

# Report of the Research Department

Johnson O'Connor Research Foundation, Inc.  
Human Engineering Laboratory, Inc.  
Johnson O'Connor Research Support Corporation



# 2015

## Goals of the Research Department

1. The isolation of aptitudes and the study of their role in various occupations.
2. The development of accurate measures of aptitudes.
3. The investigation of the role of aptitudes in education.
4. The evaluation of age and sex differences and the effect of practice on test performance.
5. The study of the processes involved in the acquisition of knowledge.
6. The development of accurate measures of knowledge.
7. The communication of research findings to the public.



Dr. Linda S. Houser-Marko, Russell E. Burke, Dr. David H. Schroeder

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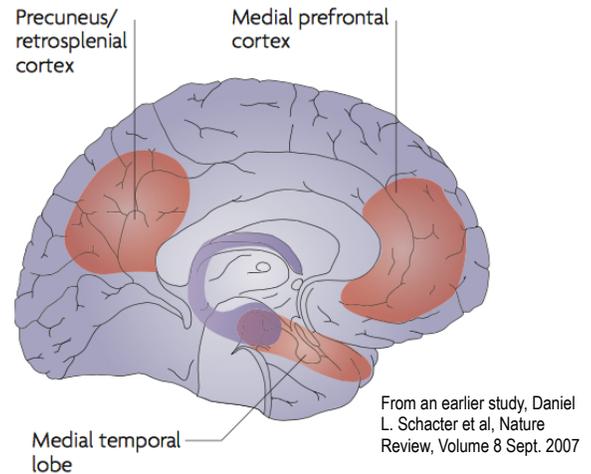
## Letter from the Research Chairman

In last year's letter, I discussed Johnson O'Connor's belief that, ultimately, it is the underlying physical basis of abilities that we want to understand; that our tests are pointers, but the "mental elements" we measure "will not be thoroughly understood until (their) physical cause is known."

2015 saw the publication of an important illustration of that idea, a study by Dr. Rex Jung and his colleagues at the University of New Mexico titled "Quantity yields quality when it comes to creativity: a brain and behavioral test of the equal-odds rule" (as discussed on page 2). Published in the online journal *Frontiers in Psychology* last June, the report was intended simply to test the "equal-odds rule" originally formulated by Dean Keith Simonton: that producing more ideas (quantity, or "fluency") should yield a greater number of good ideas (quality, or "creativity"). Rex and his team found that, indeed, there was a very strong positive correlation between high fluency scores on the JOC Foresight test and higher ratings of creativity.

Because Rex is first and foremost a neuropsychologist, he was interested in the brain regions associated with both fluency and creativity, so the subjects in the study underwent brain scanning. (This was all part of a larger study of the neuroscience of creativity, sponsored in part by the Johnson O'Connor Research Support Corporation, with major funding from the John Templeton Foundation.) Here is the passage that made me sit up and take notice when I first read the article: "Specifically, we found that a thicker left frontal pole was associated with both higher fluency and higher creativity across subjects. Of interest to this finding, a network that includes the frontal pole and the medial temporal lobes has been implicated in thinking about one's own future (Okuda et al., 2003)." Here, embedded almost as an afterthought to a study focused on a different question, was validation for something we have thought about this test since O'Connor's day, yet found difficult to nail down.

In *The Unique Individual*, first published in 1948, O'Connor had written that the Foresight test was originally intended as an alternate measure of Ideaphoria, one that would not be affected by writing speed. Originally termed Visual Imagination, then Vision, finally Foresight, the Human Engineering staff had found it seemed to measure something distinct from Ideaphoria, but it took some time to find what it might be. Finally they saw that it characterized "men and women in work which demands unremunerative years of formal training," such as lawyers and physicians. This led O'Connor to conclude: "A high score in worksample 307 seems to reveal an intellectual vision of a remote goal, foresight, a gift for seeing far ahead the worth of professional training, or the value of immediate financial sacrifice in order to gain the remote satisfaction of controlling an enterprise."



Over the years, this relationship between scores on Foresight and the pursuit of long-range goals had seemed clear to staff members experienced in the discussion of test results, yet it remained strangely elusive to quantitative validation. We came to see it as an aptitude for "seeing possibilities," and at least some of us supposed that, for the person who sees many possibilities, the long-term goal perhaps provides a way to focus attention on those which will lead to the goal, and not be distracted by the multitude of alternative paths.

Now, thanks to our collaboration with Rex Jung, it appears that, where the compiling and analysis of statistical data about test-takers came up short, neuroimaging has provided concrete evidence that the test does indeed measure an ability related to "thinking about one's own future," much as O'Connor thought. The article notes that damage to the frontal pole has been found to be associated with preference for immediate versus future reward, and "disrupted decision making," long thought to be characteristics of those low in Foresight. (O'Connor wrote in Bulletin #4, 1965, about the "low-foresight person" who "acts impulsively without foreseeing the consequences.") Other studies have found these brain regions to be related to "thinking about the near future versus far future," "extracting future prospects," and what is called "episodic future thinking." "Thus," writes Jung, "our results, implicating both left frontopolar and parahippocampal thickening appear to comport well with this particular network implicated in 'thinking about the future.'"

This is, of course, not the final word on the Foresight test and what it measures: in science, we rarely find "the final word." But it shows us that, just as testing can point the brain scientists in promising directions, so their studies can point us in promising directions as well, and provide important insights into the abilities we are measuring. We look forward to continuing to support such intriguing research.

*Rusty Panke*

April 21, 2016

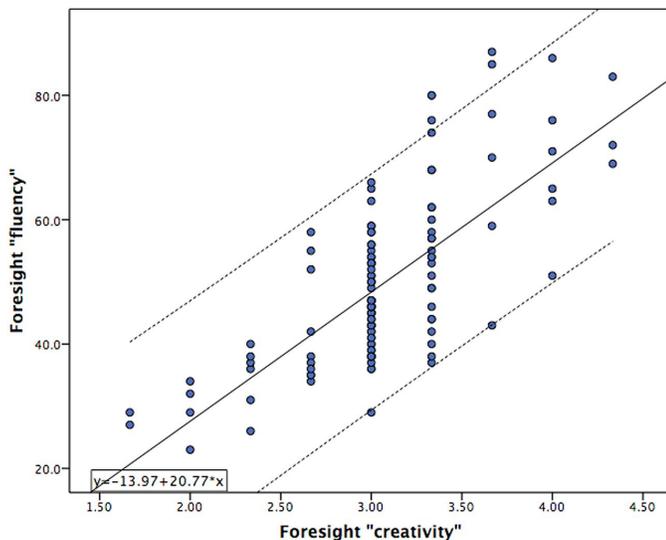
## Aptitudes and Brain Imaging Update: *Rex Jung with new view on Foresight*



In 2015, the online journal *Frontiers in Psychology* published results of a study by Dr. Rex Jung and colleagues in which the Johnson O'Connor test of Foresight, Wks. 307 AQ, was used as a measure of divergent thinking in a test of Dean Keith Simonton's "equal-odds rule." Simonton suggested that, because the odds of any given idea or production being creative or

not are equal, greater production of ideas should result in a greater number of creative ideas, or more simply, quantity yields quality.

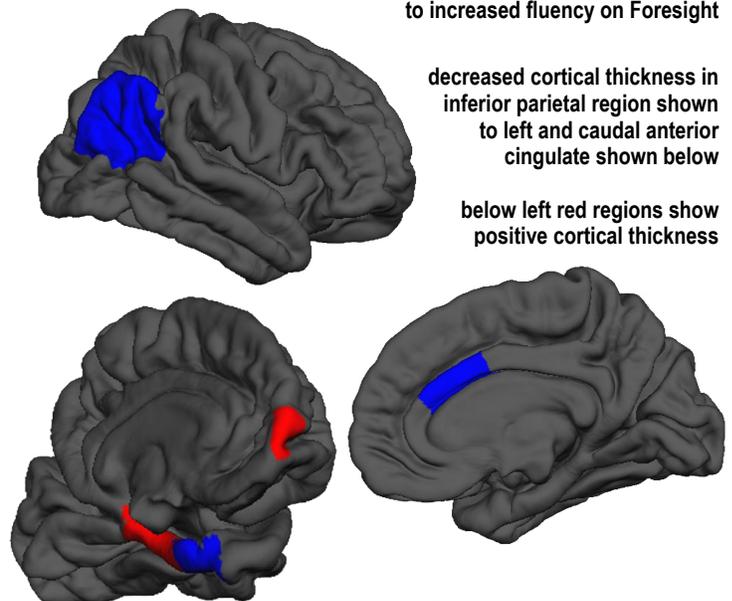
Jung and his associates gave the Foresight test to 246 subjects recruited at the University of New Mexico, and assigned scores for both fluency and creativity. "Fluency" (the number of ideas produced) was determined using the standard Foundation scoring method, counting the number of responses for each of the six test items and summing the results for all items to arrive at the total score. "Creativity" (the quality of the ideas produced) was assessed by three independent raters using the Consensual Assessment Technique, rating subjects' responses on a scale of 1 (least creative) to 5 (most creative), but using "Silvia's method of 'snapshot scoring' wherein all six subject responses were given a single holistic score by three judges," rather than the more typical approach of rating each individual response: the emphasis was on "creative" ideas as opposed to "unique" ones. The method appears to have been satisfactorily consistent across raters (Cronbach alpha = .76), and the study found a correlation of .73 between fluency and creativity, providing evidence for the equal-odds rule.



Scatterplot of "fluency" measures from the Foresight task (y-axis) versus the "creativity" measure (x-axis) obtained from 246 subjects. Significant overlap in subject scores results in fewer than 246 individual points being observed on the graph.

Structural neuroimaging for these subjects revealed significant relationships between Foresight test performance and brain regions that have been shown to be associated with creativity measures. "Fluency" was negatively correlated with the volume of the right thalamus, as well as with the cortical thickness of the right inferior parietal lobe and caudal anterior cingulate. In contrast, "fluency" was positively correlated with the cortical thickness of the left frontal pole. "Creativity" was negatively correlated with the volume of the left entorhinal cortex but positively correlated with volume of the left frontal pole and left parahippocampal gyrus.

**Freesurfer Renderings showing brain structure related to increased fluency on Foresight**



decreased cortical thickness in inferior parietal region shown to left and caudal anterior cingulate shown below

below left red regions show positive cortical thickness

Full description in paper online at:

*Front. Psychol.*, 25 June 2015 | <http://dx.doi.org/10.3389/fpsyg.2015.00864>

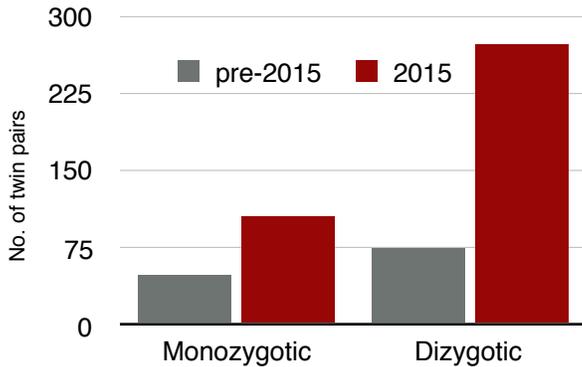
Importantly, Jung et al. noted: "Of interest to this finding, a network that includes the frontal pole and the medial temporal lobes [which include the entorhinal cortex and parahippocampal gyrus] has been implicated in thinking about one's own future.... Researchers have further parcellated the frontal lobe to indicate time valence when thinking about the near future versus far future, and integration with parahippocampal regions when "extracting future prospects." (See page 1 for further discussion of this finding.)

This study, part of a larger study of the neuroscience of aptitudes and creativity, was supported by grants from the Johnson O'Connor Research Support Corporation and the John Templeton Foundation. The article received a very gratifying response upon publication, with 1,827 views in the first month and almost 4,000 during 2015. It rated among the top 5% of all research outputs rated by Altmetric.

## Heritability

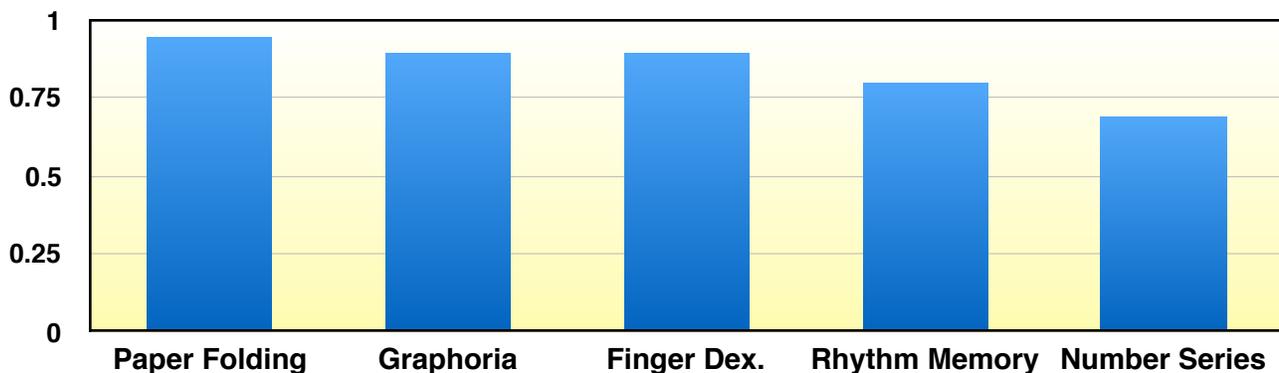
At the Foundation, we have a long history of interest in genetic influences on aptitudes, which has been passed on from our founder, Johnson O'Connor. In recent years, Dr. David Schroeder, Research Manager, has conducted a program of research on the test scores of identical and fraternal twins. Recently, we have endeavored to build up our database of twins tested by the Foundation. Beginning in late 2014, Schroeder and Dr. Linda Houser-Marko, Researcher, searched the Foundation's database of examinees and solicited assistance from our testing offices to find twins who had not been identified previously. In addition, we contacted twins if we did not know their type. We were able to increase our sample of monozygotic (MZ; identical) twins from 49 to 105 pairs and dizygotic (DZ; fraternal) twins from 74 to 274 pairs, as shown in the first accompanying figure.

**Expansion of Samples of Twins**



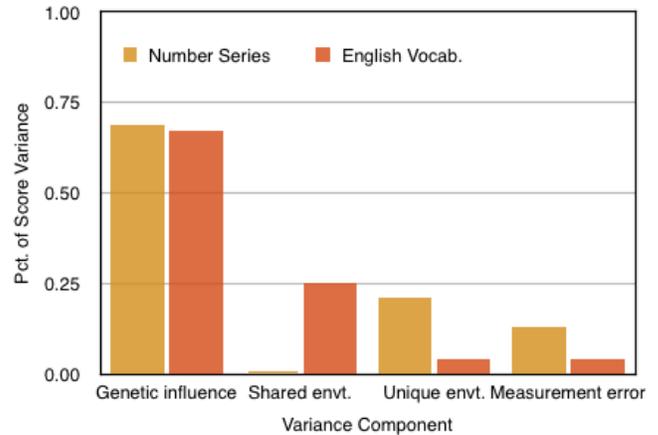
Schroeder ran heritability analyses on the expanded sample, and some of the results are shown in the figure below. Among the Foundation tests with the highest heritability values are Paper Folding (.94), Graphoria (.89), Finger Dexterity (.89), and Rhythm Memory (.80). For these aptitudes, it seems clear that most of the variation among individuals is due to genetic inheritance. For many of the Foundation's other tests, such as Number Series (.69), the heritabilities also indicate that the majority of the variation in scores is due to genetic factors.

**Heritabilities of Selected Tests**



In a third accompanying figure (*just below in this column*), we show the breakdown of variance for Number Series and English Vocabulary between genetic influence, shared-environmental (within-family) variance, unique-environmental variance, and measurement error (test unreliability). For Number Series, the majority of the variance is due to genetic contributions, essentially no variance is due to shared environments, and modest portions of variance are due to unique environments and test unreliability. In comparison, English Vocabulary also shows a large genetic component, but the shared environment appears to also have a sizable effect. Tonal Memory shows a similar pattern to English Vocabulary, and it is interesting to speculate on ways that the home environment might influence the development of musical talent.

**Variance Components for Number Series & English Vocabulary**



Schroeder presented findings from these analyses at the annual conference of the International Society for Intelligence Research in September, and he expects to publish a Foundation report on this project in 2016. In addition, we expect to continue to build our database of twins' test scores as we test more twins in our testing program.

## Test Scores Across Time

Since we have been giving our standard battery of tests for an extended period of time, we have the opportunity to examine broad trends across time in the scores of the examinees whom we test. Other things being equal, we would not expect to see a great deal of change from year to year, but when changes do occur, they can be informative, and David Schroeder has been analyzing scores on our tests across time.

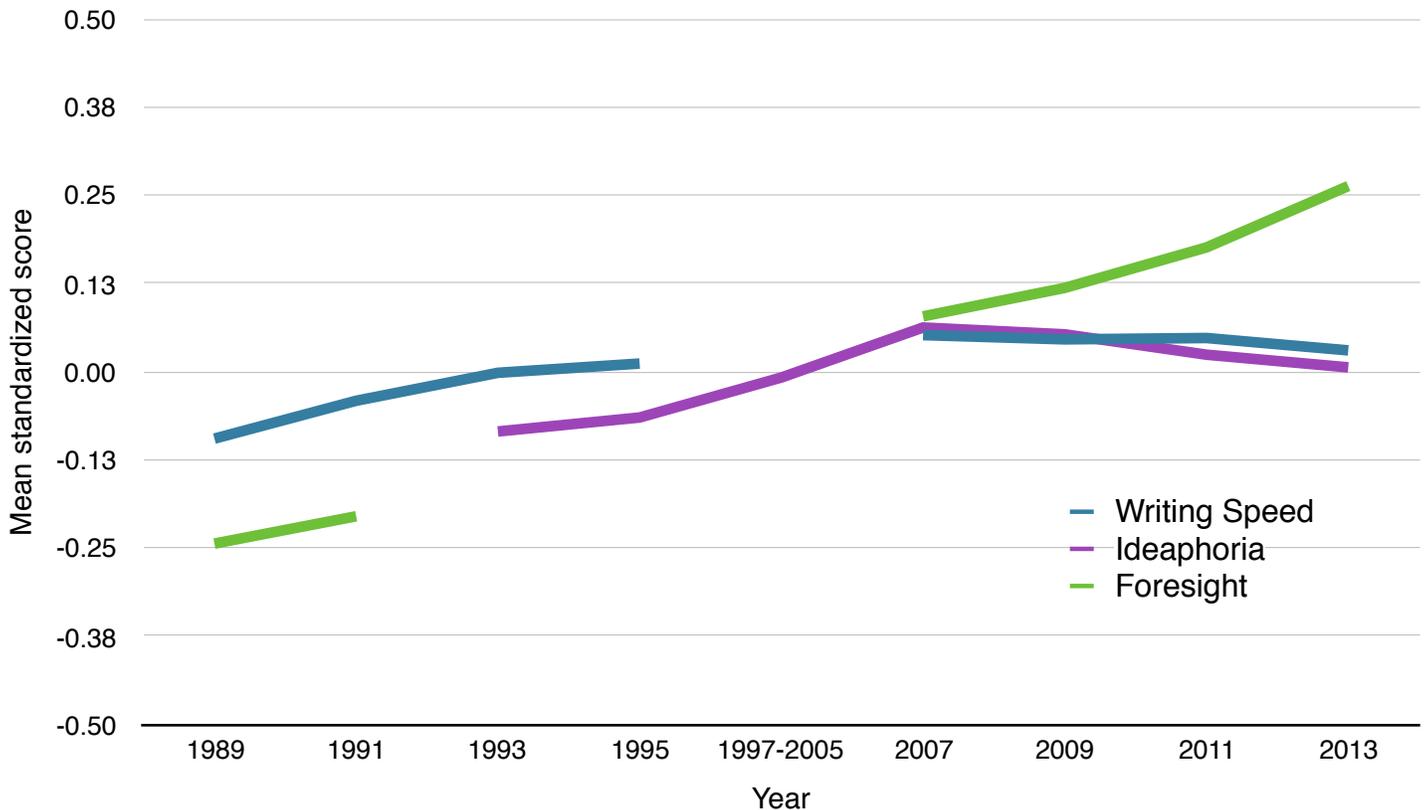
For our Writing Speed test, we have speculated that the increasing use of printing rather than cursive handwriting would cause scores to decline in recent years. However, scores have not declined, as shown in the accompanying figure: the mean standardized score for examinees in 2013 was 0.03, which is just a little higher than the mean for 1989, which was -0.09. It is also interesting to look at trends for Ideaphoria, given that Ideaphoria has a substantial correlation with Writing Speed. Since we modified the scoring for Ideaphoria in mid-1992, scores have generally remained steady, with standardized scores between -0.08 and 0.01. On the other hand, scores for our other divergent-thinking test, Foresight, have gone up by one-half of a standard deviation since 1989. A score at the 76<sup>th</sup> percentile in 1989 would be at only the 50<sup>th</sup> percentile in 2013.

Why have scores increased so much on one divergent-thinking test and so little on another? It is difficult to know for sure, since multiple factors probably affect each of the tests. However, it is worth noting that the Foresight test uses visual stimuli and Ideaphoria does not, and many modern devices such as mobile computers make use of visual representations of information (e.g., graphical interfaces). So, it is possible that examinees today can work more easily with visual representations than examinees from a few decades ago.

Another Foundation test that uses visual images is Memory for Design. It also shows an increase in scores across the 1989-2013 time period: .21 of a standard deviation. This increase is not as large as the increase for Foresight but is still sizable. So, it appears that there may be a broader pattern of increases across tests that involve processing visual information in various ways.

This phenomenon of changes in test performance over time has attracted quite a bit of attention in the scholarly community, and Schroeder will make a presentation on our findings at the conference of the Association for Psychological Science in 2016.

**Writing Speed, Ideaphoria, and Foresight Scores Across Time**

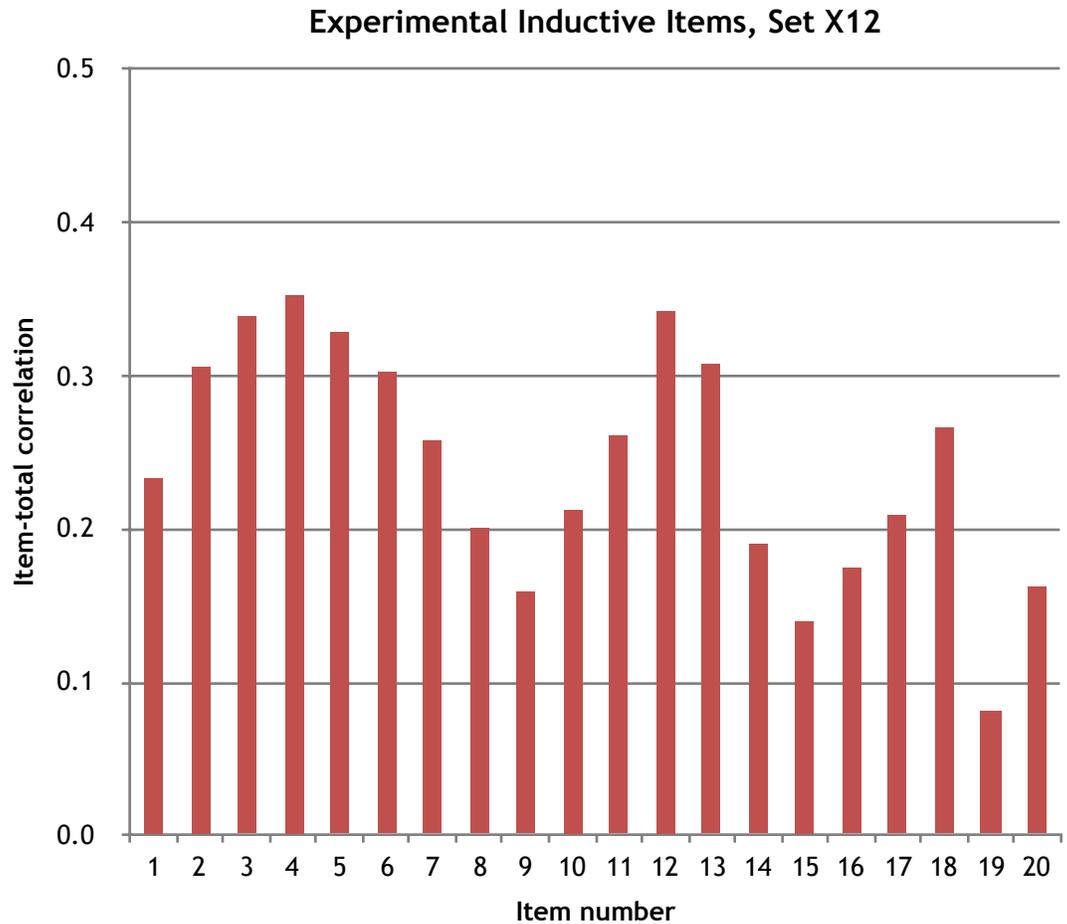


Note. Values are not shown for years in which the current versions of the tests were not given.

## Inductive Reasoning

We continued to study new Inductive Reasoning items in 2015. We analyzed three sets of 20 items each that our offices had given experimentally in conjunction with our standard Inductive test. Some of these items were devised by David Ransom, President of the Foundation, and other staff, and others had been given in previous experimental administrations.

David Schroeder examined the results of the experimental administrations and specifically assessed the item difficulties and the correlations of the items with the standard Inductive scores. The correlations for the 20 items in Wks. 164 X12 are shown in the accompanying figure. As can be seen, 14 of the items fall at or above our standard of .20 for the item-total correlations, which indicates that those items are functioning effectively.



For the 20 items in Wks. 164 X10, six showed item-total correlations that met our cutoff of .20, and two more were relatively close to the standard and might perform acceptably with some modifications.

For the Wks. 164 X11 set of experimental items, 13 showed item-total correlations that were at or above our standard of .20, and several others were close to the standard.

Schroeder also performed a study in which he compared the 1-4 scoring system that we use for the standard Inductive Reasoning test with the 0-6 system that has been used with the experimental items. Schroeder examined item data for our standard Inductive test in 2012-13 and in 2005-06 and for an experimental item set, Wks. 164 X8, which was administered in 2013.

In each analysis, the alpha reliability coefficient was higher for the 1-4 scales than for the 0-6 scales, which indicates that the 1-4 scales appear to provide a better scaling of the underlying trait than the 0-6 scales. In particular, the superiority of the 1-4 scoring system was probably attributable to the fact that the time ranges were customized for each item, whereas the 0-6 scoring system, which had the advantage of using seven scale points for each item, used the same time ranges for each item.

Schroeder also examined a 1-5 scale in which the time ranges were designed to yield an approximation of the normal (bell-shaped) distribution for each item, but this approach yielded a lower reliability value than did the 1-4 scoring system.

Schroeder reported this study of scoring systems in Statistical Bulletin 2015-5, *1-4 Versus 0-6 Scoring for Inductive Reasoning*. He reported the analyses of the experimental item sets in Statistical Bulletin 2015-1, *Analysis of Experimental Inductive Reasoning Items, Wks. 164 X10 (2014)*; Statistical Bulletin 2015-4, *Analysis of Experimental Inductive Reasoning Items, Wks. 164 X11 (2014-15)*; and Statistical Bulletin 2015-7, *Analysis of Experimental Inductive Reasoning Items, Wks. 164 X12 (2015)*.

## The High School to College Study

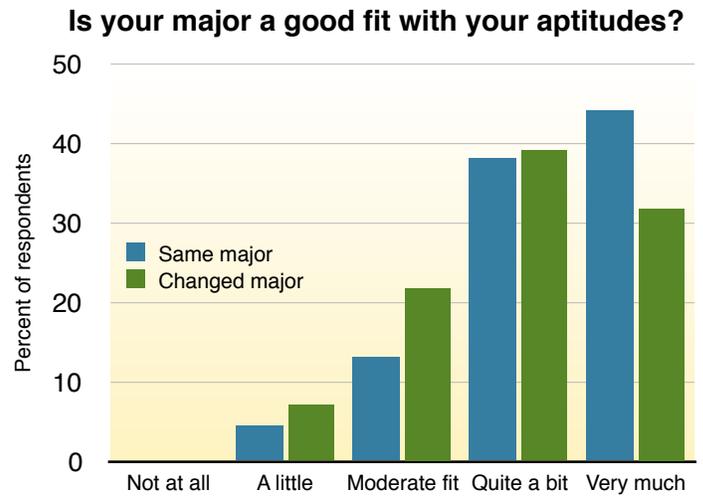
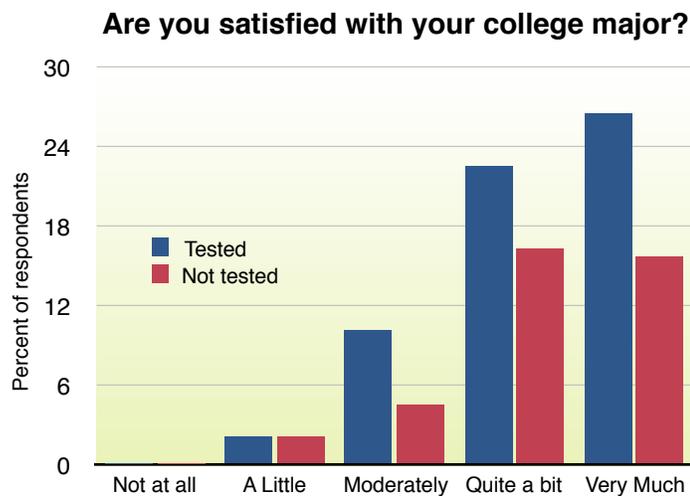
The benefits of learning about your aptitudes are wide-ranging. One benefit that we were curious about is how aptitude testing might help students entering college. College students are usually faced with the decision of what major to choose during their sophomore year of college. Other researchers have found that about 50% or more of college students change their major at least once during their time at college, and 50% stay the same. We wondered if students who have tested with JOC in high school would be more likely to stick with their declared major.

For a sample of 105 students who were tested when they were high school students, 62% had kept the same major as their original choice. For a comparison group of 67 students who did not test with the Foundation, 54% kept the same major.

Students who had kept the same major (both tested and not tested) gave ratings that indicated that they were more satisfied with their major, with 49% stating that they were “very much” satisfied with their major. Of the students who changed majors, 32% stated they were “very much” satisfied. The figure on the left below shows that students who were tested were slightly more likely to be “quite a bit” or “very much” satisfied with their college major.

The student examinees thought their college major fit with their aptitudes—38% said “quite a bit,” and 39% said “very much.”

Further, the students who had kept the same major more often said their major was a good fit with their aptitudes, as can be seen in the figure on the right below. Apparently they had found the right major from the start.



## Do theater artists share a pattern of aptitudes? What types of aptitudes do they have?

We set out to answer these questions with a study of theater artists that was spearheaded by a former aptitude consultant, Scott Barsotti. Are theater artists more verbal, creative, and musical? Are they good at everything? Of the 131 theater professionals that were in the study, most were actors, with directors making up the next biggest group, along with smaller numbers of playwrights, stage managers, designers, and technicians.

The scores that stood out for theater artists as a whole were for Foresight, an aptitude for seeing many possibilities. A recent study has shown that Foresight is a good indicator not only of seeing possibilities, but a high score on the test is associated with actual creative achievements (See p 7 - CAQ study) and higher judged levels of creativity (see p 2). It certainly makes sense that theater artists would have higher levels of creativity as revealed by the Foresight test.

Full results of the study were presented in Statistical Bulletins 2015-2 and 2015-6. Scott Barsotti wrote an article about the study for *HowlRound*, a knowledge commons by and for theatre artists, and reposted at our website. The study received a mention in an article in *The Chronicle of Higher Education*.

As expected, the theater artists scored high on tests of verbal ability, including English vocabulary and the Ideaphoria test. They scored quite high on all three music tests: Pitch Discrimination, Rhythm Memory and Tonal Memory. Actors had a tendency towards scoring Subjective on the Word Association test, while Directors scored in the other direction, more Objective. Otherwise, directors’ profiles were quite similar to the actors’ profiles, with the exception that they scored slightly lower on the music aptitudes. The long list of tests that theater artists scored high on includes Ideaphoria, Foresight, Analytical Reasoning, Number Series, Paper Folding, Tonal Memory, Pitch Discrimination, Rhythm Memory, Silograms, and English Vocabulary. Perhaps to work at the level of a professional theater artist, one must be creative, verbal, good at reasoning, and have some degree of musical aptitude.

## Foresight and Creative Achievement

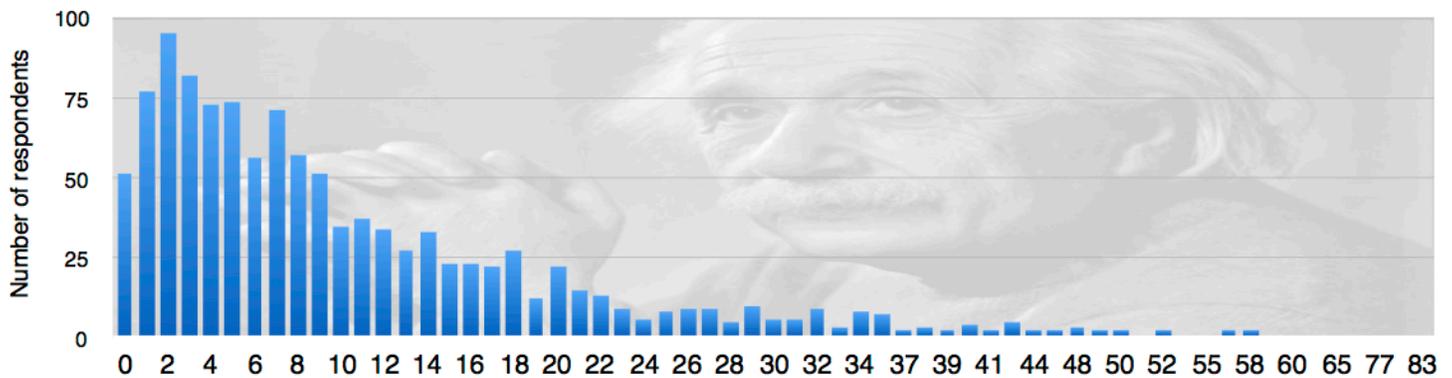
We have found that the notion of “seeing possibilities” is related to higher scores on the Foresight test. Is being able to see more possibilities also a characteristic of creativity? While we did not address that question directly, we looked at how Foresight correlates with creative achievement.

Creative accomplishment is often difficult to quantify, but we used one of the best available measures in use, the Creative Achievement Questionnaire, to gauge the attainments of a sample of our examinees. One third of the respondents had very few creative achievements, and the distribution of achievements was skewed toward the low end with a long tail at the high end. In other words, most people are not inclined to claim significant creative accomplishments. We found that Foresight scores correlated with creative achievement at a level of  $r = .26$ , while Ideaphoria, on the other hand, correlated to a lesser degree ( $r = .11$ ).

We also considered other sets of aptitudes as they related to creative achievement. The Memory aptitudes and Speed of Reasoning aptitudes were not related to creative achievement. Structural Visualization contributed to predicting scores on the CAQ, alongside Foresight. Interestingly, the Numerical aptitudes had a negative relationship with creative achievement in this multiple regression model.

Most of the creative attainments reported by this sample were in the visual arts and music. The relationship between Structural Visualization and music that has been shown in [SB 2013-2] is further supported. More research on other areas of creative achievement can examine the role of Structural Visualization for the areas of writing, inventions, and innovation. This study was presented by Linda Houser-Marko at the annual meeting of the International Society for Intelligence Research.

### Few people have very high Creative Achievement scores



### The JOCRF Examinees in 2015

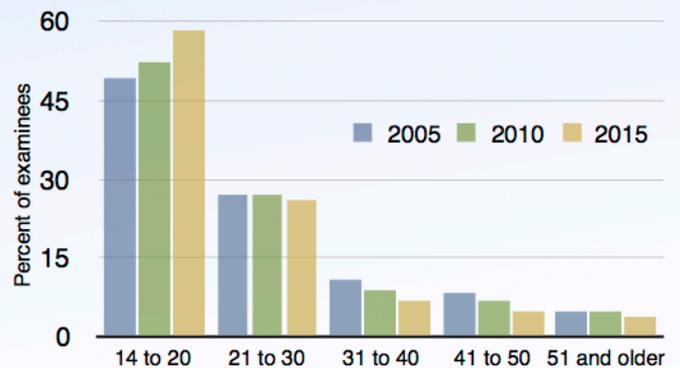
We found that examinees tested in 2015 were generally similar to those of examinees from prior years of the past decade. In other words, there were:

- slightly more males than females, 54% and 46%;
- mostly teenagers and young adults;
- the mean age was 23, and the most common age for testing is 17 years.

Half of the examinees are between ages 14 and 19, about one-quarter of the examinees are between 20 and 25, and the remaining quarter of the examinees were 26 and older. The distribution of examinees in 2015 had a slightly younger skew than in 2010. The figure shows examinee ages for 2005, 2010, and 2015.

Twenty-nine percent of clients were referred to Johnson O'Connor by a family member (went up), and eighteen percent were referred by a friend (went up).

### Examinee Age Compared by Year of Testing



## Cognitive Scales from SAPA Personality Project

How do the Foundation’s standard battery tests compare to other cognitive ability tests that are used in academic research? We compared a set of cognitive tests from the International Cognitive Ability Resource and an instrument developed by Professors William Revelle and David Condon to the Johnson O’Connor Research Foundation standard battery.

For this initial study, we had 128 respondents, with about twice as many females as males, and a mean age of 30 years old. Examinees were sent a link to the questionnaire in an e-mail that was sent after their final appointment. We had an estimated response rate of 5% of those who were sent the link.

The ICAR cognitive scales are: Verbal Reasoning, which includes logic and general knowledge questions; Letter (and Number) Series, in which a pattern of letters (or numbers) is given and the responder must give the next in the series; Matrix Reasoning, in which one selects the design that would complete a set, based on discovering the rule that defines the set; and 3-Dimensional Cube Rotation, which requires imagining a cube with a design on it, and choosing which of several options shows what the cube would look like after being rotated.

Some highlights of the correlations between scales were:

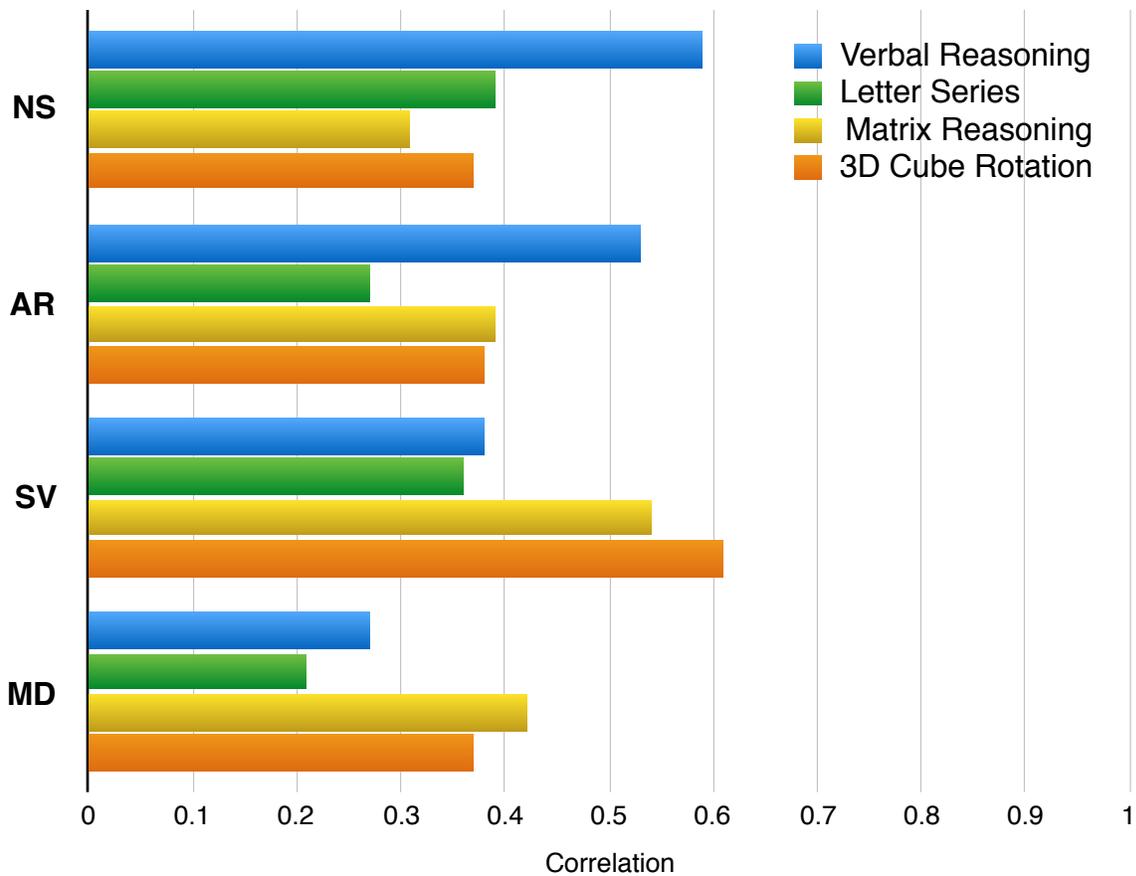
ICAR Verbal Reasoning correlated well with JOC Number Series and Analytical Reasoning. ICAR Letter Series correlated with JOC Number Series. ICAR Matrix Reasoning correlated with JOC Structural Visualization and Memory for Design. ICAR 3D Cube Rotation correlated well with JOC Structural Visualization, Paper Folding, and Wiggly Block. These correlations strongly support several of the Foundation’s reasoning and spatial ability tests. The figure below shows these correlations.

Some unexpected correlations were:

Rhythm Memory with Verbal Reasoning, Letter Series, Matrix Reasoning, and 3D Cube rotation and Tonal Memory with Letter Series and 3D Cube Rotation. These correlations might be due to the memory components that are involved for Rhythm and Tonal and for the noted ICAR tests.

The convergence of results for the reasoning-related tests, as well as for the spatial ability tests, implies construct validity for the Foundation tests.

**Cognitive Scales and Select JOCRF Tests**



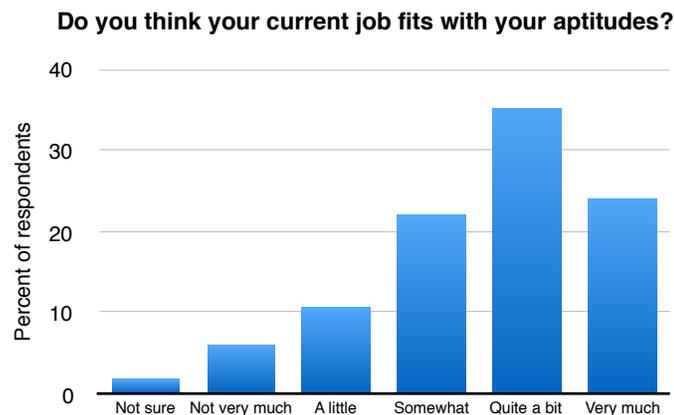
## Ten Year Follow-Up Study

At the end of 2015 we sent a postcard to former examinee-clients who had tested with the Foundation ten years before, in 2005. We invited them to complete an online survey about their activities since they tested with the Foundation. Since the postcard was sent out, we have received responses from 167 former examinees.

For this study, we were hoping to develop an understanding of how former examinees think about their experience of testing at one of the Foundation's offices ten years prior. Did aptitude testing have an influence on the direction of their occupation? Do they think that their current job fits with their aptitudes? (or aptitudes fit their job?)

We received responses from former examinees from all eleven of the testing offices. When they were tested, 45% of the respondents were in high school, 15% were in college, and 12% were mid-career. At the time of the current survey, all of the respondents had been in the working world for at least a few years. 52% said that aptitude testing had at least some or quite a bit of influence on the direction of their occupation or work life

Most people were satisfied with the tasks of their current job. When asked if they thought the activities and tasks of their job were satisfying, 36% said they were "somewhat satisfying," 39% said they were "satisfying," and 15% said they were "very satisfying." (10% said they were "somewhat not satisfying," or worse.) Many thought their current job fit with their aptitudes: 22% said they thought their job fit "somewhat," 35% said they thought it fit "quite a bit," and 24% said they thought it fit "very much." (2% were not sure, and 16% thought it fit "not very much" or "a little.") See the figure below.



Looking back on their experience of testing ten years ago, 80% of the respondents felt satisfied with the services provided by the Johnson O'Connor Research Foundation. Many commented that they felt that they understood their strengths better, and that the aptitude testing confirmed what they already thought about

themselves. Others told us that they tried new paths that they never expected, and felt happy and successful pursuing those careers. Another positive indication that former clients think fondly of their experience with the Foundation is that 87% of respondents said they could be contacted in the future for other research projects. We hope to generate an interesting Statistical Bulletin from such contact.

### Observations & Announcements

Sifting among the research projects presented in this year's report, Foresight stands out. Searching back through JOCRF history, it has a problematic background. It was kicked from measuring pure imagination to sticking to long-term goals, this being interpreted as seeing possibilities in a career. Seeing possibilities could have been projective or reflective of competitiveness — those who try harder on a test where solving for some specific correct answer was replaced by merely writing words in a list, a list that was not dependent on clever or distinctive responses, to score points. Sticking to a goal could be seen as stubbornness — if the goal ill-suited the aptitude pattern. (see p. 62 in *Understanding Your Aptitudes*.)

Visual Imagination, Vision — its erstwhile names (see p. 1); its possible locus in the brain (see p. 2); its rapid rise in scores, perhaps for its visual aspect in an increasingly visual stimulus era (see p.4); its apparent ubiquity among theater professionals (see p. 6); its connection to creative achievement (see p. 7) all tie in to our venerable, for a decade dismissed, aptitude test.

The word "aptitude" strikes a chord for all of us; the *New York Times* is generally more circumspect. In their article about retirement (4-23-16, p. B5) the prospective retiree should ask, "What am I wired for?" leading to an "inventory of who you are." This is geared to "one's aptitudes," as they say. This leads me (of a certain age) to speculate how Foresight and aptitudes can apply not just for use in school or early career vision but to the end game of life as well. With treasured memories of our founder's proclivity for ancient tomes, I discovered a gem of delayed gratification for a mighty colossus of history — Charles V. If you want to know how forbidding he was, read of him and *Stroppendragers* from a Flanders perspective or watch the opera *Don Carlos*. If you want to know how delightful an old man in early retirement from his imperial rule he was, consider this from *The History of Spain* (3 Vol., London 1793, p. 254-5):

*"...we pursue to his retirement...he seemed to view the busy scene he had abandoned with...contempt and indifference...other amusements, and other objects, now occupied him...he employed himself in studying mechanical principles and in forming curious works of mechanism, of which he had always been remarkably fond, and to which his genius was peculiarly turned...He relieved his mind, at intervals, with slighter and more fantastic works of mechanism, in fashioning puppets, which, by the structure of internal springs, mimicked the gestures and actions of men... He was particularly curious with regard to the construction of clocks..."*

His precocious need to find fulfillment before the NY Times wrote of it might be attributed to creative imagination or to finally seeing new possibilities — through abdication of so much power — for getting unfettered use of his aptitude for Structural Visualization.

David Ransom, President • JOCRF - HEL - JOCRSC

## Dissemination of Research Findings

In recent years we have made it a practice to present some of our findings in scholarly outlets such as professional conferences and journals. In 2015 we presented two papers at the annual meeting of the International Society for Intelligence Research, which was hosted by our collaborator, Dr. Rex Jung, in Albuquerque, New Mexico. Dr. Linda Houser-Marko and Dr. David Schroeder presented “Shedding Light on Intelligence, Creative Fluency, and Creative Achievement,” and Dr. Schroeder also presented “Heritability of Specific Cognitive Abilities.” In addition, David Ransom and Russell Burke attended the conference, and we made contacts with several other professional researchers, which may lead to collaborations in the future.

Also in 2015, Jung and his team published an article titled “Quantity Yields Quality When It Comes to Creativity: A Brain and Behavioral Test of the Equal-Odds Rule” in the journal *Frontiers in Psychology*. In this article, he discusses our Foresight test and its relationships with measures of creativity and structural brain indices (see page 2).

In addition, Scott Barsotti, a test administrator in our Chicago office and active playwright, wrote an account of our study of theatre artists for the industry blog [www.howlround.com](http://www.howlround.com). It received a strong response including coverage in *The Chronicle of Higher Education*.

The 2014 article by Dr. Jung and his associates in the journal *PLoS ONE* received further attention in 2015. It has now been viewed by 2,439 persons.

Other scholarly work sponsored by us has continued to receive attention in 2015. Our 2010 article with Dr. Richard Haier and his associates in *BMC Research Notes* has now been viewed by 11,866 persons, while our 2012 article by Dr. David Schroeder and others in *BMC* has been viewed by 1,474 persons. According to Google Scholar, the 2010 Haier et al. article has been cited in 13 scholarly-journal articles and books, and our 2009 article with Haier and others in *Intelligence* has been cited 54 times. In addition, our 2010 article with Dr. Cheuk Tang and others in *Intelligence* has been cited in 43 articles and books.

With regard to earlier publications, Schroeder’s 2004 article with Drs. Timothy Salthouse and Emilio Ferrer in *Developmental Psychology* has now been cited in 104 scholarly journal articles and books, and his article with Salthouse in *Personality and Individual Differences* has been cited 55 times. Our 2001 *Intelligence* article by Dr. Scott Acton, former research assistant in the Research Department, and Schroeder has been cited 53 times.

In 2016 Dr. Houser-Marko will present “Spatial Ability and the STEM Majors: Where Do the Females with High Spatial Ability Go?” at the annual meeting of the Association for Psychological Science, at which Dr. Schroeder will present “The Flynn Effect: Is It Continuing in the United States?”

## Research Department Staff



**Russell E. Burke**, Director of Research, has also served as Director in Washington, D.C. He is our senior summarizer and writer interpreting research information to the staff. An autodidact by inclination following a degree in Religious Studies at the University of Tennessee, he joined the Foundation in 1983 in New Orleans and served as Director in Houston before moving to the nation’s capital, living on Capitol Hill.



**David H. Schroeder**, Research Manager, joined the Research Department in August 1984. He has a B.S. from the University of Illinois and an M.S. from Colorado State University, as well as an M.A. and a Ph.D. in personality psychology from The Johns Hopkins University.



**Linda S. Houser-Marko**, Researcher, joined the Research Department in October 2010. She has a B.A. from Gustavus Adolphus College in Minnesota and a Ph.D. in social and personality psychology from the University of Missouri. She has published research on the self, identity, and motivation.

## Recent Technical Reports

2013-1	Sex Differences in Variability	<i>D. Schroeder</i>
2012-1	Aptitudes, Vocabulary, and Educational Attainment	<i>D. Schroeder</i>
2012-2	The Aptitudes of Engineering Students	<i>C. Condon, D. Schroeder</i>
2012-3	Four Studies of the Self-Directed Search	<i>D. Schroeder</i>
2008-1	Is the Flynn Effect Primarily a Rise in Structural Visualization?	<i>C. Condon, D. Schroeder</i>
2008-2	Memory for Design: Internal Characteristics and Validation Data	<i>D. Schroeder, C. Condon</i>
2007-1	Analyses of Fixed-Piece and Standard Administrations and Alternative Scoring Methods on the Wiggly Block Test	<i>D. Schroeder, C. Condon</i>
2005-1	The Aptitudes of Attorneys	<i>S. Goldman, D. Schroeder, K. M. Jang</i>
2003-1	The Aptitudes of Software Engineers	<i>R. Burke, T. Fitzgerald</i>

## Recent Statistical Bulletins

2015-1	Analysis of Experimental Inductive Reasoning Items, Wks. 164 X10 (2014)	<i>David Schroeder</i>
2015-2	Theatre Artists' Aptitudes Study: Results for Word Association and an Online Survey of Theatre Artists	<i>Scott Barsotti, Linda Houser-Marko, Rusty Burke</i>
2015-3	Scores on Writing Speed Across Time	<i>David Schroeder</i>
2015-4	Analysis of Experimental Inductive Reasoning Items, Wks. 164 X11 (2014-15)	<i>David Schroeder</i>
2015-5	1-4 Versus 0-6 Scoring for Inductive Reasoning	<i>David Schroeder</i>
2015-6	Theatre Artists' Aptitudes Study: Aptitudes of Theatre Professionals	<i>Linda Houser-Marko, Scott Barsotti</i>
2015-7	Analysis of Experimental Inductive Reasoning Items, Wks. 164 X12 (2015)	<i>David Schroeder</i>
2014-1	Inter-Trial Improvement of Scores on Silograms	<i>Rusty Burke</i>
2014-2	Sex Differences in Variability for Non-Cognitive Foundation Tests and SDS Scales	<i>David Schroeder</i>
2014-3	Mean Sex Differences for Foundation Tests and SDS Scales	<i>David Schroeder</i>
2014-4	Analysis of Standard Inductive Reasoning Items, Wks. 164 OA	<i>David Schroeder</i>
2014-5	Analysis of Latest Set of Experimental Inductive Reasoning Items, Wks. 164 X* (2013-14)	<i>David Schroeder</i>
2014-6	Heritability/Familiarity Studies of the Foundation's Aptitude Tests	<i>David Schroeder, Mikako Nakajima</i>
2014-7	Mean Percentiles for Individual Test by Lab and Test Administrator	<i>Linda Houser-Marko</i>
2014-8	Sensory Discrimination in Relation to a General Factor of Cognitive Ability	<i>David Schroeder, G. Scott Acton</i>
2014-9	Poster Presentation at Behavioral-Genetics Conference	<i>David Schroeder</i>
2014-10	Long-Term Stability for English Vocabulary	<i>David Schroeder</i>
2014-11	Analysis of Experimental Inductive Reasoning Items, Wks. 164 X9 (2014)	<i>David Schroeder</i>
2014-12	Number of Aptitudes Per Examinee	<i>David Schroeder</i>
2014-13	The Distributions of Times for Color Discrimination	<i>David Schroeder</i>

## Recent Publications

- Jung, R. E., Wertz, C. J., Meadows, C. A., Ryman, S. G., Vakhtin, A. A., & Flores, R. A. (2015). Quantity yields quality when it comes to creativity: A brain and behavioral test of the equal-odds rule. *Frontiers in Psychology*, 6:864. doi: 10.3389/fpsyg.2015.00864
- Jung, R. E., Ryman, S. G., Vakhtin, A. A., Carrasco, J., Wertz, C., & Flores, R. A. (2014). Subcortical correlates of individual differences in aptitude. *PLoS ONE*, 9(2): e89425. doi: 10.1371/journal.pone.0089425
- Schroeder, D. H., Haier, R. J., & Tang, C. Y. (2012). Regional gray matter correlates of vocational interests. *BMC Research Notes*, 5(1), 242. doi: 10.1186/1756-0500-5-242
- Haier, R. J., Schroeder, D. H., Tang, C. Y., Head, K., & Colom, R. (2010). Gray matter correlates of cognitive ability tests used for vocational guidance. *BMC Research Notes*, 3(1), 206. doi: 10.1186/1756-0500-3-206
- Tang, C. Y., Eaves, E. L., Ng, J. C., Carpenter, D. M., Kanellopoulou, I., Mai, X., Schroeder, D. H., Condon, C. A., Colom, R., & Haier, R. J. (2010). Brain networks for working memory and factors of intelligence assessed in males and females with fMRI and DTI. *Intelligence*, 38, 293-303.
- Haier, R. J., Colom, R., Schroeder, D. H., Condon, C. A., Tang, C. Y., Eaves, E., & Head, K. (2009). Gray matter and intelligence factors: Is there a neuro-g? *Intelligence*, 37, 136-144.
- Schroeder, D. H., & Salthouse, T. A. (2004). Age-related effects on cognition between 20 and 50 years of age. *Personality and Individual Differences*, 36, 393-404.
- Salthouse, T. A., Schroeder, D. H., & Ferrer, E. (2004). Estimating retest effects in longitudinal assessments of cognitive functioning in adults between 18 and 60 years of age. *Developmental Psychology*, 40, 813-822.

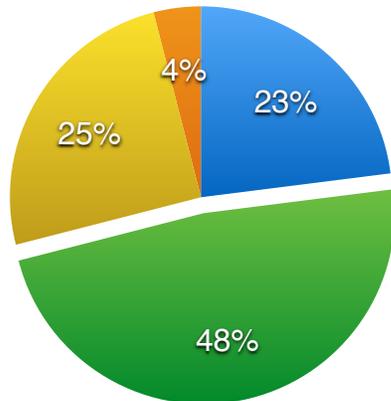
## Recent Presentations

- Houser-Marko, L. S., & Schroeder, D. H. (2015, September). *Shedding light on intelligence, creative fluency, and creative achievement*. Paper presented at the annual meeting of the International Society for Intelligence Research, Albuquerque, New Mexico.
- Schroeder, D. H. (2015, September). *Heritability of specific cognitive abilities*. Paper presented at the annual meeting of the International Society for Intelligence Research, Albuquerque, New Mexico.
- Schroeder, D. H. (2014, June). *Resemblance for twins on a battery of ability tests*. Poster session presented at the annual meeting of the Behavior Genetics Association, Charlottesville, VA.
- Houser-Marko, L. S., & Schroeder, D. H. (2014, May). *Three musical ability tests as they relate to cognitive measures and musical experience*. Poster session presented at the annual meeting of the Association for Psychological Science, San Francisco.
- Houser-Marko, L. S., & Schroeder, D. H. (2012, December). *Cognitive abilities of engineers and computer scientists*. Poster session presented at the annual meeting of the International Society for Intelligence Research, San Antonio.
- Jung, R. E., Frantz, J., Ryman, S., Carrasco, J., Shamiloglu, S., Vakhtin, A., Burke, R. E., Schroeder, D. H., & Haier, R. J. (2012, December). *Subcortical correlates of aptitude*. Poster session presented at the annual meeting of the International Society for Intelligence Research, San Antonio.
- Jung, R. E., Ryman, S., Frantz, J., Carrasco, J., Shamiloglu, S., Vakhtin, A., Burke, R. E., Schroeder, D. H., & Haier, R. J. (2012, December). *Differentiation of intelligence, creativity, and aptitude via brain-behavior imaging*. Paper presented at the annual meeting of the International Society for Intelligence Research, San Antonio.
- Schroeder, D. H. (2012, December). *Gender differences in variability in ability factors over time*. Paper presented at the annual meeting of the International Society for Intelligence Research, San Antonio.
- Haier, R. J., Jung, R. E., Ryman, S. G., Frantz, J. A., Carrasco, J., Burke, R. E., & Weisend, M. (2012, December). *Sequence and speed of information flow among brain areas during problem solving in high and average intelligence individuals*. Paper presented at the annual meeting of the International Society for Intelligence Research, San Antonio.
- Houser-Marko, L. S., & Schroeder, D. H. (2012, May). *Cognitive abilities of males and females who work in STEM fields*. Poster session presented at the annual meeting of the Association for Psychological Science, Chicago.
- Schroeder, D. H. (2012, May). *Gender differences in variability of specific cognitive abilities*. Poster session presented at the annual meeting of the Association for Psychological Science, Chicago.

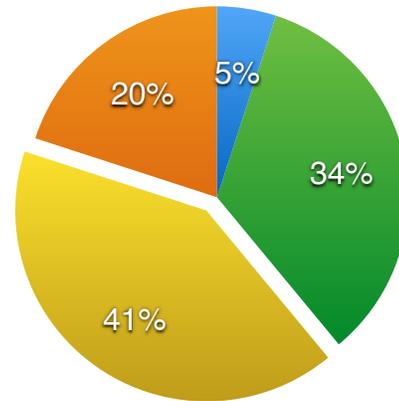
## A Highlight of Past Research — illustrating an interpretation of Foresight

### Interaction of Vocabulary & Foresight on Years of Education

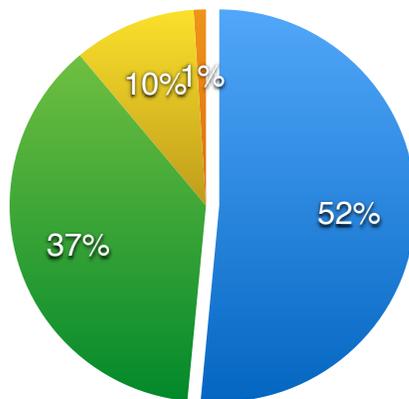
Low Vocabulary - High Foresight



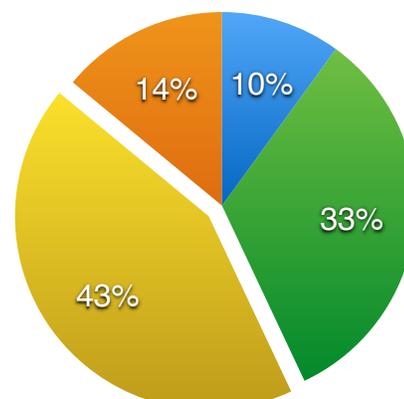
High Vocabulary - High Foresight



Low Vocabulary - Low Foresight



High Vocabulary - Low Foresight



- some college, no degree
- college degree
- some graduate study & masters
- professional & advanced degree

The study above illustrates how high Foresight individuals, even without a high score on vocabulary, are more likely to graduate from college, even pursue some graduate study than those low in Foresight. Those with the requisite high vocabulary but low in Foresight were somewhat less likely to finish college or obtain an advanced degree. Those high in both were, as expected, more likely to keep going longer in college and graduate study than those low in either area.

## Trustees

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Linda Houser-Marko, Ph.D., *Researcher*

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