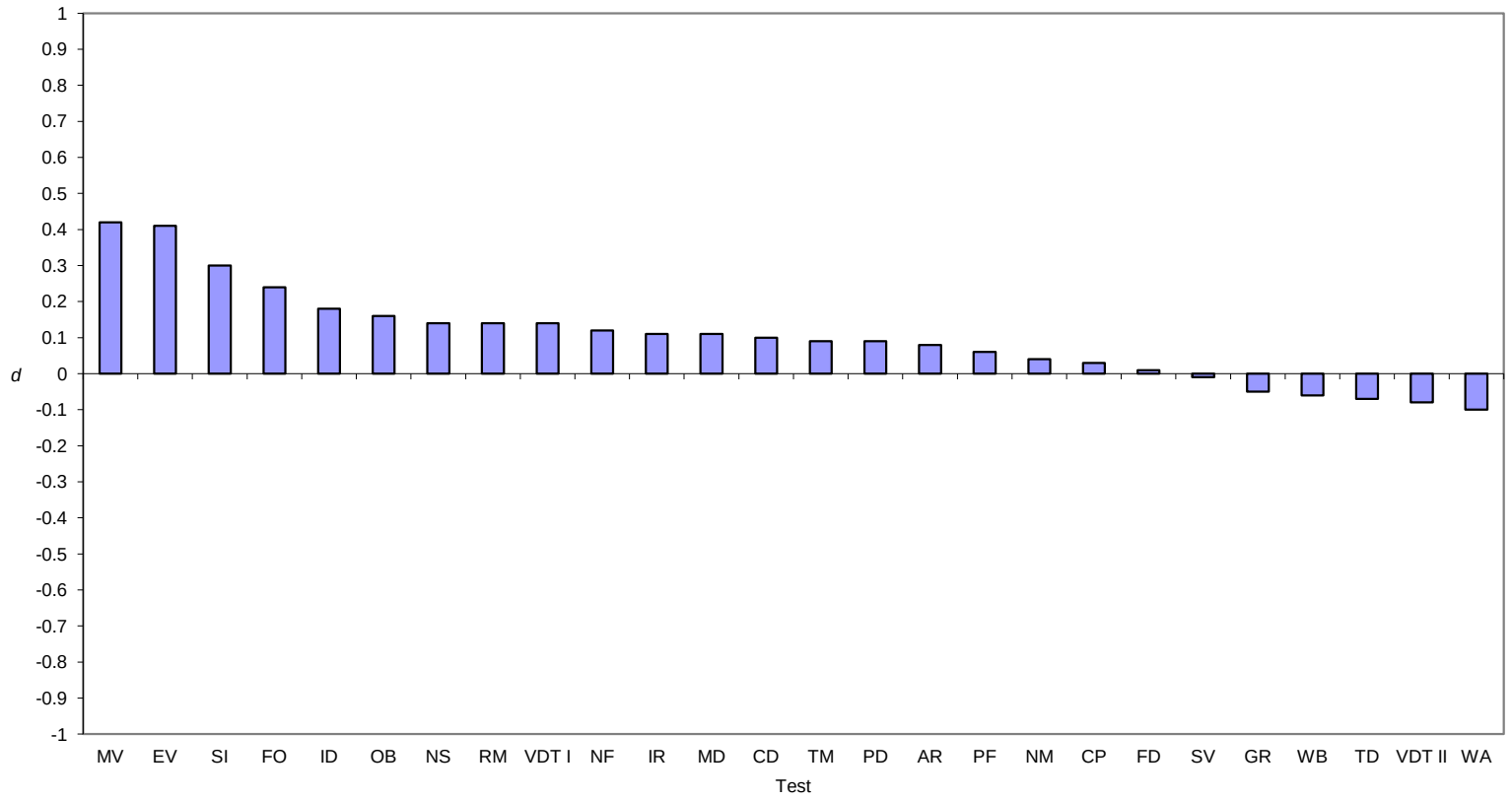
Effect Sizes for Aptitude Scores of Examinees Working in Special Education Compared to the General Testing Population



Note. This figure shows the effect size differences (*d*) based on normalized aptitude scores on the standard battery tests for examinees with occupations in Special Education compared to the general testing population. The normalized aptitude scores were obtained by transforming percentile scores. See the note in Table 3 for full names of the tests, *d* values, *N* sizes, standard deviations, and standard errors of the mean.

Figure 6

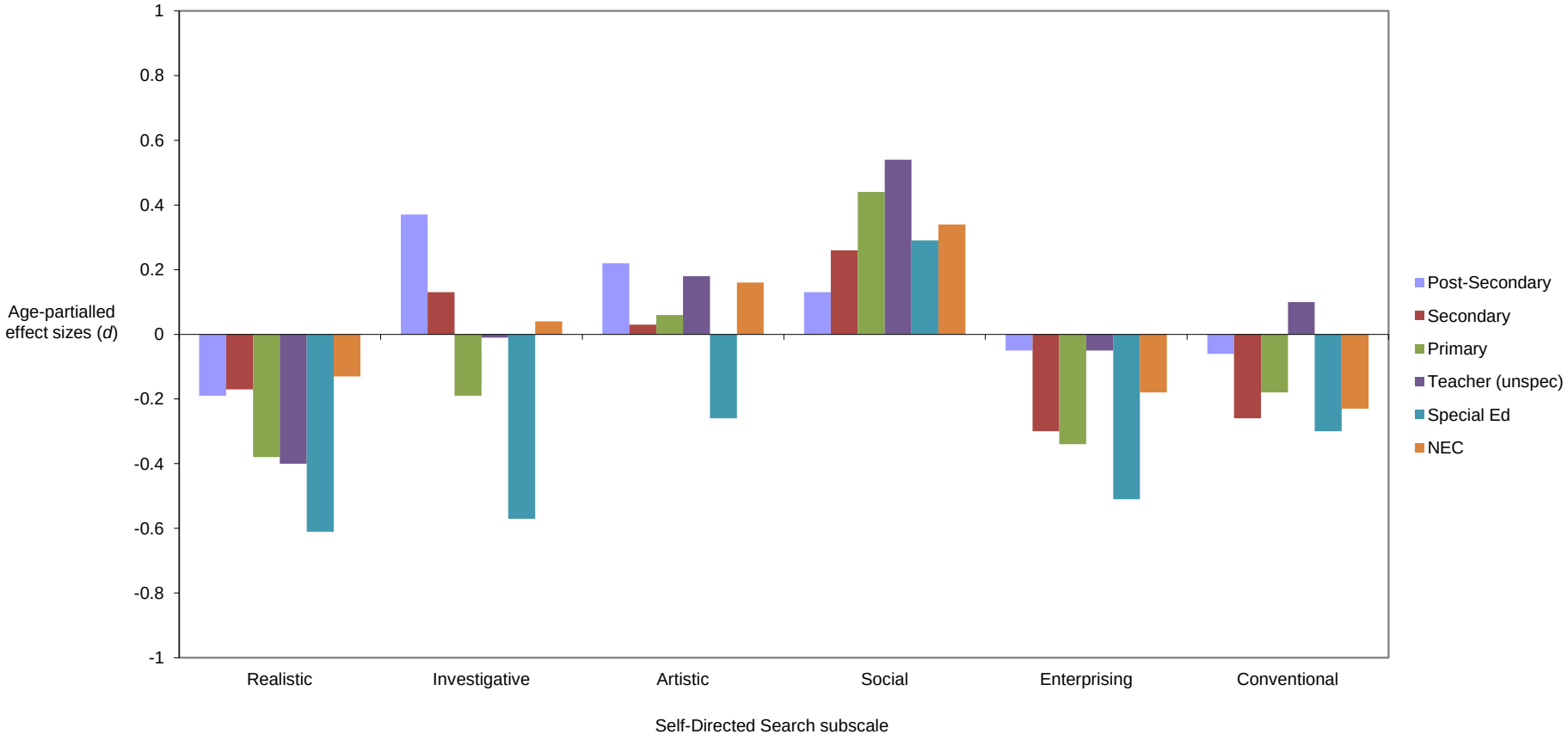
Effect Sizes for Aptitude Scores of Examinees Classified as Education, Not Elsewhere Classified (NEC) Compared to the General Testing Population



Note. This figure shows the effect size differences (*d*) based on normalized aptitude scores on the standard battery tests for examinees with occupations in Education, Not Elsewhere Classified (NEC) compared to the general testing population. The normalized aptitude scores were obtained by transforming percentile scores. See the note in Table 3 for full names of the tests, *d* values, *N* sizes, standard deviations, and standard errors of the mean.

Figure 7

Average Age-Partialled Self-Directed Search Effect Sizes (d) for Examinees With Occupations In Education



Note. This figure shows the age-partialled effect sizes (*d*) comparing the means for occupations in education with the general testing population on each Self-Directed Search subscale. See the note in Table 4 for full names of the tests, *d* values, *N* sizes, standard deviations, and standard errors of the mean.