Aptitudes, Vocabulary, and Educational Attainment

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ABSTRACT

In this report, the relationships between the tests in the Foundation's standard battery and educational attainment are examined. English Vocabulary shows a strong relationship with years of education, with very high scorers averaging 2.2 more years of education than very low scorers. A number of other tests show low to moderate relationships, including Number Series, Ideaphoria, Number Facility, Silograms, Foresight, and Analytical Reasoning. When English Vocabulary is partialled out, these tests still show modest positive relationships.

Among males, Graphoria is another low to moderate predictor, but it shows little relationship for females. Structural Visualization shows a relatively weak relationship with educational attainment for both sexes. On the Self-Directed Search, the vocational-interest test that the Foundation gives, only the Investigative scale is related to educational attainment.

Finally, there is some indication that Foresight has a stronger effect when English Vocabulary and/or Ideaphoria is low—in other words, it appears that high Foresight can compensate to some extent for low Vocabulary or Ideaphoria.

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ACKNOWLEDGMENTS

As with many of the Foundation's research projects, this study of educational attainment was made possible by the creation and maintenance of the Research Department's bargraph database over the last several decades. This database has been the result of the efforts of the Foundation's testing staff, who collected the data, and the Research Department's professional and support staff over the years, and the author is pleased to acknowledge their contributions.

INTRODUCTION

The purpose of this technical report is to examine the relationships between examinees' educational attainment and the aptitudes that we measure and the vocabulary measures that we give. Baccalaureate and postbaccalaureate education plays an important role in the career plans of many of the persons that the Foundation tests. In terms of the Foundation's tests, we would expect that higher levels of English Vocabulary would be associated with better performance in school and higher levels of educational attainment. Also, the Foundation has traditionally linked Foresight to the ability to focus on long-term goals. Hence, one would expect that Foresight would be positively related to completion of educational programs. The overlap between Foresight and English Vocabulary would also need to be examined, however (see Technical Report 1981-7).

Historically, Foundation staff have emphasized the effect of Graphoria on educational experience—more specifically, the role of low Graphoria as a challenge to getting through school. Therefore, one would expect that Graphoria would be positively related to educational attainment, although it is possible that Graphoria plays a larger role at lower levels than at higher levels of education.

Based on previous studies of high school grades (Technical Report 1983-4) and quality of undergraduate institution (Statistical Bulletin 2005-3), one might also anticipate that Ideaphoria, Number Series, and Silograms would be positively related to educational attainment. An aptitude such as structural visualization, though, might be expected to have a more-complex relationship with years of education because, arguably, high-visualization persons may have difficulty maintaining interest in nonstructural classes and therefore choose not to pursue higher education even though they have the talents for advanced work. Finally, regarding Word Association, a previous study suggested that Subjective persons may tend to go further in education than Objective persons (Technical Report 1981-7).

In this report, the relationships of the tests in our standard battery with educational attainment, operationalized as years of education, will be examined. The bivariate relationships will be analyzed in three ways: First, the correlations between the Foundation's tests and years of education will be computed. Correlation coefficients indicate the magnitude of the linear relationships between pairs of variables and provide a good index of relationships when variables more-or-less steadily increase together (or one increases while the other decreases). On the chance that some relationships might not be steady across the variables, categorical relationships will also be assessed--that is, years of education will be divided into five categories, and analyses of variance will be performed in which any pattern of differences among the educational categories will be detected. Finally, the relationships of extreme groups on vocabulary and other predictors with respect to educational attainment will be compared with the relationships of Foundation examinees as a whole.

In additional analyses, since English Vocabulary was found to be a strong predictor of education, consideration was also given to the relationships for our aptitude tests with English Vocabulary statistically controlled. Also, interactions between pairs of standard-battery variables and educational attainment will be examined: In an earlier study, for example, Burke (1993) showed evidence that the relationship between Foresight and years of education is stronger for lower levels of vocabulary than for higher levels of vocabulary. Finally, because there are sex differences on a number of the battery variables (Statistical Bulletin 1990-2), the primary analyses will be repeated for males and females separately to see if there are differences in the relationships with education.

METHOD

Sample

The sample for this study consisted of all 5,467 paying clients (examinee code = 0) of the Foundation between 2004 and 2007 who were at least 26 years of age at the time of testing and had valid values for years of education. Four years' worth of examinees were used in order to have a large enough sample for stable results. Of the full sample, 2,765 (50.6%) were male and 2,702 (49.4%) were female. Examinees ranged in age from 26 to 77 (M = 38.7, SD = 9.7). In most cases, the examinees took the Foundation battery for the purpose of gaining information about their aptitudes that they could use in making educational and occupational decisions. The Foundation's testing population is described further in Statistical Bulletin 1998-3.

Measures

The examinees in this study took the Foundation's standard battery of aptitude tests plus English Vocabulary. Given the examinees' age at testing (26+), they generally did not take our Mathematics Vocabulary test. The examinees also took the vocational-interest test that the Foundation gives, Holland's (1994) Self-Directed Search (SDS). For this study, the summary scores for the six areas of the SDS were used, and there were no analyses of sub-components of those areas such as self-estimated abilities (*cf*. Statistical Bulletin 2011-15).

For each examinee, Foundation staff calculated their years of education using conventional rules (Test Information Bulletin 1986-1) and entered those values into our standard database of examinee data. For purposes of performing categorical analyses, the range of years of education was divided into five groups: (a) 12 years or less, (b) 13 to 15 years, (c) 16 years, (d) 17-18 years, and (e) 19 years and up. (For continuous analyses, such as correlations, the full distribution of years of education was used.)

To control for age-related variation, scores on each of the standard-battery tests and the SDS scales were partialled for examinees' age at time of testing.[1]

RESULTS

Descriptive statistics

In general, the Foundation's testing population is a fairly well-educated sample of examinees. For years of education, the overall mean in this sample was 16.4, with a standard deviation of 1.9. In terms of the categories, 4.1% of the sample had 12 years of education (high school degree) or less, 12.5% had at least 13 years of education but less than 16 (college degree), 47.5% had 16 years, 25.4% had 17 or 18 years (either some graduate work but no degree or a master's degree), and 10.4% had more than 18 years of education.

In general, this distribution of years of education is much higher than for the general adult population in the United States. As reported by Burke, Condon, and Schroeder in Statistical Bulletin 2006-1, for the general U.S. population in 2004, 46.8% had 12 years of education or less, 25.5% had 13 to 15 years, and only 27.7% had 16 years or more.

In previous reports, we noted that the educational achievement of Foundation examinees had been rising over time (Statistical Bulletins 1998-3 and 2006-1). It appears that this trend has essentially leveled off. For example, the percentage of examinees with 12 years or less declined from 8.1% to 3.8% between 1984 and 1996, but now it is 4.1%--more-or-less the same as in 1996. The percentage of examinees with more than 16 years of education went from 32.1% in 1984 to 37.3% in 1996, and now it is 35.8%.

In terms of sex effects, within the Foundation population, there is no material difference between males and females in years of education, with both groups averaging 16.4 years.

[1] To control for curvilinear as well as linear effects, each score was partialled for age, age-squared, and age-cubed.

When one compares across labs, there are significant differences in years of education (see Figure 1). The labs with the highest means are Washington, D.C., and New York, with 16.8 and 16.7 years, respectively. The labs with the lowest means are Seattle, Denver, and Dallas, with 16.1, 16.1, and 16.2 years, respectively. (Note that only examinees aged 26 and higher are included here.)

Linear relationships with standard-battery tests and SDS

The correlations of years of education with the standard-battery and SDS scores are shown in Table 1 and Figure 2. As can be seen, the strongest correlate of years of education in the standard battery is English Vocabulary (r = .35). The next-strongest correlates are Number Series (.30), Ideaphoria (.25), Number Facility (.20), Silograms (.19), Foresight (.18), and Analytical Reasoning (.17). Among the SDS scales, the strongest correlate is Investigative (.16), with the other scales showing little relationship with years of education.

Because many of the scales that correlate with years of education are also correlated with English Vocabulary, partial correlations were calculated in which relationships with Vocabulary were statistically controlled, and these are shown in the second column of data in Table 1. As can be seen, these partial correlations are much smaller than the simple correlations in the first column—for example, the simple correlation for Number Series is .30, whereas the partial correlation is .18. In addition to Number Series, the highest partial correlations are for Ideaphoria (.19), Foresight (.12), and Number Facility (.11). The partial correlations for Silograms and Analytical Reasoning were reduced to less than .10. For the SDS scales, the partial correlations are all less than .10. With correlational analyses, we cannot determine for certain when variables have causal relationships, especially when predictors overlap with each other, but it seems clear that English Vocabulary has a pervasive relationship with educational attainment, while the strength of relationship for some of the other tests is uncertain.

The correlations with parents' years of education were also examined—see the two remaining columns of data in Table 1. In general, the correlations are small and somewhat parallel to the correlations for examinees' years of education. For example, English Vocabulary correlates .24 with both father's and mother's years of education, and it correlates .35 with examinee's years of education. An unexpected finding is that parents' years of education are correlated to a small degree with musical aptitudes, including Pitch Discrimination (.16 with father's and .17 with mother's years of education).

Categorical relationships with standard-battery tests and SDS

As noted earlier, it was possible some aptitudes were more related to educational attainment at some levels than at others. For example, suppose Silograms was strongly related to whether an examinee completed a baccalaureate degree but not related to achievement beyond that level. In that instance, the correlation would underestimate the effect of Silograms. In those situations, relationships can be more-easily detected when educational attainment is defined in terms of categories rather than a linear scale. The means on the standard-battery tests and SDS scales for [the] five educational-attainment categories are shown in Table 2. To facilitate comparisons among tests, the means are shown in standard-deviation units—for example, on Graphoria, the high-school-or-less group scored .36 of a standard deviation (*SD*) below the mean, while the some-college group scored .26 *SD* units below the mean, the college-degree group scored right at the mean, and the other two groups scored .12 and .13 *SD* units above the mean. The last column in the table shows the percentage of variance in each test that is accounted for by the educational-category differences—for example, for Graphoria, 2.0% of the variance in test scores is accounted for by the differences among the five categories.

In general, the means for most of the tests increase fairly steadily from the lowest-attainment group (high-school education and below) to the highest group (more than a master's degree), and so the relationships are fairly linear. As a result, the findings here closely parallel the findings for linear relationships, in Table 1. Among our tests, the greatest percentage of variance accounted for across the categories (see Table 2) is for English Vocabulary (13.7% of the variance). Correspondingly, the means for English Vocabulary show the greatest range across the five groups, from -.91 for high-school-or-less examinees to .65 for the beyond-master's group. These means correspond to VSS values of 139 and 186. The second-greatest percentage of variance is for Number Series (9.3%), with means ranging from -.86 to .38 (raw scores 19.3 to 25.0). The five tests with the next-greatest percentages of variance follow the same order as for the correlations: Ideaphoria (7.0%), Number Facility (4.3%), Silograms (4.2%), Foresight (3.9%), and Analytical Reasoning (3.1%). For the SDS, the Investigative scale showed the strongest effect (2.1% of the variance), with means arrayed in order from -.45 for the lowest-education group to .30 for the highest-education group.

Extreme-group analyses

Another possible outcome was that the results for relatively extreme groups on the standard-battery tests would be different than the results for the full distributions, which are reflected in the results in Tables 1 and 2. For each test, the mean educational attainment for the top and bottom 10% of the sample was calculated, and these values are shown in Table 3. In general, the results are similar to the results for the full distributions, with differences of about the size that would be expected for a linear relationship. As an example, for English Vocabulary, the extreme groups differ by 3.4 *SD* units, and so the expected differences for years of education based on the correlation would be 1.2 standard-deviation units ($r_{EV \cdot EDUC}$ * 3.4 = .35 * 3.4 = 1.2), and the actual difference is 1.2 standard-deviation units (2.3 years). Similarly, for Number Series, the expected difference would be 1.9 years, and the actual difference is 2.0 years. So, it appears that the effects are fairly linear across the score ranges of the battery tests/scales.

Combinations of scales

Interaction effects. It is also of interest to consider the relationships for more than one test at a time. Table 4 shows the results for combinations of ranges of English Vocabulary and Graphoria with years of education. In this analysis, examinees were divided into the two extreme groups for English Vocabulary (see previous analysis) plus a third group for examinees between the extreme groups. (The three groups are referred to as "very high," "intermediate," and "very low.") In a similar way, examinees were divided into three groups for Graphoria. Table 4 shows the means for the nine combinations of English Vocabulary and Graphoria levels.

As can be seen, when the Graphoria levels are combined (right-most column), the effects for English Vocabulary correspond to the results reported earlier, with very-high-English-Vocabulary examinees completing 2.32 more years of education than very-low-English-Vocabulary examinees. Similarly, across English Vocabulary levels, very-high-Graphoria examinees completed 0.99 more years of education than very-low-Graphoria examinees. The means for various combinations of English Vocabulary and Graphoria ("cells") are approximately what one would expect for the sum of the two effects (e.g., __ + __ = __), and there is little evidence of any interaction—that is, the effects for Graphoria are about the same at each level of vocabulary, and the effects for vocabulary are about the same at each level of Graphoria.

In contrast, the means for English Vocabulary and Foresight combined are shown in Table 5 and Figure 3. As can be seen, there are main effects for both English Vocabulary and Foresight, with each positively related to years of education. There is also a significant interaction, however, such that the effect of Foresight is greater for very-low English Vocabulary than for intermediate English Vocabulary, and for very-high English Vocabulary, there is little effect for Foresight. Specifically, among very-low-English-Vocabulary examinees, very-high-Foresight examinees averaged 1.8 more years of education than very-low-Foresight examinees, whereas among very-high-English-Vocabulary examinees, very-high-Foresight examinees averaged only 0.1 more years of education than their very-low-Foresight counterparts. This result is similar to one reported previously by Burke (1993).

In a similar way, two-way analyses were performed for each test in the Foundation's standard battery paired with English Vocabulary. In addition to English Vocabulary paired with Foresight, there were statistically significant interactions for English Vocabulary paired with Tonal Memory ($p = .049$), Color Discrimination ($p = .004$), and Visual Design II ($p = .024$). For Tonal Memory, scores have a positive relationship with years of education for very-low-English-Vocabulary examinees for not for intermediate-English-Vocabulary or very-high-English-Vocabulary examinees. Similarly, Color Discrimination has a positive relationship with years of education for very-low-English-Vocabulary examinees, with a weaker effect for intermediate-English-Vocabulary examinees and possibly a negative effect for very-high-English-Vocabulary examinees. Thus, for Foresight, Tonal Memory, and Color Discrimination, it appears that scoring higher on the given aptitude may compensate to some extent for having a limited vocabulary.

The effect for Visual Designs II may have been due to chance given that 28 English-Vocabulary-by-standard test interactions were examined here. Among very-high-English-Vocabulary examinees, Visual Designs II was negatively related with years of education whereas among very-low- and intermediate-English-Vocabulary examinees, there was no effect for Visual Designs II.

For each of these two-way analyses, the pattern of means may be somewhat unreliable because of the low sample sizes for some of the combinations (e.g., see Tables 4 and 5). The significance tests for the interactions may lack power to some extent for the same reason.

For Structural Visualization, two-way analyses were performed with the other tests in the standard battery in the same way as the two-way analyses for English Vocabulary. There were significant interactions with only Analytical Reasoning ($p = .032$) and Visual Designs II ($p = .011$), and those effects may have been due to chance.

Another series of two-way analyses were performed for Word Association (divided into Subjective, Intermediate, and Objective categories—see Test Information Bulletin 1996-5) and the other tests in the standard battery. The largest interaction was for Word Association and Ideaphoria ($p = .006$). The positive effect for Ideaphoria on years of education was stronger for Intermediate and Objective examinees than for Subjective examinees. The only other significant interaction was for Word Association and Number Series (p = .045), and it parallels the finding for Word Association and Ideaphoria. Thus, there is a hint of a pattern of certain aptitudes making more of a difference for Intermediate and Objective examinees than for Subjective examinees, but the evidence is fairly modest.

Finally, in an exploratory spirit, one more two-way analysis was performed, in which Ideaphoria and Foresight were used to predict years of education. Initially, the groups for Ideaphoria and Foresight (very low, intermediate, very high) did not yield enough cases with very low Ideaphoria/very high Foresight and very low Foresight/very high Ideaphoria to permit a proper analysis. So, Ideaphoria and Foresight scores were re-divided into three groups each of nearly equal size (low, average, high), and the analysis was performed. In addition to main effects for Ideaphoria and Foresight, there was a significant interaction, with the effect of Foresight being greater for low-Ideaphoria than for high-Ideaphoria examinees, and the effect of Ideaphoria being greater for low-Foresight than for high-Foresight examinees. On other words, Ideaphoria and Foresight appear to compensate for each other to some extent, in a similar manner to Foresight and English Vocabulary.

Additional pairings of standard-battery tests were not analyzed for this report but could be pursued in the future if there is interest in the Foundation. Another avenue for further study would be the analysis of combinations of three or more standard-battery tests.

Multiple regression. When the linear effects of all the cognitive-ability tests in the battery (including English Vocabulary) are combined, the multiple correlation with years of education is .44, which accounts for 19.4% of the variance. In comparison, English Vocabulary alone accounts for 12.3% of the variance in years of education.

Separate-sex analyses

Previous research has indicated sex differences on many of the tests in the Foundation's standard battery (Statistical Bulletin 1990-2) and on the SDS scales (Holland, Fritzsche, & Powell, 1994). In addition, there is some indication that sex interacts with the relationships between these scores and educational attainment (Statistical Bulletin 2011-15). That is to say, there is some indication that, for example, the relationship between Structural Visualization and years of education is different for males and females. In view of this, all of the analyses to this point were performed again for males and females separately.

In general, the results were similar for both sexes. For example, Number Series correlated .29 with years of education for males and .30 for females. There was an interesting finding for Graphoria, however, with the correlation being .07 for females but .18 for males. Similarly, for the SDS Conventional scale, the correlation for males is .09 while the correlation for females is actually negative, -.06. For Structural Visualization, the relationship with years of education was just a little higher for females (.12) than for males (.09).

In an additional analysis, two-way analyses of variance were performed for sex and each of the standard-battery and SDS scores (independent variables) and years of education (the dependent variable). In these analyses, the standard-battery and SDS scores were divided into very-high, intermediate, and very-low categories, as described earlier. There were significant interactions between sex and Graphoria and between sex and the SDS Conventional scale, with both effects in line with the correlational results just reported.

To spell out further the effect for Graphoria, scores were divided into three groups of nearly equal size (low, average, high), and the two-way distributions of Graphoria versus educational categories (see earlier analysis) were examined for males and females. Among males, for those who scored low in Graphoria, 7.6% completed 12 years of less of education. In contrast, only 1.5% of average-Graphoria males and 1.9% of high-Graphoria males had only 12 years or less of education. For females, the corresponding percentages are 4.8%, 4.6%, and 3.5%. For the other educational levels, one also sees a material effect of Graphoria on educational attainment for males and little effect for females.

Also in the two-way analyses, there was a significant interaction between sex and Color Perception, with the aptitude having a small positive effect among males and little effect among females, which may be due to the greater presence of color deficiencies in males than females.

In an exploratory analysis, three of the two-way analyses performed earlier (English Vocabulary by Foresight, Word Association by Ideaphoria, and Ideaphoria by Foresight) were repeated with sex as a third independent variable. In other words, two three-way analyses of variance were performed. For the analysis of English Vocabulary by Foresight, there was again a two-way interaction between English Vocabulary and Foresight, but there were no interactions with sex (including the sex x English Vocabulary x Foresight interaction). Similarly, for Word Association by Ideaphoria and Ideaphoria by Foresight, there were no interactions with sex.

Fit with aptitudes

Finally, one could hypothesize that how far individual persons go in terms of education might depend on what fields that they go into, and how those fields relate to their patterns of aptitudes. In simple terms, one might expect that persons would go further in fields that are well-matched to their aptitude patterns than in fields that are poorly matched. As an initial investigation of this possibility, mean years of education were compared for examinees with very high, intermediate, and very low Structural Visualization in STEM (Science, Technology, Engineering, and Mathematics) and non-STEM majors. (Our previous research has indicated that examinees in most STEM majors tend to score high [or above average] on Structural Visualization [Statistical Bulletin 2005-4].) The results confirmed our finding that persons in STEM fields tend to score high on Structural Visualization and also showed that persons in STEM majors tend to average a bit more years of education than non-STEM majors (16.8 vs. 16.4 years). Among STEM majors, however, there was no tendency for examinees with very high Structural Visualization to achieve more years of education than examinees with very low or intermediate Structural Visualization. The relationship between aptitude-major fit and educational attainment is another topic that could be pursued in further research.

DISCUSSION

In summary, a number of the Foundation's tests have substantial relationships with examinees' educational attainment. The strongest relationship is for English vocabulary, for which very high scorers average 2.2 more years of education than low scorers. The next-strongest relationships are for, in order, Number Series, Ideaphoria, Number Facility, Silograms, Foresight, and Analytical Reasoning. When one partials for vocabulary, the other tests' relationships are reduced, and so it is possible that a portion of those relationships are due to overlap with vocabulary, but for Number Series, Ideaphoria, Foresight, and Number Facility, the partial correlations are still greater than .10.

The relationships appear to be largely linear, or at least monotonic (that is, increases of one variable are accompanied by increases in the other variable, even if the relationship does not form a perfectly straight line).

The results here correspond fairly well with the results of other educational validation studies that the Foundation has conducted in recent decades. In a study of the quality of undergraduate institutions attended by Foundation examinees (Statistical Bulletin 2005-3), the greatest effect sizes were for English Vocabulary, Mathematics Vocabulary (not studied here), Ideaphoria, and Number Series. In a study of high school grades (Technical Report 1983-4), the strongest predictors were English Vocabulary, Graphoria, Silograms, Analytical Reasoning, and Ideaphoria.

Graphoria was not one of the stronger overall predictors of educational attainment, but there was a difference between the sexes. Among males, Graphoria was the seventh-best predictor among the battery tests, whereas among females, Graphoria had little relationship with attainment. It may also be the case that Graphoria has a stronger relationship with experience at the primary and secondary levels of education rather than at postsecondary levels, and the pattern of means here for educational categories (see Table 3) provides some support for that notion.

In terms of other aptitudes, Structural Visualization showed a fairly modest correlation with years of education (.10), and the correlation dropped to zero when English Vocabulary was partialled out. As noted, it is possible that some high-visualization examinees are drawn to high-visualization fields that do not require a high level of education.

In terms of Word Association, in earlier research Bowker found a negative relationship between Word Association scores and years of education—that is, Subjective examinees achieved more years of education than Objective examinees (Technical Report 1981-7). In the present study, there was essentially no relationship between Word Association and educational attainment.

Regarding Grip, scores for males showed a modest negative relationship with educational attainment. It is possible that males who score high on Grip are sometimes drawn to fields in which they can use their physical strength, which may draw them away from pursuing education.

Finally, on the SDS, the vocational-interest test that the Foundation gives, the Investigative scale was the only scale that was related to educational attainment. Since the Investigative scale measures interest in science and fields related to science, that relationship is not surprising. In future research, it would be interesting to consider subcomponents of the SDS scale scores, such as the self-estimated abilities, in relation to educational attainment.

There is also some evidence that some of our tests compensate for others to some degree in terms of educational attainment. In particular, Foresight appears to have a stronger influence on education when English Vocabulary and/or Ideaphoria is low rather than high.

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Table 1

Correlations Between Battery Tests/Scales and Years of Education

Test/scale	Corr., educ.	Partial corr., educ.	Father's educ.	Mother's educ.
Graphoria	13	09	-01	-03
Ideaphoria	25	19	11	09
Foresight	18	12	11	09
Inductive Reasoning	03	-04	02	02
Analytical Reasoning	17	02	10	12
Number Series	30	18	13	14
Number Facility	20	11	06	08
Wiggly Block	05	-02	05	06
Paper Folding	13	02	10	11
Structural Visualization	10	00	08	09
Tonal Memory	07	-01	13	13
Pitch Discrimination	07	-02	16	17
Rhythm Memory	08	-01	08	07
Memory for Design	11	01	05	07
Silograms	19	05	10	09

(*table continues*)

Table 1 (*continued*)

Test/scale	Corr., educ.	Partial corr., educ.	Father's educ.	Mother's educ.
Number Memory	13	06	05	05
Observation	00	-05	00	-01
Color Perception	03	02	00	02
Color Discrimination	11	05	07	08
Finger Dexterity	01	02	00	00
Tweezer Dexterity	01	01	-01	-01
Word Association	01	-02	00	01
English Vocabulary	35	--	24	24
Visual Designs I	02	-02	04	03
Visual Designs II	00	00	01	01
Grip (males)	-05	-03	-02	-02
Grip (females)	-01	-03	01	02
Writing Hand	-02	-01	-05	-03
SDS Realistic	-01	-06	-02	-01
SDS Investigative	16	09	07	06
SDS Artistic	04	-01	10	09

(*table continues*)

Table 1 (*continued*)

Test/scale	Corr., educ.	Partial corr., educ.	Father's educ.	Mother's educ.
SDS Social	04	06	01	02
SDS Enterprising	02	05	-02	00
SDS Conventional	02	03	-04	-05

Note. Decimals omitted. *N*s range from 4,043 to 5,458. All correlations greater than .03 are significant at α = .05. The Mathematics Vocabulary test was omitted because it is not given to examinees over age 23. Writing Hand was coded 1 for the left hand and 2 for the right hand. The Grip score is the higher of the left- and right-hand scores.

Table 2
Means on Battery Tests/Scales by Level of Education

Test/scale	H.S. or less	Some college	College degree	College + 1-2 yrs.	Beyond master's	% var.
Graphoria	-.36	-.26	.00	.12	.13	.020
Ideaphoria	-.70	-.45	.00	.18	.39	.070
Foresight	-.63	-.33	.02	.14	.19	.039
Inductive Reasoning	-.11	-.06	.00	.02	.05	.001
Analytical Reasoning	-.52	-.28	.00	.15	.19	.031
Number Series	-.86	-.50	-.01	.25	.38	.093
Number Facility	-.60	-.36	.02	.17	.20	.043
Wiggly Block	-.14	-.03	-.02	.05	.08	.003
Paper Folding	-.25	-.20	-.04	.11	.19	.015
Structural Visualization	-.22	-.13	-.03	.09	.16	.010
Tonal Memory	-.23	-.11	.00	.06	.07	.005
Pitch Discrimination	-.27	-.11	.02	.03	.09	.006
Rhythm Memory	-.27	-.12	.00	.07	.08	.007
Memory for Design	-.36	-.20	.00	.12	.04	.015
Silograms	-.53	-.35	-.01	.15	.29	.042

(*table continues*)

Table 2 (*continued*)

Test/scale	H.S. or less	Some college	College degree	College + 1-2 yrs.	Beyond master's	% var.
Number Memory	-.35	-.22	-.02	.13	.17	.019
Observation	-.02	-.05	.01	.00	-.01	.000
Color Perception	-.02	-.10	.02	.01	.00	.001
Color Discrimination	-.31	-.25	.02	.06	.12	.014
Finger Dexterity	-.08	-.04	.02	.01	-.07	.001
Tweezer Dexterity	-.08	-.07	.02	.01	-.06	.001
Word Association	.02	.01	-.02	.02	.06	.001
English Vocabulary	-.91	-.60	-.02	.23	.65	.137
Visual Designs I	-.13	-.03	.02	.00	-.01	.001
Visual Designs II	.13	-.01	-.03	.03	-.02	.001
Grip (males)	.21	-.04	.02	.01	-.01	.005
Grip (females)	.06	.08	-.01	-.04	.01	.001
Writing Hand	.09	-.01	.01	-.01	-.04	.001
SDS Realistic	.18	.13	.03	-.05	-.14	.006
SDS Investigative	-.45	-.11	-.01	.13	.30	.021

(*table continues*)

Table 2 (*continued*)

Test/scale	H.S. or less	Some college	College degree	College + 1-2 yrs.	Beyond master's	% var.
SDS Artistic	-.12	-.09	.02	.01	.06	.002
SDS Social	-.14	-.14	-.02	-.01	.01	.002
SDS Enterprising	-.10	-.09	.00	.03	-.04	.002
SDS Conventional	-.18	-.02	.00	.01	-.06	.002

Note. *N*s = 223 for the "high-school-or-less" group, 685 for "some college," 2,599 for "college degree," 1,390 for "college + 1-2 yrs.," and 570 for "beyond master's." The means in this table are for *z*-scores for the tests/scales—that is, the values are in standard-deviation units. The "% variance" value in the rightmost column is the percent of the variance in the scores (partialled for age) attributable to differences among the educational groups. When the percentage of variance is .003 or greater, the differences among the groups are significant at the α = .05 level. The Mathematics Vocabulary test was omitted because it is not given to examinees over age 23. Writing Hand was coded 1 for the left hand and 2 for the right hand. The Grip score is the higher of the left- and right-hand scores.

Table 3

Years of Education for Very-Low and Very-High Groups on Battery Tests/Scales

Test/scale	Mean, very low	Mean, very high	Difference
Graphoria	15.7	16.7	1.0
Ideaphoria	15.3	17.1	1.8
Foresight	15.5	17.0	1.5
Inductive Reasoning	16.4	16.5	0.1
Analytical Reasoning	15.7	17.0	1.3
Number Series	15.3	17.3	2.0
Number Facility	15.5	16.9	1.4
Wiggly Block	16.2	16.7	0.5
Paper Folding	15.9	16.8	0.9
Structural Visualization	16.0	16.8	0.8
Tonal Memory	16.0	16.6	0.6
Pitch Discrimination	16.1	16.6	0.5
Rhythm Memory	16.2	16.6	0.4
Memory for Design	16.0	16.6	0.6
Silograms	15.6	17.0	1.4

(*table continues*)

Table 3 (*continued*)

Test/scale	Mean, very low	Mean, very high	Difference
Number Memory	16.1	16.9	0.8
Observation	16.4	16.4	0.0
Color Perception	16.4	17.0	0.6
Color Discrimination	16.1	16.8	0.7
Finger Dexterity	16.4	16.6	0.2
Tweezer Dexterity	16.3	16.5	0.2
Word Association	16.3	16.5	0.2
English Vocabulary	15.1	17.4	2.3
Visual Designs I	16.2	16.5	0.3
Visual Designs II	16.5	16.3	-0.2
Grip (males)	16.6	16.1	-0.5
Grip (females)	16.4	16.3	-0.1
Writing Hand	16.5	16.6	0.1
SDS Realistic	16.6	16.3	-0.3
SDS Investigative	16.0	17.1	1.1

(*table continues*)

Table 3 (*continued*)

Test/scale	Mean, very low	Mean, very high	Difference
SDS Artistic	16.2	16.5	0.3
SDS Social	16.1	16.5	0.4
SDS Enterprising	16.3	16.4	0.1
SDS Conventional	16.0	16.3	0.3

Note. The values in the table are for years of education. The sample sizes for the "very low" groups range from 416 to 580 and for the "very high" groups from 415 to 548, except for the Grip test. For Grip, there were 276 "very low" and 275 "very high" males and 266 "very low" and 267 "very high" females. All differences of 0.3 years and greater are significant at the α = .05 level.

Table 4

Mean Years of Education for Three Levels of English Vocabulary Crossed With Three Levels of Graphoria

	Graphoria level			
Eng. Vocab. level	Very low	Intermediate	Very high	All groups combined
Very low	14.3 (82)	15.2 (399)	15.2 (47)	15.1 (528)
Intermediate	15.9 (409)	16.5 (3,435)	16.7 (412)	16.5 (4,256)
Very high	16.7 (41)	17.4 (421)	17.5 (72)	17.4 (534)

All groups combined	15.7 (532)	16.5 (4,255)	16.7 (531)	16.4 (5,318)

Note. For each cell, the mean years of education is shown on the first line, and the sample size is shown in parentheses on the second line. In a two-way analysis of variance, there were significant main effects for Graphoria ($F[2, 5309] = 18.17$, $p < .001$) and English Vocabulary ($F[2, 5309] = 101.31$, $p < .001$), and the interaction was not significant ($F[4, 5309] = 0.29$, $p = .887$).

Table 5

Mean Years of Education for Three Levels of English Vocabulary Crossed With Three Levels of Foresight

	Foresight level			
Eng. Vocab. level	Very low	Intermediate	Very high	All groups combined
Very low	14.3 (101)	15.4 (315)	16.1 (12)	15.2 (428)
Intermediate	15.9 (298)	16.5 (2,698)	16.9 (343)	16.5 (3,339)
Very high	17.5 (22)	17.4 (339)	17.6 (65)	17.4 (426)

All groups combined	15.6 (421)	16.5 (3,352)	17.0 (420)	16.5 (4,193)

Note. For each cell, the mean years of education is shown on the first line, and the sample size is shown in parentheses on the second line. In a two-way analysis of variance, there were significant main effects for English Vocabulary ($F[2, 4184] = 43.36$, $p < .001$) and Foresight ($F[2, 4184] = 9.59$, $p < .001$) and a significant effect for the interaction between the two ($F[4, 4184] = 8.66$, $p = .034$).

Figure 1
Lab Differences in Years of Education

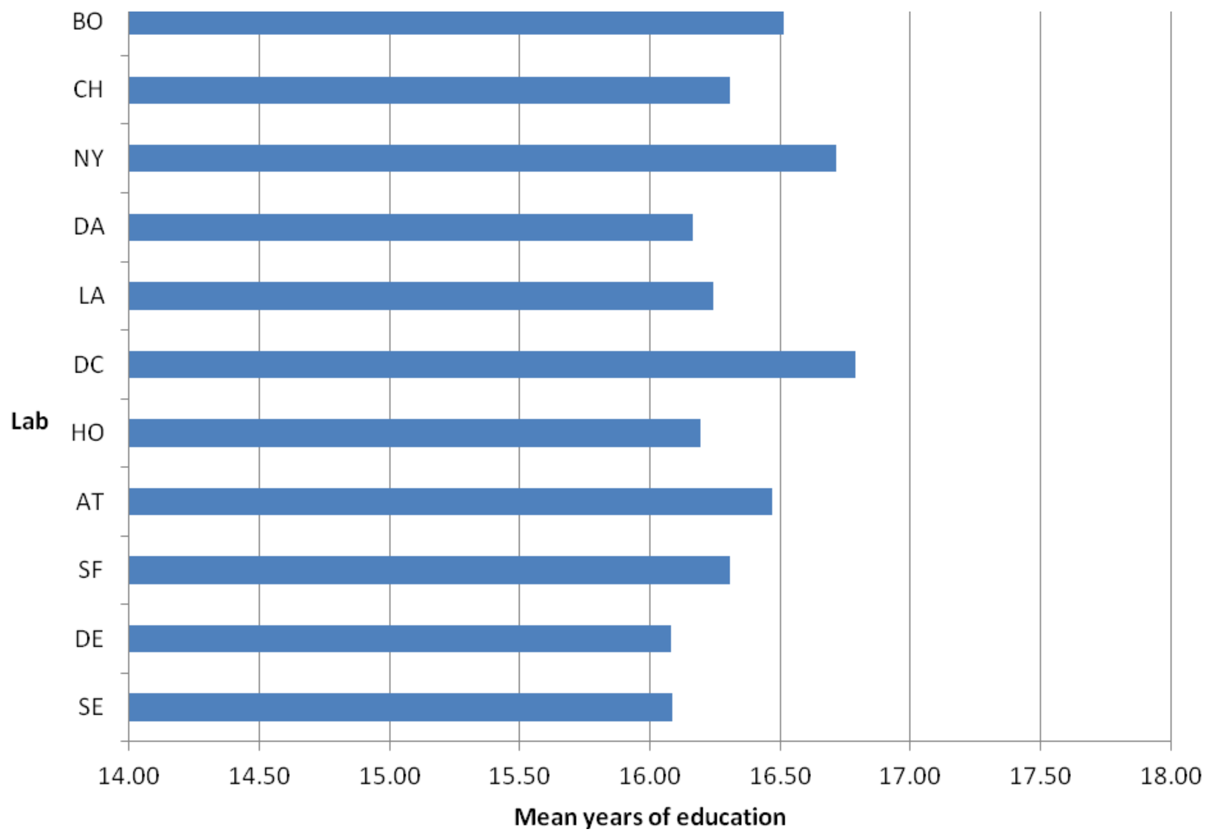
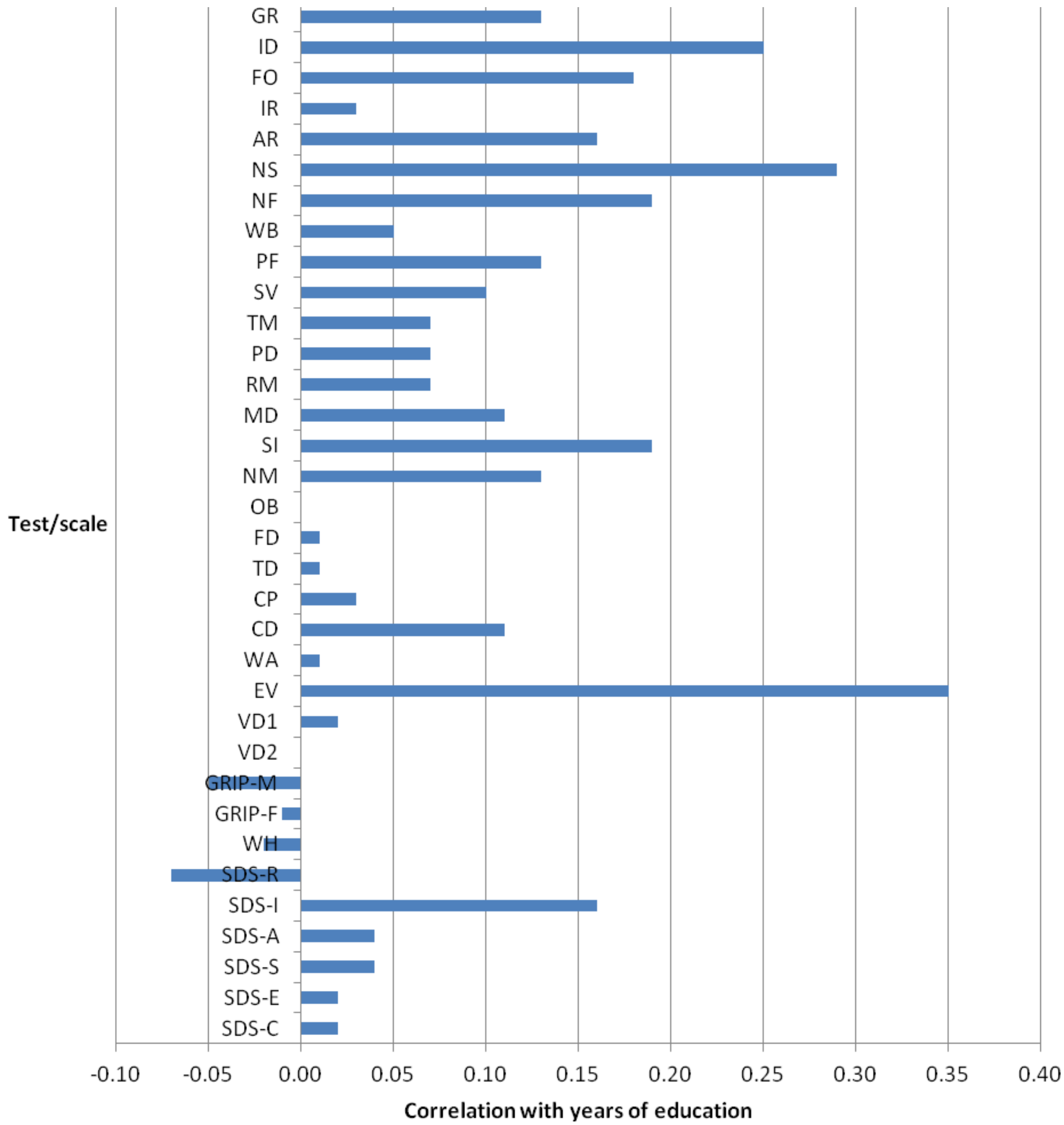


Figure 2

Correlations for the Foundation's Tests and SDS Scales With Years of Education



Note. No bars are displayed for Observation and Visual Designs II because those correlations are zero.

Figure 3

Years of Education as a Function of Foresight and English Vocabulary