The International Society for Intelligence Research
11th Conference
Alexandria, Virginia (USA)
December 9-11, 2010

Committee on the Psychological Examination of Recruits (The people who developed the Army Alpha and Army Beta tests) – 1917. Yerkes, the committee chair, is center (second from left) in the third row.[1]

Organizers: Joe Psotka and Peter Legree

Officers and Advisory Board:
Doug Detterman, Earl Hunt, Linda Gottfredson, Wendy Johnson, Tom Bouchard

Numbers in parentheses following names are page numbers for abstracts.

---

[1] Image from Plucker, J. A. (Ed.). (2003). *Human intelligence: Historical influences, current controversies, teaching resources*. Retrieved October 12, 2010 from http://www.indiana.edu/~intell

Thursday, December 9

8:00-8:30 am, Opening and welcome, Inauguration of new president, Introduction of other newly elected officers, Announcement of Lifetime Achievement Award

8:30-10:00, Symposium: Predicting Academic Achievement Using Non-*g* Variance
Organizer: Thomas R. Coyle (6-10)

10:00-10:20 Coffee Break

10:20-12:00 Talks, generally about achievement
10:20-10:40 A genetically informed study of infant mental and motor predictors of kindergarten-aged achievement**,** Christopher R. Beam (29)
10:40-11:00 Predictors of Mathematical Achievement: the nature of the association, Yulia Kovas (49)
11:00-11:20 Parents' education, less so their money, nurtures the intelligence of their children: Results of 19 studies in six countries at different development levels, Heiner Rindermann (68)
11:20-11:40 Ability Factors Underlying the National Assessment of Educational Progress (NAEP) Grade 8 Reading, Mathematics, and Science Assessments, William C. Tirre (75)
11:40-12:00 Educational achievement and attitudes: the individual and contextual national level, Karin Täht (73)

12:00-1:30 Lunch

1:30-3:00 Symposium: The Relationship between Working Memory and Intelligence: New Insights from Executive Attention Theory
Organizers: Randall W. Engle and Andrew R. A. Conway (11-15)

3:00-3:20 Coffee Break

3:20-5:00 Talks, generally about aspects of processing
3:20-3:40 How to get really smart: Practice and Training Effects in ability testing using computer-generated figural matrix items, Ph. Alexander Freund (40)
3:40-4:00 Differential use of peripheral stimuli in problem solving as a function of intelligence, E.V. Gavrilova (42)
4:00-4:20 Ratio Scale Measurement of Mental Processes by Means of Mental Chronometry, Arthur R. Jensen (46)
4:20-4:40 Response Time and Intelligence: Problems of Data Weighting and Averaging, Yury S. Dodonov (33)
4:40-5:00 Speed of Shape and Color Discrimination as Related to Nonverbal Intelligence**,** Yulia A. Dodonova (35)

5:00-5:30 Break

5:30-6:30 Distinguished Interview with Frank Schmidt

6:30-8:30 Reception and Poster Session

Friday, December 10

8:30-10:00 Symposium: Intellectual Giftedness: Mechanisms, Malleability and Manifestations
Organizer: Scott Barry Kaufman (16-20)

10:00-10:20 Coffee Break

10:20-12:00 Talks, generally about occupation

10:20-10:40 Occupational Achievement as a Function of Information Processing Ability, Knowledge, Self Control and Race, Joseph F. Fagan (37)
10:40-11:00 Testing for Cognitive Ability with Reduced Adverse Impact: Hiring in Work Organizations, Harold W. Goldstein (43)
11:00-11:20 An examination of sex differences in the top 5% of cognitive abilities: 1981-2010, Jonathan Wai (78)
11:20-11:40 Development of scientific excellence in top STEM graduate students as a function of the adviser-advisee relationship, Stijn Smeets (72)
11:40-12:00 Time-saving from acceleration and the effect on STEM productivity in adulthood, Gregory Park (60)

12:00-1:30 Lunch

1:30-3:00 Symposium: Challenges in Reporting Mainstream Science on Human Variation in Socially Important Traits: In Memoriam of Science Writer Constance Holden
Organizer: Linda S. Gottfredson (21)

3:00-3:20 Coffee Break

3:20-5:00 Talks, generally about neuroscience

3:20-3:40 White Matter Integrity and General Cognitive Performance: a Tract-based Spatial Statistics approach, M. Burgaleta (31)
3:40-4:00 Hippocampal Structure and Human Cognition, Roberto Colom (32)
4:00-4:20 Global cortical thickness-based network efficiency is associated to rate of cognitive growth in developing children and adolescents, Sherif Karama (47)
4:20-4:40 A Comparison of the Gray-Matter Correlates of Vocational-Interest and Cognitive-Ability Scales, David H. Schroeder (70)
4:40-5:00 Of valid concerns and invalid effects: Meta-analyzing associations of in-vivo brain volume and IQ, Jakob Pietschnig (63)

5:00-5:30 Break

5:30-6:30 Featured Speaker, David Geary, Evolution of Sex Differences in Brain and Cognition

Saturday, December 11

8:30-10:00 Symposium: Research on the Biological Basis of Intelligence
Organizers: Con Stough and Tim Bates (22-27)

10:00-10:20 Coffee Break

10:20-12:00 Talks, mostly technical

10:20-10:40 The dependability of the general factor of intelligence: Why *g* is not a first principal component, Jason T. Major (55)
10:40-11:00 Are We Really Overfactoring Modern Cognitive Tests? Test of a Hypothesis via Plausible Simulated Data, Timothy Keith (48)
11:00-11:20 Scoring Emotional Intelligence Tests Using Profile Similarity Metrics, Peter Legree (51)
11:20-11:40 Practical Intelligence and Self Awareness: An evaluation of alternative scoring procedures for Situation Judgment Tests (SJTs), Joseph Psotka (65)
11:40-12:00 The Utility of CHC Taxonomy in Identifying the Factorial Composition of Intelligence Subtests: A Joint Confirmatory Factor Analysis, Matthew R. Reynolds (67)

12:00-1:30 Lunch

1:30-2:00 ISIR Business Meeting

2:00-3:00 Talks, generally about health and cognition
2:00-2:20 The Dynamic Relationship Between Health and Cognition: Findings From the Seattle Longitudinal Study, Tara Madhyastha (53)
2:20-2:40 Differential Epidemiology: IQ, Neuroticism and Chronic Disease by the 50 U.S. States, Bryan J. Pesta (62)
2:40-3:00 Empirical Verification of the Model of Relation of Cognitive and Emotional Abilities, Ekaterina Valueva (77)

3:00-3:20 Coffee Break

3:20-5:00 Talks, generally about evolution
3:20-3:40 General Intelligence, Creativity, and Runaway Sexual Selection, Sacha Devine Brown (30)
3:40-4:00 IQ, Pigmentocracy, Crime, and Income in 50 U.S. States, J. Philippe Rushton (69)
4:00-4:20 Executive Functions, Emotional Intelligence, and Life History Strategy, Aurelio José Figueredo (38)
4:20-4:00 Are *g* and the General Factor of Personality (GFP) correlated? Paul Irwing (45)
4:40-5:00 Introducing the cognitive differentiation-integration effort hypothesis: A coherent evolutionary explanation for SLODR and related effects, Michael A. Woodley (80)

SYMPOSIA

Predicting Academic Achievement Using Non-*g* Variance

Organizer/chair/correspondent: Thomas R. Coyle (Thomas.Coyle@utsa.edu)
Department of Psychology, University of Texas at San Antonio

Discussant: David Lubinski (David.Lubinski@vanderbilt.edu)
Department of Psychology & Human Development, Vanderbilt University

An axiom of psychometrics is that general intelligence (*g*), empirically defined as variance common to cognitive tests, contributes substantially to the predictive validity of cognitive tests. This axiom has received considerable support: (a) the predictive validity of cognitive tests varies directly with their *g* loading; (b) removing *g* from tests generally neutralizes their predictive validity; and (c) non-*g* variance from tests generally contributes little to predictive validity.

Although the contribution of *g* to predictive validity is well established, recent research has shown that, in some cases, non-*g* variance also contributes significantly to predictive validity. This symposium presents a sample of this research, with emphasis on predicting academic achievement using non-*g* variance.

The symposium includes four presentations. Thomas Coyle examines whether test-specific variances (TSVs) from the SAT subtests, obtained after removing general variance from the SAT, predict college GPAs in specific subject areas (e.g., science and humanities). Meredith Frey examines whether residual variances from the ACT subtests, obtained after removing *g*, predict college GPA. Jason Purcell examines whether non-*g* variances from the SAT and Armed Services Vocational Aptitude Battery contribute to predictive validity for college GPA. Anssia Snyder examines whether a high-stakes, high-school exit test in Texas (Texas Assessment of Knowledge and Skills) predicts college GPA after removing *g* from the test. David Lubinski will serve as a discussant.

A goal of the symposium is to encourage researchers to look beyond *g* and pay more attention to non-*g* variances that contribute to predictive validity.

Predicting College GPA Using Test-Specific Variances (TSVs) From the SAT

Thomas R. Coyle (Thomas.Coyle@utsa.edu)
Department of Psychology, University of Texas at San Antonio

The SAT (formerly, Scholastic Aptitude Test) is a standardized test for college admissions. It is moderately related to college freshman GPA ($r \approx .35$), and strongly related to general intelligence (g) ($r \approx .80$; Coyle & Pillow, 2008; Frey & Detterman, 2004). g refers to variance common to mental tests, and is strongly related to predictive validity. Although non-g variance typically contributes little to the predictive validity of cognitive tests, non-g variance from the SAT has been found to predict GPA almost as well as g (Coyle & Pillow, 2008). This raises an important question: What are the non-g variances of the SAT that allow it to predict GPA? The research presented here explores the possibility that the SAT taps test-specific variances (TSVs) that contribute to its predictive validity. TSVs are defined as unique (non-g) variances from each SAT subtest that are independent of general variance from all the subtests.

This research examined the predictive validity of TSVs from the SAT using data from the College Board SAT Validity Study ($N = 192467$). The data included SAT scores for the math (SATm), reading (SATr), and writing (SATw) subtests, as well as GPAs in different subject areas (e.g., English, math, history). Structural equation modeling (SEM) estimated a general SAT factor (SATg) from the three SAT subtests, as well as TSVs for each subtest. SEM also estimated a general GPA factor (GPAg) from two GPA group factors: GPAstem, based on GPAs in science, technology (computer science), engineering, and math; and GPAhuman, based on GPAs in the humanities (art/music, English, foreign language, history).

Results indicated that SATg was related to GPAg (standardized coefficient = .48). TSVs from SAT subtests were related to the two GPA group factors, but in a domain-specific way. TSVs from SATm were positively related to GPAstem (.14) but negatively related to GPAhuman (-.11). Conversely, TSVs from SATr and SATw were negatively related to GPAstem (-.16 and -.05) and positively related to GPAhuman (.07 and .09). The results suggest that TSVs have positive effects when they complement the outcome being predicted (SATm and GPAstem) but negative effects when they don't (SATm and GPAhuman). The results support an "investment" theory of non-g skills. It appears that investing in the development of non-g skills in one area is associated with less investment of non-g skills in other areas.

ACT Subtests Predict College GPA Beyond a General Factor

Meredith C. Frey (MFrey@Otterbein.edu)
Department of Psychology, Otterbein University

Coyle and Pillow (2008) demonstrated that residual variance on both SAT and ACT college admissions tests predict college GPA after removing g. However, because their analyses were performed separately for each SAT and ACT subtest, residual variances from each subtest, independent of general variance from all subtests, were not examined. Moreover, in the ACT analyses, the science subtest was not evaluated. In the present study, ACT subtests (including science) were examined for their predictive validity after controlling for general reasoning ability and general variance from all subtests.

A sample of 239 undergraduates from a small non-selective private university completed a 36-item test of general reasoning ability (Raven's APM) and provided transcript-based GPA and ACT data. The ACT data included scores from the four ACT subtests (English, Math, Reading, and Science) and a composite score.

A general factor (ACTg) was extracted from the subtests and entered at the first step in a stepwise multiple regression to predict college GPA. Raven's APM scores were entered at a second step. After controlling for ACTg and general reasoning ability, only the Science subtest added significantly to the prediction of college GPA, though the magnitude of the change was small ($\Delta R2 = .04$). In a subsample of 47 first quarter freshmen, the relationship between ACT-Science scores and GPA was even more pronounced ($\Delta R2 = .15$).

These findings are of particular interest in that the unique relationship between ACT-Science and college GPA is negative ($sr = -.143$). Possible reasons for this relationship are discussed.

Predicting College GPA Using Non-*g* Variances From the SAT and ASVAB

Jason M. Purcell (ofp811@my.utsa.edu) and Thomas R. Coyle (Thomas.Coyle@utsa.edu)
Department of Psychology, University of Texas at San Antonio

The SAT (formerly, Scholastic Aptitude Test) is a standardized test for college admissions. The predictive validity of the SAT for first-year college GPA (GPA) is well established, as is its relationship to general intelligence (*g*). Although non-*g* factors typically contribute little to the predictive validity of cognitive tests, the unique (non-*g*) variance of the SAT, obtained after removing *g*, predicts GPA almost as well as *g* (Coyle & Pillow, 2008).

This research extends Coyle and Pillow (2008) by examining the predictive validity of non-*g* variances from the SAT compared to non-*g* variances of other academic and non-academic tests. SAT scores, cognitive test scores, and GPAs were obtained from the Armed Services Vocational Aptitude Battery (ASVAB) and the National Longitudinal Survey of Youth (N = 1591). Structural equation modeling (SEM) was used to estimate the following constructs: *g*, based on all ASVAB tests and the SAT; Speed, based on ASVAB speed tests (numerical operations and coding speed); School, based on ASVAB school tests (arithmetic reasoning, general science, paragraph comprehension, word knowledge); and Shop, based on ASVAB shop tests (automobile information, electronics information, mechanical comprehension, shop information). GPA was based on first-year college GPA.

The results indicated that the SAT, Speed, School, and Shop factors positively predicted GPA. However, when *g* was removed, the non-*g* variances of Speed and School did not predict GPA (.06 and .00). Conversely, the non-*g* variance of the SAT was positively related to GPA (.25), whereas the non-*g* variance of Shop was negatively related to GPA (-.16). Explanations for the different predictive validities of the non-*g* variances are discussed in terms of trade-offs in cultivating non-*g* skills.

Predicting First-Year College GPA Using the Exit-Level TAKS Examination

Anissa Snyder (uek952@my.utsa.edu) and Thomas R. Coyle (Thomas.Coyle@utsa.edu)
Department of Psychology, University of Texas at San Antonio

The Texas Assessment of Knowledge and Skills (TAKS) is a high-stakes exit examination used in Texas public high schools. The purpose of the TAKS is to assess the extent to which students have learned and can apply grade-relevant concepts and skills. Students need to pass the TAKS in order to receive a high school diploma. Although the TAKS is used as an exit exam, little is known about its predictive validity after high school (i.e., in college).

The purpose of this research was to examine the predictive validity of the TAKS for college achievement as measured by first-year college grade point average (GPA). A secondary purpose was to examine if the predictive validity of the TAKS was attributable to g, as measured by the Wonderlic Personnel Test (WPT). g refers to variance that is common to mental tests, and is strongly related to the tests' predictive validity (Jensen, 1998). The WPT is a highly g-loaded test, as it correlates strongly with g (Coyle & Pillow, 2008).

A sample of 352 undergraduates from a large, non-selective public university provided WPT scores and transcript-based GPAs and TAKS scores. Correlations among the two TAKS subtests (Math and English), WPT, and GPA were computed. Significant correlations were found between the two TAKS tests (r = .33) and between the WPT and the TAKS tests (rs = .51 and .24 for TAKS Math and English, respectively). However, only TAKS Math (r = .36) and WPT (r = .14) significantly predicted GPA.

A simultaneous regression predicted GPA using the TAKS Math and WPT as independent variables. The results indicated a significant relation between the predictors and GPA (R^2 = .13, F = 14.47, p < .001), but only TAKS Math significantly predicted GPA (β = .39 and -.05 for TAKS math and WPT, respectively). Further analysis indicated that the semipartial correlation between TAKS math and GPA (sr = .33), controlling WPT, was very similar to the zero-order correlation between TAKS math and GPA (r = .36, not controlling WPT). Together, these results suggest that the predictive validity of TAKS Math is attributable to factors other than g. (A parallel regression adding TAKS English as a predictor yielded similar results.)

Further research is needed to identify the factors that contribute to the predictive validity of the TAKS Math. The fact that TAKS Math predicts GPA uniquely, after controlling WPT (a g-loaded measure), suggests that the TAKS Math derives its predictive validity from non-g factors. These results, along with others (Coyle & Pillow, 2008), suggest that achievement tests derive their predictive validity partly from non-g factors.

The Relationship between Working Memory and Intelligence: New Insights from Executive Attention Theory

Organizers:
Randall W. Engle, Georgia Institute of Technology, randall.engle@psych.gatech.edu
Andrew R. A. Conway, Princeton University, aconway@princeton.edu

The executive attention theory of individual differences in working memory (Engle & Kane, 2004; Kane & Engle, 2002) is supported by a wealth of empirical evidence and is one of the leading accounts of the strong relationship between working memory capacity and intelligence. The purpose of the proposed symposium is to present a diverse set of new studies, each conducted from the perspective of executive attention theory, and to consider the implications of the results for contemporary views of intelligence. The new studies include: (1) a developmental investigation of children, (2) a large sample psychometric study on young adults, (3) an applied perspective on real-world job performance, and (4) a critique of the exciting new field of working memory training. Individual abstracts for each study are provided below.

The Development of Working Memory Capacity and Fluid Intelligence in Children

Pascale M. J. Engel de Abreu, Susan E. Gathercole, & Andrew R. A. Conway

A longitudinal study was conducted to investigate the relationship between working memory capacity and fluid intelligence and how this relationship develops in early childhood. The major aim was to determine which aspect of the working memory system – short-term storage or executive attention – drives the relationship with fluid intelligence. A sample of 119 children was followed from kindergarten to second grade and completed multiple assessments of short-term memory, working memory, and fluid intelligence. Latent growth curve modeling was employed to investigate the factor structure in each grade and to assess the stability of the factor structure over time. The data suggest that working memory, short-term memory, and fluid intelligence are highly related but separate constructs in young children and the factor structure among these constructs is invariant across time. The results further showed that when the common variance between working memory and short-term memory was controlled, the residual working memory factor revealed significant links with fluid intelligence whereas the residual short-term memory factor did not. These findings, consistent with previous research on young adults, suggest that executive attention, rather than the storage component of working memory, is the primary source of the relationship between working memory capacity and fluid intelligence.

The Role of Executive Attention in the Link between Working Memory Capacity and Fluid Intelligence

Thomas S. Redick, D. Zachary Hambrick, Michael J. Kane, Nash Unsworth, & Randall W. Engle

Abundant evidence from psychometric research suggests that working memory capacity is related to fluid intelligence. In addition, experimental studies have consistently shown a link between working memory capacity and attention control. However, relatively few studies have explicitly addressed whether attention control or other executive functions, such as updating, mediate the relationship between working memory capacity and fluid intelligence. To address this, we assessed working memory capacity, attention control, updating, and maintenance as separate predictors of fluid intelligence and multitasking in a diverse sample of 586 young adults. Hierarchical regression, confirmatory factor analysis, and structural equation modeling revealed several key findings. First, all of the constructs were strongly interrelated. Second, the predictor constructs each accounted for substantial variance in fluid intelligence and multitasking. Third, statistically controlling for other predictors attenuated but did not fully mediate the relationship between any one cognitive predictor and the fluid intelligence and multitasking criteria variables. The results suggest that attention control partially but not fully mediates the relationship between working memory capacity and fluid intelligence.

Working Memory Capacity in the Wild: Individual Differences in Geological Field Mapping

D. Zachary Hambrick, Julie Libarkin, Tara Rench, Sheldon Turner, Heather Petcovic, Caitlin Callahan, & Kathleen Baker

Working memory is thought to be an important contributor to individual differences in complex cognition but still little is known about its role in the sorts of tasks that people actually perform in the "wild" – in environments such as the workplace. The purpose of this project was to investigate the role of working memory in a task performed by geologists called *field mapping*. The goal of field mapping is to infer the geological structure of an area based on observable features, such as rock outcrops. Thus, field mapping is essentially a reasoning task. Our question was whether working memory capacity adds to the prediction of mapping success, after taking into account domain-relevant experience. Subjects completed standard working memory tasks, along with tests and questionnaires to assess mapping experience and geological knowledge. They then attempted to map a 400-acre region at the Indiana University geological field station, near Cardwell, Montana. Last summer, we tested 29 participants, ranging from novice to expert in mapping, and this summer we will test another 40. Initial analyses ($N = 29$) reveal strong relationships between mapping experience and expert ratings of map quality, as expected. However, independent of mapping experience, relationships between working memory capacity and map quality are consistently in the direction of higher map quality for individuals with high working memory capacity, and are similar in magnitude to correlations between working memory capacity and complex task performance in other domains (e.g., piano sight-reading).

Does Working Memory Training Improve Cognitive Ability and Fluid Intelligence?
Zachary M. Shipstead & Randall W. Engle

A relatively new line of research in cognitive psychology addresses the question of whether training working memory results in increased cognitive ability and improved fluid intelligence. Several studies now indicate that this style of training does lead to improved scores on untrained measures of working memory and according to some researchers this effect transfers to cognitive abilities that are associated with working memory, such as attention, learning potential, and fluid intelligence. Does the evidence really support such bold claims? It is our contention that, before this question can be answered affirmatively, several key concerns must be addressed. For instance, cognitive training studies tend to regard change on single test scores as change in cognitive constructs (e.g., change on Raven's Progressive Matrices is assumed to represent a change in fluid intelligence). However, this ignores the multiply determined nature of test scores, and the possibility that what is driving them may change over repeated administrations. Another area of concern regards the use of no-contact control groups that do not interact with the experimenters during the training period. This practice leads to concerns regarding Hawthorne effects and demand characteristics that may create artificial differences between control and experimental groups. It will only be after these issues have been addressed that we can confidently state that adaptive working memory training programs lead to improvements in cognitive ability and fluid intelligence.

Intellectual Giftedness: Mechanisms, Malleability and Manifestations

Moderator: Scott Barry Kaufman, Ph.D., New York University
Email: scott.barry.kaufman@nyu.edu

In the proposed symposium *Intellectual Giftedness: Mechanisms, Malleability and Manifestations*, speakers will present their ideas and research on various aspects of intellectual giftedness. Wendy Johnson will start off the symposium talking about intelligent/cultural performance in nonhuman animals, what it implies about intellectual performance in humans, and implications for conceptualizing talent as a manifestation of an extremely individualized culture. Next, Colin DeYoung will talk about the cognitive mechanisms that causally determine intellectual giftedness. After Colin, Paul O'Keefe and Carol Dweck will discuss the ways in which one thinks about one's own ability affects the ability displayed. Finally, John Protzko, Joshua Aronson, and Lindsay Juarez will address the extent to which intellectual giftedness is amenable to intervention. After all the talks, Scott Barry Kaufman will ask each of the speakers questions.

The Role of Cultural Platforms in the Manifestation of High Ability

Wendy Johnson,Centre for Cognitive Ageing and Cognitive Epidemiology and Department of Psychology, University of Edinburgh

There is increasing evidence that large-brained mammals besides humans display culture, and it is clear that their cultural displays augment their performance in ways that we as humans would recognize as manifestations of intelligence. Moreover, when exposed to human culture, in particular language, they can make spontaneous and creative use of it and pass their new skills to the next generation. These new skills can also inspire spontaneous changes in cooperative, empathetic, and problem-solving behaviours. In this talk I will highlight some examples of this in dolphins, chimpanzees, bonobos, and dogs. I will then argue that high intellectual ability in humans develops through access to a cultural 'platform' that provides a base of (usually specialized) knowledge beyond that available to most individuals in society, and through extensive effort in pursuit of complete mastery of this platform. I will argue that it is through this knowledge, in a process very similar to that displayed by nonhuman animals when given access to human language, that high-ability individuals develop insights and creative products that extend human knowledge, technical resources, and artistic endeavours in new directions. Our challenge, I contend, is thus to understand individual difference in ability in the context of inherent differences in intellectual capacity that can be displayed within quite a broad range by any of us, depending on not only the educational stimulation we receive but also the effort we put into seeking greater stimulation. The difference between geniuses and the rest of us is likely to be the sources of their inspiration to pursue their subjects and their energy to do so in spite often of missing out on positive social interactions and experiencing extreme social and even material discomfort because of them.

Intelligence, creativity, and insight: From individual differences to causal models

Colin G. DeYoung, University of Minnesota

Individual differences in intelligence have typically been investigated as a latent factor hierarchy with g at the top. The existence of a factor like g is often taken to imply a common cause of variation among lower-level traits. However, the nature of the cause of g remains ambiguous, in part because models of covariance structure do not allow conclusions about causal mechanisms at the level of the individual. What is needed is the development and testing of models specifying the causal mechanisms underlying intelligence. The possibilities for such a model range from the existence of a single simple mechanism underlying intelligence (e.g., neural conduction speed), to a lack of any common mechanism underlying g (i.e., causal heterogeneity, in which different people utilize completely different mechanisms to produce intelligent behavior). In between these two options are models in which, despite some causal heterogeneity, there are multiple mechanisms supporting intelligence that are present in every intact human brain. These seem most likely to be accurate. I discuss empirical attempts to identify such models, as well as attempts to extend this kind of model to the sources of creative cognitive abilities beyond standard intelligence.

Meaning and Achievement: The Self-Evaluative and Self-Protective Motives Elicited by Implicit Theories of Intelligence

Paul A. O'Keefe, *New York University*
Carol S. Dweck, *Stanford University*

The purpose of this presentation is to demonstrate how theories of intelligence (Dweck, 1999, Dweck & Leggett, 1988) elicit distinct self-evaluative and self-protective motives that influence preferences for remediation and defensiveness, and the development of competencies. An *incremental theory* refers to the belief that intelligence is malleable and improvable, leading to the adoption of achievement goals focused on learning and competency development (*learning goal*). Consequently, incremental theorists prefer to evaluate their performance accurately, even when it is poor, and exhibit remedial responses in the service of improving their abilities. An *entity theory*, in contrast, refers to the belief that intelligence is limited and fixed, leading to the adoption of goals focused on validating or demonstrating competencies relative to others (*performance goal*). Consequently, entity theorists are generally less concerned about accurately assessing their performance. Instead, they prefer to evaluate their performance in a self-enhancing manner by employing self-serving biases and downward social comparisons. Furthermore, when actual or predicted performance is unfavorable, entity theorists tend to self-protect by avoiding feedback and self-handicapping in order to maintain their self-image as competent individuals. Taken together, implicit theories of intelligence create meaning systems that determine remedial or defensive responses in achievement contexts. The motives elicited by an incremental theory contribute to the development of competencies, whereas those elicited by an entity theory are largely detrimental.

Can we become lastingly smarter?

John Protzko, Joshua Aronson, and Lindsay Juarez
New York University

Given its links with success in school and the workplace, most of us would like to improve our intelligence if we could. But can we? In this talk we discuss the research on the modifiability of intelligence. Although intelligence has been shown to be substantially genetic in origin, there are also substantial effects of the environment on both its expression and development. For example, poor children adopted into more well to do families will become substantially smarter than those raised under impoverished circumstances; exceptionally good teachers can raise the IQs of their students; and targeted early intervention programs like the Perry Pre-school program can measurably improve young children's mental abilities. On a societal level, steady secular gains on certain types of intelligence have been documented, suggesting that as cultures modernize, new demands on human cognition result in measurable mental improvements. Thus human intelligence is at least somewhat malleable. Yet a consistent theme in the literature is that IQ gains resulting from educational interventions are ephemeral; they typically fade once the intervention ends or the cognitive challenges abate. We will discuss the possible reasons for theses fade out effects, as well as the implications for programs designed to improve intelligence. A key insight from this research is that the mind is similar to a muscle in a very practical respect: for intelligence gains to be maintained, one needs regular cognitive exercise.

Challenges in Reporting Mainstream Science on Human Variation in Socially Important Traits: In Memoriam of Science Writer Constance Holden

Organizer: Linda S. Gottfredson

Writing accurately and effectively about human variation is a challenge when the differences in question are socially important and genetically influenced. Scientists who would report such evidence outside their narrow specialties are keenly aware of the challenge. They may be less aware, however, of the hurdles that journalists themselves face in writing with scientific fidelity on socially sensitive topics, not least of which is determining where fidelity lies.

This symposium honors a professional science writer who strove tenaciously to do so: Constance "Tancy" Holden, who wrote for *Science Magazine* until her untimely death earlier this year. The session will open with a testimonial to her passionate pursuit of the arts, from painting to communicating sound science.

A panel of three well-known journalists will then offer their insights into the demands and opportunities for reporting research and speculation on human diversity, either within or between human groups. All have addressed the topic to some extent in their own writings. Together, they represent decades of experience in traditional print media as well as internet publications.

Where appropriate, the presenters will point to challenges that journalists and scientists share when writing about "controversial" topics: judging the relevance and soundness of different types of evidence, assessing the credibility of sources making competing claims, vetting by editors of which content is fit for publication, and handling social and professional pressure to self-censor or otherwise redirect one's conclusions. They will also discuss how the two professions' differences in responsibilities and rewards, if not appreciated, can frustrate communication between scientists and science writers.

Finally, the panel will entertain questions on how the two sets of practitioners can help each other report more effectively on individual differences research that is vulnerable to misuse or misconstrual. We mourn the loss of a special individual who was interested in precisely that.

Research on the Biological Basis of Intelligence
Convenors Prof Con Stough (cstough@swin.edu.au) & Prof Tim Bates

This symposium is concerned with understanding the biological basis of intelligence. Over 5 papers, different researchers utilise many different approaches ranging from cardiovascular, genetic, psychopharmacology and nutrition to better understand relationships between biological processes and human intelligence and cognition. In the first presentation Prof Bates discusses new research on fluctuating asymmetry and intelligence. In the second presentation Prof Scholey discusses the role of gluco-regulatory processes in intelligence. Mathew Pase in the third presentation presents some new evidence linking arterial stiffness to individual differences in intelligence. The last two presentations are concerned with nootropics. In the first presentation Dr David Camfield presents an overview of nootropic and neutraceutical mechanisms that may be important for intelligence. In the second presentation Prof Con Stough discusses the results of some recent studies examining the effect of acute and chronic nootropic administrations on human intelligence. Biological and genetic mechanisms relevant to intelligence are highlighted throughout the symposium.

Fluctuating Asymmetry, Developmental Precision and Intelligence

Timothy C. Bates (1),(2) (tim.bates@ed.ac.uk), David Hope(1),(2), Alan J. Gow(1),(2), Alison Pattie(2), John M. Starr(1),(3), Ian J. Deary(1),(2)

(1) Centre for Cognitive Aging and Cognitive Epidemiology, University of Edinburgh
(2) Department of Psychology, University of Edinburgh
(3) Geriatric Medicine Unit, Royal Victoria Hospital, Edinburgh, UK

Greater fluctuating asymmetry (FA) is associated with lower intelligence. We tested three theorized causes of this association and propose a novel explanation. The standard developmental stability interpretation of FA assumes that symmetry reflects differences in the ability to maintain a species-typical developmental plan against environmental stress. This predicts that FA should show a main effect of stress, and an interaction of stress with differences in genetic resilience. We tested this prediction using paternal education as an index of environmental stress during development, but no main effects on FA or interactions of paternal education and FA on ability were found. A related hypothesis is that FA reflects resource availability during development. This was tested using height as a biomarker of developmental resource. Height was related to age-11 IQ, but not to FA. Controlling for height left the FA-IQ relationship unchanged. A third account, Hamilton's antagonistic pleiotropy hypothesis of aging suggests that traits such as FA which are associated with better ability during adolescence, may be associated with costs in old age. A similar direction and magnitude of effect size of FA on IQ from age 11 through age 87, however, failed to support this explanation. FA was unrelated to the specific cognitive functions of logical memory and a verbal fluency measure of executive function, and was also unrelated to cognitive changes within in old age. As a novel alternative hypothesis, we suggest that FA may reflect individual differences in the precision of the developmental blueprint rather than differences in buffering of a standard developmental plan. This suggests that general ability (but not memory) may partly depend on the precision of neuronal assembly. Genetic pathways affecting the precision of neuronal differentiation and migration may be candidates for general ability.

Effects of Individual Differences in Glucoregulation on Mental Performance with and without Nutritional Interventions

Andrew Scholey (ascholey@swin.edu.au), Lauren Owen, Anastasia Ossoukhova, Con Stough
Brain Sciences Institute, Swinburne University

The effects of glucose administration on mental capacity has been studied for several decades. As such it has offered a prototypical model for studying the effects of nutritional interventions on cognitive performance. There is good evidence that glucose administration can improve aspects of memory performance and other cognitive domains when the cognitive load is relatively high. This paper will briefly review this literature and present data regarding the extent to which cognitive 'domain' or 'demand' determine the strength of the phenomenon within a biologically plausible framework. Of particular interest to the field of intelligence research is the fact that there are a number of physiological individual differences which moderate the glucose enhancement effect and also performance in the absence of any nutritional load. These include physiological 'trait' variables such as insulin resistance, glucose tolerance and related measures. Recent data describing the moderating effects of morphology, thirst and stress will presented. Finally recent data from studies into the neurocognitive effects of herbal extracts with glucoregulatory properties (including ginseng, rosemary and others) will be presented.

Arterial Stiffness: An Important Predictor of Cognitive Performance in Mid-Life

Matthew P. Pase (MPASE@groupwise.swin.edu.au), Andrew Pipingas, Marni Kras, Karen Nolidin, Amy L. Gibbs, Keith A.Wesnes, Andrew B. Scholey, & Con Stough

Brain Sciences Institute, Swinburne University of Technology, Melbourne, Australia

Ageing is associated with a decline in fluid intelligence and a slowing of cognitive abilities. Although specific domains of cognitive performance are known to decline with increasing age, the underlying causes remain to be elucidated. Uncovering the mechanisms underpinning cognitive decline may help guide and tailor future interventions with the aim of preserving intelligence across the lifespan. The integrity of the cardiovascular system is emerging as a significant determinant of cognitive performance. As the human body ages there is an increase in the stiffness of the body's arteries. This increase in stiffness has recently been associated with cardiovascular disease, mortality and even cognitive performance. Although arterial stiffness predicts cognitive decline in cohorts with pre-existing cardiovascular disease, until recently, it was unclear whether healthy individuals were vulnerable to cognitive deficits as a result of age-associated increases in arterial stiffness. In a recent study, we examined the relationship between arterial stiffness and specific domains of cognitive performance in a healthy middle-aged sample. Based on previous findings, it was hypothesised that increased arterial stiffness would predict memory performance.

The sample comprised 92 healthy subjects, aged between 40 and 65 years, with no history of cardiovascular disease, diabetes, stroke, hypertension, smoking and were free from medication. The Cognitive Drug Research (CDR) computerized system was implemented to asses domains of cognitive performance whilst indices of arterial stiffness (pulse pressure and augmentation index) were determined centrally by a non-invasive SphygmoCor device.

Pulse pressure independently predicted both Episodic Secondary Memory performance (beta = - .27, *R2 change* = .07, $p < .05$) and Speed of Memory retrieval (beta = .24, *R2 change* = .06, $p < .05$). Augmentation index also independently predicted Speed of Memory retrieval (beta = .27, *R2 change* = .07, $p < .01$).Working Memory, Power of Attention and Continuity of Attention were neither predicted by pulse pressure nor augmentation index.

Arterial stiffness is an important determinant of memory performance in healthy middle-aged individuals. Reducing arterial stiffness in midlife may be one means of preserving intelligence in later life by protecting against age-associated cognitive decline.

Neutraceutical Nootropics

Dave Camfield (dcamfield@swin.edu.au), Andrew Scholey, Marni Kras and Con Stough
Brain Sciences Institute, Swinburne University

This presentation will focus on a current review of nutraceutical nootropiocs, natural substances that have the ability to bring about acute changes in attentional and memory processes through modulation of cholinergic function. Acute Nootropic agents are invaluable in times when enhanced concentration, focus and memory storage and retrieval processes are required. The current review will use an evidence-based approach to present a "short-list" of nutraceuticals which have demonstrated the most consistent and reliable effects in terms of acute cholinergic enhancement. The available safety data will also be summarized, together with pharmacokinetic and effective dosage information, so that an informed decision can be made as to the best candidates for supplementation strategies. Nutraceuticals reviewed included Huperzine A, Rhodiola Rosea, Schizandra Chinensis, Eleutherococcus Senticosus, Ginkgo Biloba and Bacopa Monieri.

Evaluating Nootropic and Nutraceuticals for Intelligence: Recent Studies

Con Stough (cstough@swin.edu.au), David Camfield, Marni Kras and Andrew Scholey

Cognitive enhancing substances such as amphetamine and modafinil have become popular in recent years to improve acute cognitive performance particularly in environments in which enhanced cognition or intelligence is required. Nutraceutical nootropics, which are natural substances that have the ability to bring about acute or chronic changes in cognition have also been gaining popularity in a range of settings and applications including the workplace, to improve exam performance and in the amelioration of age related cognitive decline. There are many unsubstantiated claims in this area. In this presentation we present an overview of nootropic and nutraceuticals for intelligence and cognition with specific reference to a number of acute and chronic recent trials conducted at the Brain Sciences Institute. Nootropics and nutraceuticals utilize a variety of pharmacological mechanisms to improve intelligence which may have important implications for our understanding of the biological basis of intelligence. These are described and hypotheses regarding efficacy and relevant mechanisms including potential genetic targets are presented.

PAPERS
AND
POSTERS

A genetically informed study of infant mental and motor predictors of kindergarten-aged achievement

Christopher R. Beam, University of Virginia, Charlottesville, VA, crb8v@virginia.edu
Eric Turkheimer, University of Virginia, Charlottesville, VA, ent3c@virginia.edu
David Grissmer, University of Virginia, Charlottesville, VA, grissmer@virginia.edu
David L. Fask, University of Virginia, Charlottesville, VA, fask@virginia.edu

Email correspondence to Christopher Beam at crb8v@virginia.edu

Prior research demonstrates that early cognitive ability predicts later achievement. Using individual participant data from the Early Childhood Longitudinal Study – Kindergarten Cohort (ECLS-K), Duncan, Dowsett, Claessens, Magnuson, Huston et al. (2007) showed that kindergarten math and reading ability significantly predicted 3rd grade math and reading achievement. Using the same sample from the ECLS-K, Grissmer, Grimm, Aiyer, Murrah, and Steele (in press) investigated the association between motor skills and cognitive ability. In their study, they regressed 5th grade math and reading achievement scores on math and reading ability *and* gross and fine motor skills assessed at kindergarten. They found that fine motor skills significantly predicted 5th grade math and reading ability above and beyond kindergarten math and reading ability, suggesting that complex cognitive ability partly results from early motor skill development. However, neither Duncan et al. (2007) nor Grissmer et al. (in press) considered the role of nonrandom genetic and shared environmental selection as possible confounds, inhibiting their ability to draw firm causal conclusions about the effects of early achievement and motor skills on later achievement.

The goal of the present study is to model the effect of infant mental and motor scores on kindergarten math and reading scores, statistically adjusting for nonrandom genetic and shared environmental selection effects. By taking into account nonrandom selection, we can test Grissmer et al.'s (in press) finding that early motor skills causally relate to later achievement. For this study, we used 750 pairs of twins (MZ = 200, DZ = 750) from the Early Childhood Longitudinal Study – Birth Cohort (ECLS-B). Twins' mental ability and motor skills were measured at 9 months of age on a reduced version of the Bailey Scales of Infant Development, and math and reading achievement scores were collected during kindergarten. Results from our analysis reveal a significant shared environmental correlation between 9-month mental scores and kindergarten math and reading ability. They also demonstrate significant genetic and shared environmental confounds between 9-month motor scores and both indices of kindergarten achievement. Lastly, our results indicate that non-shared environmental differences within twins' 9-month mental and motor ability accounts for a significant portion of the variance in kindergarten math and reading scores, even after accounting for these nonrandom selection effects.

Results from the ECLS-B twin sample support Grissmer et al.'s (in press) finding that early motor skills significantly predict later achievement. The present analysis also allows for firmer causal conclusions about the role of early motor skill development on kindergarten achievement, as our model explicitly accounts for nonrandom selection.

General Intelligence, Creativity, and Runaway Sexual Selection

Sacha Devine Brown sdbrown@email.arizona.edu
Kari Celeste Ross kross4@email.arizona.edu
Aurelio José Figueredo ajf@u.arizona.edu
Department of Psychology, University of Arizona, Tucson, Arizona
Ilanit Tal Young ital@unm.edu
Geoffrey F. Miller gfmiller@unm.edu
Department of Psychology, University of New Mexico, Albuquerque, New Mexico

Previous research indicates that intelligence and creativity are often correlated. Evolutionary psychological studies of mate preference suggest that women find both intelligence and creativity attractive in potential mates. Certain evolutionary psychological theories, such as Geoffrey Miller's (2000) Fitness Indicator Theory (FIT), predict that individuals will utilize observable signs of genetic quality (low mutation load) as a valid cue to assess mate value. Because both general intelligence and creativity are hypothesized to be fitness indicators, FIT provides a possible explanation for this observed correlation.

Another possible evolutionary explanation is that creativity conforms to Fisher's (1915) Runaway Sexual Selection Theory (RSST). RSST posits that when a trait with no obvious survival value is found sexually or socially attractive by a large proportion of the individuals within a breeding population, a "runaway" chain of events arises. Individuals with the attractive trait are more successful than others in mating as a result of this general preference, so the trait becomes more prevalent in the population over evolutionary time. Consequently, RSST predicts that the perception of, the preference for, and the prevalence of the trait itself within the population will be selected to covary positively with each other. The genes that influence the preference for the trait will become associated with the genes that influence the development of the trait through the mating of individuals possessing each. Consequently, the genes influencing the perception of the trait are necessary for those influencing the preference for the trait to be able to function, and should also be selected to covary positively with the others.

We tested the hypotheses that creativity conforms to this three-part criterion of RSST and that intelligence is associated with greater creative performance, preference for creativity, and ability to perceive creativity. General intelligence and the three aspects of creativity under investigation were evaluated in a sample of heterosexual female undergraduates. Factor-Analytic Structural Equations Modeling was used to examine the relationship between these four constructs. Greater creative performance, greater preference for creativity in a potential mate, and self-perception of creativity were in fact positively correlated, as predicted by RSST. While general intelligence was found to contribute to creative performance, it did not contribute significantly to either creative partner preference or creative self-perception, so it did not explain this observed three-way correlation as spurious. These results inform knowledge of the complicated evolutionary relationships that may exist between human intelligence, creativity, and mate preference.

White Matter Integrity and General Cognitive Performance: a Tract-based Spatial Statistics approach.

Burgaleta, M(1)., Stein, J.L.(2), Barysheva, M.(2), Lee, A.D.(2), Ho, A.(2), Martínez, K.(1), Colom, R.(1), Álvarez-Linera, J.(3), Thompson, P.M.(2)
(1). Faculty of Psychology, Universidad Autónoma de Madrid (Spain)
(2). Laboratory of Neuro Imaging, Dept. Neurology, UCLA School of Medicine, Los Angeles, CA (USA) · (3) RUBER International Hospital, Madrid (Spain)
Contact: miguel.burgaleta@uam.es

Diffusion Tensor Imaging (DTI) is a magnetic resonance imaging modality that allows the estimation of indices of white matter integrity (WMI; e.g., fractional anisotropy, FA). Some recent studies (Yu et al., 2008; Chiang et al., 2009; Penke et al., 2010) have related WMI to general cognitive performance, but only one of them (Chiang et al.) used a whole-brain, voxel-wise exploratory approach instead of studying a reduced number of tracts selected *a priori*. However, whole-brain DTI studies are affected by several well known problems, i.e. partial volume effects and arbitrary smoothing extent. The Tract-Based Spatial Statistics (TBSS; Smith et al., 2006) method is a robust alternative to traditional voxel-wise analyses that automatically extracts a group mean FA mask ("skeleton") representing the centers of the tracts across subjects. Further analyses are constrained to the skeleton, avoiding problems related to misalignment (especially relevant at the tracts' borders) and arbitrary smoothing (which is no longer necessary). In the present study, DTI was acquired in a sample of 102 normal subjects (44 men, 58 women, mean age = 19.83, SD = 1.64) to explore the relationships between WMI and cognitive performance. Diffusion tensors were computed from the diffusion-weighted images, and several scalar indices of WMI were obtained (FA; mean diffusivity, MD; axial diffusivity, AD; and radial diffusivity, RD). TBSS was applied to these images to obtain their skeletons. A total of nine cognitive tests were used to measure reasoning (Gf), verbal (Gc), and spatial intelligence (Gv). General performance scores were also obtained from PAF1. Statistical analyses were conducted using non-parametric inference, given the non-Gaussianity of the WMI scalars. Gc was significantly correlated with FA in females, but not in males, mainly in the splenium of the corpus callosum and in the right superior longitudinal fasciculus (corrected for multiple comparisons, P<0.05). Gf and FA were correlated in males, but not in females, in the right inferior fronto-occipital fasciculus (corrected for multiple comparisons, P<0.1). No significant correlations were found for MD, AD, and RD. Our results point to sex differences in brain structure and to the relevance of WMI for cognitive performance.

Hippocampal Structure and Human Cognition

Roberto Colom (1), Jason Stein (2), Priyanka Saharan (2), David Hermel (2), Juan Álvarez-Linera (3), Miguel Burgaleta (1), Kenia Martínez (1), Mª Ángeles Quiroga (4), Pei Chun Shih (1), Wang, Y. (2), & Paul Thompson (2)

 (1) Universidad Autónoma de Madrid
 (2) Laboratory of Neuro Imaging (LONI), UCLA School of Medicine, Los Angeles
 (3) Hospital Ruber Internacional
 (4) Universidad Complutense de Madrid
 Email: roberto.colom@uam.es

The hippocampus belongs to the limbic system and is involved in memory and spatial cognition. This brain structure is located inside the medial temporal lobe showing connections with the perirhinal, entorhinal and parahippocampal cortices. Here we apply a method for segmenting the hippocampus automatically in 3D T1-weighted structural brain MRI scans. The sample comprised 104 subjects (59 females and 45 males) with a mean age of 19.9 (SD = 1.6). Twenty one tests and tasks were administered for measuring fluid-abstract, crystallized-verbal, and spatial intelligence, along with working memory, updating, attention, and processing speed. In a training phase, the algorithm used 20 manually-traced segmentations to learn a classification rule for hippocampal versus non-hippocampal regions (reliability > .80). The remaining scans (N = 84) were submitted to a pipeline for automatic segmentation developed at the UCLA Laboratory of Neuroimaging (LONI) (Morra et al., 2009). Computed regional volumetric differences for the left and right hippocampus were related to the psychological measures of interest. After permutation tests corrected for multiple comparison ($p < .05$) the obtained probability maps showed several noteworthy results. First, significant complete group differences were found for spatial intelligence, spatial working memory, and a spatial version of the n back task. Second, for males the Progressive Matrices Test (APM) and the n back task correlated with structural differences in the left hippocampus. Third, females showed much more significant correlations than males in the following measures: general (g), fluid, crystallized, and spatial intelligence, along with memory span and updating. Finally, attention and processing speed were unrelated to hippocampal regional structural differences.

Response Time and Intelligence: Problems of Data Weighting and Averaging

Yury S. Dodonov
Moscow City University of Psychology and Education, ys.dodonov@gmail.com

Investigation of the relationships between ability measures and individual speed of processing is an important direction in intelligence studies. Different tasks designed to measure response time normally include a number of trials and thus the first step of data analysis is calculating of mean response times representing speed of task performance. However simple mean response time is not always an appropriate measure of central tendency as response times of each given individual mostly are not normally distributed and besides frequently contain so-called "outliers" which are regarded as artifacts in most of the studies. Thus data filtering traditionally includes deletion of all response times lying outside two standard deviations before averaging. Obviously there is no substantial basic for this method of data filtering; the term "outlier" itself is quite relative. One can never be sure that each particular response time is an outlier and should be deleted from the analysis. At the same time preferred method of dealing with outliers influences not only calculated values of mean response time but also magnitude of correlations between individual speed of performance and intelligence measures (RT-IQ correlations).

We use the results of our experiment to estimate possible change of RT-IQ correlations depending on the preferred way of data filtering and averaging. Verbal subtests of the Amthauer's Intelligence Structure Test (IST, N=204) and Raven's Advanced Progressive Matrices (APM, N=227) were used as intelligence tests. In our speeded task participants had to determine if the presented figure was a triangle or not. We used different thresholds for deleting outliers (from 0,5 to 2,5 standard deviations) and different measures of central tendency (arithmetic mean, median, geometric mean and harmonic mean) when calculated individual response time. RT-IQ correlations varied from -.110 (p=.119, ns) to -.168 (p=.017) for verbal scale of IST and from -.197 (p=.003) to -.229 (p=.001) for APM. Although the differences between exact correlation coefficients were not significant for both intelligence tests, correlations observed between response time measure and IST could be regarded as statistically significant or non-significant depending on the way of data filtering and averaging.

One of the ways to calculate central tendency taking into account all individual response times is data weighting. However simple weighting by standard deviation based on the assumed distribution again requires mean as entry information and thus may be biased because of the preferred measure of central tendency. The present study proposes an original method for calculating a measure of central tendency via scalar weighting which allows taking into account all data points and relatively weighting them with respect to the whole data array. Central tendency measure is calculated based on the derived data array, obtained by pairwise averaging of all data points with further weighting. Calculation of weighting coefficients is based on the following idea. Each data point is regarded as a unit vector angle ranging from 0 to 0.5 pi. Weighting coefficient for each averaged pair of data points is calculated as an absolute value of scalar product of the corresponding unit vectors.

Thus the proposed method of scalar weighting provides a central tendency measure taking into account each data point with respect to its distance from the majority of data. In our opinion this method could be useful for psychological studies as a unifying measure of central tendency, particularly for response time analysis or the analysis of other data sets containing possible "outliers".

Response Time in Two-Dimensional Mental Rotation Task:
Average and Individual Growth Trajectories

Yury S. Dodonov & Yulia A. Dodonova
Moscow City University of Psychology and Education, ys.dodonov@gmail.com

Mental rotation tasks are commonly used in recent studies on intelligence. Traditional two-dimensional mental rotation tasks are mostly constructed according to the description firstly provided by Cooper and Shepard (1973) and require the participants to determine if the rotated letter or digit is presented in normal or mirror reversed form. An assumption of mental rotation as a cognitive process underlying performance in this task is based on the observed increase in average response time with an increase in the degree of rotation of stimuli.

Although these relationships between the degree of rotation and response times are reported in many studies for average group data, patterns of individual data may vary greatly. This fact is shown in the Experiment 1 (N=84) for classical task of two-dimensional rotation of letters and digits. Analysis of individual trajectories of response time change with an increase in the degree of rotation revealed unsatisfactory correspondence with the hypothesis of monotonically increasing trend. One of the possible reasons for such lack of correspondence may lie in the construction of classical mental rotation task as it apparently requires a number of different cognitive processes. Participants not only rotate stimuli but also make a judgment concerning its normal or mirror-reversed form; this or some other additional processing required by the task may influence individual patterns of response time masking the real tendency. We modified classical two-dimensional mental rotation task trying to minimize influence of any additional cognitive processes. In the Experiment 2 (N=127) participants were presented with a rotated human hand (dorsal surface). Participants had to press left or right button depending on the hand appeared on the screen (left or right). Again individual trajectories of response time change with an increase in the degree of rotation were analyzed.

Principles of latent growth modeling were used for data analysis in the second experiment; such analysis allowed testing the hypothesis of similar trend of response time change with an increase in task complexity through individuals. Possible types of the function fitting the data in the best way are also discussed.

Finally latent intercept and latent slope obtained in growth curve modeling were analyzed in their relationships with intelligence measured by the subtest of Amthauer's Intelligence Structure Test (IST). Such analysis seems to be informative additionally to traditional estimation of the relationships between mean response time in mental rotation task and intelligence.

Speed of Shape and Color Discrimination as Related to Nonverbal Intelligence

Yulia A. Dodonova & Yury S. Dodonov

Moscow City University of Psychology and Education, ya.dodonova@mail.ru

The present study aimed to investigate the relationships between speed of stimuli discrimination and nonverbal intelligence. We focused on visual stimuli discrimination and designed series of speeded tasks requiring shape and color comparison. Nonverbal intelligence was measured via nonverbal subtests of the Amthauer's Intelligence Structure Test (IST), namely calculation tasks, number series, figure selection and tasks with cubes. The main questions of the study were the following:

(1) Are there significant relationships between latent Discrimination Time (DT), representing common variance for color and shape discrimination, and latent nonverbal intelligence? If yes, could it be explained via basic processing speed underlying both DT and intelligence? In other words, is latent DT related to latent nonverbal intelligence after controlling for basic speed of performance? Significant relationships between these latent variables could be discussed in terms of Spearman's hypothesis concerning general discrimination and general intelligence (1904) and its possible applicability to speed of processing in discrimination tasks.

(2) Do individuals with different nonverbal intelligence levels differ in speed of processing specific for the information concerning shape and color of the objects? Are color DT and shape DT related to nonverbal intelligence after controlling for general speed of discrimination? Moreover, do the observed relationships change when the task requires processing of shape and color at one time and are these effects of simultaneous processing related to intelligence level?

In the Experiment 1 (N=132) a basic model with two correlated latent variables (DT and nonverbal intelligence) was tested. The fit of this first model was not satisfactory, but the second model with two additional direct correlation paths between intelligence factor and unique variables for color DT and shape DT fitted the data well. Latent DT and nonverbal intelligence correlated significantly (r=-.295); however the correlation coefficient observed for latent nonverbal intelligence and the unique variable for shape DT was even higher (r=-.493). Highly intelligent individuals were generally faster than low intelligent individuals in speeded discrimination task, but besides they were faster specifically in processing of information concerning shape of the objects, although such relationships were not observed for processing of colors. Experiment 2 was designed to confirm these results and included series of shape and color discrimination tasks that provided information for the analysis of color DT and shape DT at latent level. Discussion concerns possible mechanisms for explanation of the observed differences in the speed of shape and color discrimination between individuals with different nonverbal intelligence levels.

Dynamics of Intelligence Test Scores and Educational Environment

Yulia A. Dodonova & Tatyana N. Tikhomirova
Institute of Psychology, Russian Academy of Sciences, ya.dodonova@mail.ru

The present study focused on the dynamics of child's intelligence test scores during the first year of school education. We aimed to specify factors of teacher's influence predictive to increase in test scores. The relationships between the dynamics of cognitive scores during the first year at school and further school achievement were also investigated.

Individual differences in intelligence were measured twice during an academic year (N=143). The first measurement was held in the beginning of the year as children just started their school education; the second testing was held at the end of the first year at school. Raven's Standard Progressive Matrices and the subtests of Wechsler's test namely Information, Vocabulary, Similarities, Comprehension and Arithmetic were used as intelligence scales. The magnitude of increase in test scores was calculated for each participant by simple subtraction of test score obtained in the beginning of the year from the corresponding value obtained at the end of the academic year.

Firstly the structure of intelligence test scores was analyzed separately for each testing. Exploratory factor analysis of intelligence test scores revealed the first factor accounting for 21% and 34% of variance in the beginning and in the end of the year respectively. This first unrotated factor was interpreted as g factor for each testing. We further followed an algorithm developed by Jensen and investigated if the observed change in intelligence scores can be attributed to g regarded as general intelligence. The observed correlation coefficient between the vector of mean g-loadings and the vector of standardized differences in test scores in the beginning and in the end of the year was 0.797 (p=0.057).

Elements of educational influence used by teachers with reference to each student were also measured via special questionnaire. Structural equation model with three factors of teacher's influence fitted the data satisfactory. These factors were named "Strict control", "Stimulation of development" and "Emotional support". Factor scores were calculated for each factor of teacher's influence and were used as predictors in multiple regression analysis with the magnitude of test score change as the dependent variable. As the relationships between the factors of teacher's influence and the dynamics of test scores were frequently curvilinear, both linear and quadratic components of each factor were included to the regression models. Dynamics of scores in Information and Similarities subtests was best predicted by factors of teacher's influence. We adopted Jensen's method to estimate the relationships between test g-loadings and the observed R-squared as the measure of teacher's influence on the increase in test scores. The correlation between two vectors was -0.280 (p=0.591).

Finally scores in intelligence tests as well as the measures of score change during the first academic year were used as predictors of further school achievement. Factors of teacher's influence mostly important for cognitive development and school achievement are also discussed.

Occupational Achievement as a Function of Information Processing Ability, Knowledge, Self Control and Race

Joseph F. Fagan(1)   and Cynthia R. Holland(2)
(1)Case Western Reserve University
(2)Cuyahoga Community College
jff@case.edu, cindy.holland@tri-c.edu

The present study examined the extent to which information processing ability, past knowledge, self control (corrected for socially desirable responding), and race interact to determine occupational success. Specifically, 422 employed adults with a mean age of 43 years, whose range of occupational status was representative of the general population, were given brief tests of knowledge of word meanings, sayings, similarities and analogies based on newly learned words and novel sayings to measure information processing ability. In addition to the tests of new learning, participants were also tested for their knowledge of word meanings, opposites, and analogies using items of the type given on the verbal section of the SAT. Each participant also filled out a brief, self report questionnaire to measure self control and a second scale to estimate the tendency to give socially desirable answers. In the present study, information processing ability, extent of past knowledge, self control (corrected for socially desirable responding) and race independently predicted occupational success. The ability to process information, self control, and race were each found to influence the extent of the verbal knowledge base predictive of occupational success. The ability to process information, however, was not influenced by self control or race. Self control was also independent of information processing ability and race. The present results suggest that racial differences in occupational success are not likely due to differences in basic information processing ability or in self control. They are to be sought in cultural differences in access to information.

Executive Functions, Emotional Intelligence, and Life History Strategy

Aurelio José Figueredo ajf@u.arizona.edu
Paul Robert Gladden pgladden@u.arizona.edu
Department of Psychology, University of Arizona, Tucson, Arizona

Previous research indicates that a slow Life History Strategy is positively correlated with both enhanced Executive Functions and increased Emotional Intelligence. However, the relation between Executive Functions and Emotional Intelligence had not previously been fully explored, especially in view of the common causal influence of Life History Strategy on both. A sample of 347 undergraduate students completed a packet of questionnaires including the following 3 major constructs: (1) The Arizona Life History Battery (*ALHB*) (Figueredo, 2007), including subscales for Insight, Planning, and Control, Mother and Father Relationship Quality, Family Support, Friends Support, Partner Attachment, General Altruism, and Religiosity; (2) the Behavioral Regulation Scales of the Behavior Rating Inventory of Executive Function - Adult version (*BRIEF-A*) (Gioia, Isquith, Retzlaff, & Espy, 2002) , including subscales for Emotional Control, Inhibiting, Self-Monitoring, and Shifting; the Trait Emotional Intelligence Questionnaire (*TEIQue-LF*) (Petrides, & Furnham, 2003), including subscales for Self-Esteem, Emotional Expression, Motivation, Emotional Regulation, Happiness, Empathy, Social Awareness, Deliberation, Emotional Perception, Stress Management, Emotion Management, Optimism, Relationships, Adaptability, and Assertiveness.

Simple unit-weighting was used to construct the theoretically-specified common factors (Gorsuch, 1983). We constructed a Life History factor, with loadings ranging from .40 to .83; an Executive Functions factor, with loadings ranging from .82 to .83; and (3) an Emotional Intelligence factor, with loadings ranging from .52 to .83. The Executive Functions factor was moderately correlated with the Life History factor ($r = .22, p < .0001$); the Emotional Intelligence factor was substantially correlated with both the Executive Functions factor ($r = .60, p < .0001$) and with the Life History factor ($r = .50, p < .0001$)

We compared two restricted path models to the saturated path model in which the Executive Functions Factor was causally influenced by the Life History Factor, and the Emotional Intelligence factor was causally influenced both by the Executive Functions Factor and by the Life History Factor. In the first of these two alternative restricted models, both the Executive Functions Factor the Emotional Intelligence factor were causally influenced by the Life History Factor, but neither of them directly influenced the other, modeling their relationship as purely spurious. In the second of these alternative restricted models, the Executive Functions Factor was causally influenced by the Life History Factor, and the Emotional Intelligence factor was causally influenced only by the Executive Functions Factor, with no additional direct effect by the Life History Factor, modeling the relationship between Life History and Emotional Intelligence as purely indirect and fully mediated by Executive Functions.

Neither of these alternative models was acceptable by either statistical or practical criteria of fit. Although Executive Functions make a very important contribution to Emotional Intelligence, they do not completely mediate the effect of Life History on Emotional Intelligence. Nor is the relation between Executive Functions and Emotional Intelligence completely spurious due to the common causal influence of Life History. The implications of these findings are discussed.

Educational effect on intelligence in a sample representative of School Population of Belo Horizonte - Brazil

Carmen E. Flores-Mendoza(1), Earl Hunt(2), Carlos G.M. Schlottfeldt(1) & Tara M. Madhyastha(2)
(1). Universidade Federal de Minas Gerais, Brazil
(2). The University of Washington, Seattle, USA
Corresponding author:
Av. Antônio Carlos, 6627. FAFICH – Depto. de Psicologia - Gab. 4042. Universidad Federal de Minas Gerais - Brazil.CEP: 31270-901, e-mail: carmencita@fafich.ufmg.br / carmencita@ufmg.br

There has been considerable research on the influence of schooling upon measures of intelligence. Studies during the first half of the twentieth century contrasted the test scores of children in communities that either did or did not have access to schools. Children who received schooling had higher test scores. However this research is ambiguous because of the difficulty of determining whether the communities themselves were equivalent in all ways except access to schools. More recent studies have made use of the fact that there is some variation in the age at which children begin school. For instance, if compulsory schooling begins for all children who are age 7 as of September 1st, children born in late august will be one year ahead of children born in early September. Studies using this design have also shown a positive effect of schooling on test scores. However these studies have made use of the Armed Forces Qualifying Test (AFQT). The AFQT is made up of subtests that evaluate skills explicitly taught in schools, such as language arts and mathematics. In our research 4th and 5th grade students in Belo Horizonte, Brazil, were administered the Raven Standard Progressive Matrices (RSPM) test, a widely used non-verbal marker of *g*. We constructed two samples that were exactly matched for age, but differed by one year in the amount of schooling received. RSPM scores were higher in the sample receiving more schooling. This indicates 'far transfer' of school training to the skills evaluated by the RSPM, even though these skills are not explicitly trained in school.

How to get really smart: Practice and Training Effects in ability testing using computer-generated figural matrix items

Ph. Alexander Freund (1), & Heinz Holling (2)

(1) University of Osnabrück, Germany, pfreund@uos.de
(2) University of Münster, Germany, holling@psy.uni-muenster.de
eMail: pfreund@uos.de

Intelligence is assumed to be a relatively stable construct. However, repeatedly taking an intelligence test leads to score gains and, at face value, to higher ability estimates. In addition to simple retest effects, training interventions can lead to even larger gains. The interpretation of score gains is problematic because they potentially induce a measurement bias and a predictive bias, impacting construct validity. In addition, their size differs as a function of various factors.

This paper investigates retest and training effects and the use of identical vs. parallel retest forms for figural matrix items. A total of $N = 189$ subjects are repeatedly tested (two times; pure power conditions) with matrix items that were automatically generated according to a strict construction rationale. Between test administrations, participants in the treatment groups receive a training intervention, while controls do not. Our results reveal a lack of Rasch model item parameter invariance across time points, indicating the existence of a measurement bias. We then use logistic regression methods in a multilevel framework to examine the effects of training and the use of identical vs. parallel test forms. We find that training leads to additional score gains above practice, but there is no large difference between identical and parallel test forms. We also find considerable between-person differences.

Our results clearly show that repeatedly taking an intelligence test makes it hard, if not actually impossible, to make meaningful comparisons between test scores. Since we can show that training and test familiarity lead to great score gains, it is even difficult to compare test scores from persons with and without prior experience. The paper accordingly outlines practical implications of these findings.

Ability, Achievement, and Elementary Cognitive Tasks

Meredith C. Frey (MFrey@Otterbein.edu)
Department of Psychology, Otterbein University

Luo, Thompson, and Detterman (2006) examined the predictive validity of what they call tasks of basic cognitive processes (TBCPs). They found that an aggregate performance measure from a battery of TBCPs correlated moderately ($r = .635$) with an index of achievement (Luo et al., 2006, p. 103). Furthermore, at least in some age groups, TBCPs explain more of the variance in scholastic achievement than is explained by fluid reasoning factors.

With this finding in mind, an attempt was made to examine the findings of Luo et al. in an older sample. Three elementary cognitive task (ECT) types with a total of 10 individual tasks, along with a computer-adapted short form of the Advanced Progressive Matrices, were administered to undergraduates at a non-selective private university. Transcript ACT data and achievement data (GPAs) were also obtained.

Initially, no significant relationship between speed on ECTs and general ability was evident for several of the tasks. However, when these correlations were examined within APM quartiles, interesting results emerged: in the highest ability groups the relationship between speed and general ability was moderate and indicated that higher ability participants actually took longer to complete ECTs.

The correlations between speed and achievement were also found to vary across ability levels. When examining all participants, the relationship between speed and academic achievement was generally non-significant; however, when participants were separated by ability quartile, some small but significant correlations emerged.

Differential use of peripheral stimuli in problem solving as a function of intelligence

E.V. Gavrilova, Institute of Psychology, Russian Academy of Sciences, g-gavrilova@mail.ru

G. Mendelsohn proposed that creative subjects are better able to use peripheral priming information to solve anagrams. According to C. Martindale creativity is linked to the ability to switch between focused and defocused attention. Recent studies suggest however that the ability to use peripheral information is rather a function of intelligence than of creativity. The present study aims to consider the relations of the intelligence with the ability to use peripheral information. We hypothesize that highly intelligent subjects will better use peripheral priming information in problem solving.

In our study 131 first-year students from psychological universities (mean age 19.5, S.D. = 1.7) were primed with nouns. All participants were divided into two groups depending on experimental conditions of information encoding (grounded on the theory of levels-of-processing by F. Craik and R. Fisher). The 1st group had to judge whether the pair of words rhymes or not (phonemic priming). The 2nd group had to make the decision whether the word belongs to the category "the city" or not (semantic priming). The lists of words presented for both experimental groups were identical.

After experimental priming participants had to produce as many rhymes to a list of new words as they could, and then they had to list as many cities as they were able to. Some words presented in the priming part of the study could be used as cues for the rhymes and cities generation. The verbal scale of Amthauer's intelligence test was used to measure the verbal intelligence. The creativity was measured with the Guilford test, the Mednick's RAT and the TCT-DP test (Urban-Jellen).

For all data we used regression analysis. No significant effect of creativity on the use of peripheral priming information neither by the rhymes generation (β = -0.071, p = 0.711; the total amount of generated rhymes was controlled) nor by the cities generation (β = 0.078, p = 0.576; the total amount of generated cities was controlled) has been discovered. For the intelligence there was a significant positive effect of the verbal intelligence on the use of peripheral priming information both in rhymes generation (β = 0.559, p = 0.014; the total amount of generated rhymes was controlled) and in cities generation (β = 0.4, p = 0.05; the total amount of generated cities was controlled).

These results support our hypothesis that intelligence is linked to the ability to use peripheral information in problem solving.

Testing for Cognitive Ability with Reduced Adverse Impact: Hiring in Work Organizations

Harold W. Goldstein, Baruch College-CUNY, harold.goldstein@baruch.cuny.edu (correspond)
Charles A. Scherbaum, Baruch College-CUNY, Charles.scherbaum@baruch.cuny.edu
Kenneth P. Yusko, Marymount University, Kenneth.Yusko@marymount.edu
Rachel Ryan, Baruch College-CUNY, rachelryan212@gmail.com
Paul J. Hanges, University of Maryland, hanges@psyc.umd.edu

Traditional assessments of general cognitive ability are widely used in personnel selection partially due to empirical research demonstrating that they predict job and training outcomes (Schmidt & Hunter, 1998). While such tests are lauded in terms of predictive validity, they have also been disparaged for differential performance outcomes for racial/ethnic groups (e.g., Whites typically outscore Blacks by 1 SD) (Hough, Oswald, & Ployhart, 2001). Although certain perspectives on intelligence such as the psychometric approach state that observed racial differences on such tests reflect the reality that Whites generally possess significantly more general cognitive ability than Blacks (Jensen, 1985; Spearman, 1927), others state that the racial differences observed in test scores depend on the manner in which general cognitive ability is defined and measured (Fagan, 2000; Fagan & Holland, 2002; Sternberg, 2006). The latter notion is supported by research findings showing that the size of racial differences in mean test scores varies depending on how intelligence is conceptualized (Fagan & Holland, 2002; 2007) and which measure is used to capture the construct (Naglieri, 2005; Wasserman & Becker, 2000). Such findings bolster an argument that conceptualizations of the construct of intelligence and characteristics of the cognitive ability measurement device contribute to the size of the mean-score differences observed and that alternative approaches to assessing general cognitive ability may demonstrate lower adverse impact for protected groups (e.g., Edwards & Arthur, 2007; Sternberg, 2006). Given the implications of racial differences on high-stakes tests involving general cognitive ability (e.g., Sackett, Schmitt, Ellingson, & Kabin, 2001), additional research aimed at developing such alternative approaches for measuring this construct is warranted. Several researchers have suggested that subgroup mean differences could be reduced by modifying certain elements of a traditional cognitive test to limit the extent to which test takers can rely on previously acquired information and knowledge (Fagan, 2000; Sternberg, 1981).

Drawing from these findings, the present research examines the Black-White differences and predictive validity of a nontraditional measure of cognitive ability that uses novel stimuli and tasks to reduce the reliance on previously acquired knowledge and information. Findings from five studies conducted in various work organizations (jobs included firefighter, deputy sheriff/ corrections officer, production operator, and intelligence analyst. Across these five studies, the test yielded significant uncorrected correlations with performance that ranged from 0.27 to 0.49. These studies were a mixture of concurrent and predictive designs and involved a range of different criteria including both on-the-job performance and learning criteria such as training academy grades. For each study, a traditional cognitive test of varying type (e.g., Wonderlic; mechanical ability test, reading comprehension test) was also administered for comparison purposes. In general, the new test performed as well as or better than such traditional tests in terms of predictive validity. In terms of racial differences, the new test consistently outperformed these standardized tests yielding Black-White mean differences that ranged from 0.20 to 0.40 SDs. These findings provide support that valid tests of intelligence can be developed for work organizations that show smaller subgroup differences than currently assumed. These results have positive implications for furthering the hiring of minorities.

Cognitive abilities of two-year college students in workforce preparation programs: Differential performance of technological and non-technological students in community and technical colleges

Darrell M. Hull, University of North Texas (Darrell.Hull@unt.edu)
A. Alexander Beaujean, Baylor University (Alex_Beaujean@baylor.edu)
Rebecca J. Glover, University of North Texas (Becky.Glover@unt.edu)

The present study examined individual differences in a variety of cognitive abilities (i.e., spatial, verbal, fluid, reaction time) of students (n=400) attending a two-year college. Initial results found that there were differences in technological students that pursue career-oriented (technician) programs at a two- year college when compared to their non-technological counterparts that are also seeking a two-year career education. In particular, technological students were found to have higher skills on psychometric spatial tasks and were more acute on the spatial reaction time task, but longer reaction times on the spatial retain time tasks than non-technological students. Mutivariate profile analyses tend to suggest that students may opt to pursue such programs based upon proclivities they possess that would permit them to be successful in careers for which they prepare.

Are *g* and the General Factor of Personality (GFP) correlated?

Paul Irwing, Tom Booth, Manchester Business School, Helmuth Nyborg, University of Aarhus, and J. Philippe Rushton, University of Western Ontario.
paul.irwing@mbs.ac.uk

Life history (LH) theory posits that clusters of correlated traits lie on a continuum. Fast strategies are hypothesized to evolve in harsh and unpredictable environments, while the reverse holds for slow strategies. Previous research has shown that a slow strategy correlates with law abidingingness, behavioural restraint, maturational delay and longevity. Diverse characteristics are predicted to correlate together as a suite of characteristics genetically organized to meet the trials of life: survival, growth and reproduction. LH theory has also predicted (and found) a general factor of personality (GFP), and the evidence for this is now substantial.

One outstanding issue is whether the GFP is related to the g factor of cognitive ability. There is reason going back to Spearman (1932; e.g., the work of Webb, 1915) to believe they are related. In this paper, we test this possibility using data from the Vietnam Experience Study which randomly sampled 4,462 Vietnam war veterans from a total sample of about five million Vietnam era army veterans. Exclusionary criteria included passing a fitness test, and achieving a final rank of no higher than sergeant, but otherwise the sample is representative of the US male population for the period 1965-1971.

We applied hierarchical confirmatory factor analysis to the Minnesota Multiphasic Personality Inventory and 15 cognitive ability tests. The MMPI yielded three first-order factors of Somatization, Internalizing and Externalizing, while the cognitive ability measures provided a fit to four first-order factors of Memory, Dexterity, Crystallized and Fluid intelligence. At the apex of both measures there was a general factor and we were able to fit a model which integrated both structures. This model provided a close fit to the data ($\chi2 = 3114.1$, df = 235, RMSEA = .052, SRMR = .047, NNFI = .97), and provided an estimate of -.23 for the correlation between the GFP and g. Possible explanations for the low correlation will be discussed including that intelligence and personality are largely mutually exclusive reproductive strategies, the first aimed at generating resources and the second at maximizing one's share of resources.

Ratio Scale Measurement of Mental Processes by Means of Mental Chronometry

Arthur R. Jensen
University of California, Berkeley (Emeritus)
Institute of Mental Chronometry

This presentation is based on CLOCKING THE MIND (CTM) by Arthur R. Jensen (Elsevier, 2006). Mental chronometry (MC) studies cognitive processes measured by time. MC provides an absolute, ratio scale. The limitations of instrumentation and statistical analysis, caused the early studies in MC to be eclipsed by the 'paper-and-pencil' tests of Binet (1905). The Binet-type tests had pragmatic utility, such as being able to predict scholastic performance. However, they use an age-normed, rather than a ratio scale, which severely limits the ability of IQ tests to probe the physical basis of differences in cognition.

For this reason Arthur Jensen reinitiated mental chronometry in the 1970s. He designed an apparatus that measures reaction time to a task known as the Hick paradigm that requires a testee to respond to a set of 1 to 8 lights.

Jensen demonstrated an increase in decision making time that is proportional to the number of lights from which the testee has to choose and that this variable correlates with 'paper-and-pencil' test scores. He was able to do this, where many other studies had failed, mainly because Jensen's apparatus clearly separated movement time (MT) from reaction time (RT, also called decision time). Interestingly, MT is not related to IQ, while RT clearly is. Principal components analysis reveals RT as a cognitive variable and MTas a motor variable. Failure to distinguish between them drastically obscures the correlation between RT and other cognitive variables.

When Jensen reviewed the literature on MC in 2006 in CTM, he found there was a shocking lack of standardization in administration, recording, and analysis in the field of mental chronometry. Consequently, the results from a study conducted at one lab, even when measured in absolute time, cannot be compared directly with those obtained in other studies. Termed 'method variance', this is a major obstacle to the advancement of the science of mental chronometry. (The poster presentation, the Jensen Mental Chronometer, provides a demonstration of this apparatus).

Global cortical thickness-based network efficiency is associated to rate of cognitive growth in developing children and adolescents.

Sherif Karama(1), Budhachandra Khundrakpam(1), Richard Haier(2), Ian Deary(3), Wendy Johnson(3), Gaolang Gong(1), Roberto Colom(4), Alan C Evans(1), Brain Development Cooperative Group(5)

1) Montreal Neurological Institute
2) UC Irvine
3) University of Edinburgh
4) Universidad Autónoma de Madrid
5) National Institute of Health, US

sherif.karama@mail.mcgill.ca

Evidence supporting an association between brain efficiency and intelligence has been accumulating for the last two decades or so (Haier, et al. 1988; Neubauer and Fink 2009). Recently, teams using graph-theoretical approaches have shown associations between various indices of brain network efficiency and measures of intellectual performance in the adult population (Li, et al. 2009; Neubauer, et al. 2005; van den Heuvel, et al. 2009). Here, we investigated large-scale anatomical networks using cortical thickness measurements as estimated by magnetic resonance imaging in a large longitudinal cohort of healthy children and adolescents (n=602 scans) aged between 6 and 18 years and representative of the US population. Cortical thickness-based network analysis was implemented using various processing steps that include using patterns of correlations between various cortical regions to make inferences on connection patterns and calculating global efficiency of the network by taking into account variables such as number of connections and ratio of long distance connections to short distance connections. As cortical thickness-based global efficiency can only be estimated at the group level, the sample was separated into different age as well as IQ-level groups. Measures of cortical thickness-based global network efficiency were calculated for these various age groups as well as for the various IQ-level groups. Results show an association trend between Full Scale IQ and global network efficiency (r=.3) but a much stronger association between rates of raw score improvement per year and global network efficiency for various Wechsler and Woodcock-Johnson III (WJ-III) subtests (with most correlations ranging between .6 and .8). Surprisingly, cortical thickness-based network efficiency tends to peak approximately between the ages of 8 and 10 years which corresponds, for most subtests, to the period of maximal mean rate of raw score improvement per year in this sample. Results can be interpreted as suggesting that global network efficiency is tied to cognitive ability via its relationship to cognitive growth.

Are We Really Overfactoring Modern Cognitive Tests? Test of a Hypothesis via Plausible Simulated Data

Timothy Keith, University of Texas at Austin, tim.keith@mail.utexas.edu
Matt Reynolds, University of Kansas, mreynolds@ku.edu

Recent research has shown an increase in the number of factors extracted from newer tests of cognitive ability compared to previous versions to such tests (Frazier & Youngstrom, 2007). These authors argued for the use of two methods for determining the number of factors in principal components and factor analysis: Horn's parallel analysis (HPA) and Minimum Average Partial analysis (MAP). In a series of analyses using these methods they extracted fewer factors for modern tests than those tests supposedly measure. In contrast, for older tests the number of factors were generally closer to the hypothesized number of factors. The authors suggested that publishers and researchers are overfactoring modern tests: finding more factors than actually exist.

We used a different approach to determine whether modern methods, especially confirmatory factor analysis, results in overfactoring, or whether a HPA or MAP approach would produce more accurate results. Our research asked whether, given a plausible factor structure (and the covariance matrix implied by that structure), will CFA recover the factor structure correctly? Will exploratory analysis using HPA or MAP? Plausible models with multiple first-order factors, two or more subtests per factor, and a higher-order g factor were used to generate implied variance/covariance matrices that were then factor analyzed using model comparisons in CFA and EFA with HPA and MAP. Preliminary analysis suggests that CFA is quite capable of recovering the correct factor structure (including the correct number of factors), and that the correct structure fits better than do other structures. In contrast, HPA and MAP often underestimated the correct number of factors. These findings suggest that modern tests are not being "overfactored," and that EFA approaches for discovering the correct number of factors may underestimate those factors, at least for cognitive ability data. We also argue for the importance of theory as a guide for such analyses.

Predictors of Mathematical Achievement: the nature of the association.

Yulia Kovas(1),(2),*, Maria Tosto(1), & Robert Plomin(2)
(1)Psychology Department, Goldsmiths College, London
(2)Social, Genetic and Developmental Psychiatry Centre, Institute of Psychiatry, UK
E-mail:
Yulia Kovas (*Corresponding author): y.kovas@gold.ac.uk
Maria Tosto: psp01mt@gold.ac.uk
Robert Plomin: robert.plomin@kcl.ac.uk

The nature of the relationships between mathematical ability/achievement and untaught spatial and numerical abilities remain poorly understood. We present the first genetically sensitive investigation into these relationships as part the Twins Early Development Study (TEDS).

In the first phase of the investigation we created and validated an on-line battery of mathematics-related tests suitable for 16-year-olds. Ninety-eight Sixth-Graders (16 year-old students) were individually tested with a battery of eleven tests administered via computer or in a pen and paper format. The tests assessed specific ability to approximate numerosity, numerical magnitude, non-verbal spatial memory, speed of processing, and a range of mathematical skills. A measure of the students' mathematical achievement, their GCSE maths grade, was also collected. Based on the analysis of these data, 7 out of 11 tests were deemed suitable for web-implementation and were assembled into an on-line battery. This battery was administered to the same sample of 98 students, as well as to 34 naïve 16 year-old students for test re-test reliability analyses and for validating on-line administration. In the second phase of the study the battery was administered to a large, representative sample of the TEDS twins, allowing us to examine aetiological links among the cognitive and achievement traits.

The tests administered in-person and their on-line adaptations showed good test-retest correlations, reliability and internal validity. Analyses of the relationships among the measures suggested that measures of speed of processing, visuo-spatial short-term working memory, and estimation of numerical magnitude were the best predictors of maths ability and achievement. The results of the quantitative genetic analyses from the twin study will also be presented, providing the first information on the aetiology of the individual differences in specific maths-related traits and their genetic and environmental links to mathematical achievement.

The findings of the study confirm that both general cognitive ability and specific numerical abilities contribute to mathematical achievement. Univariate and Multivariate genetic analyses reveal complex aetiology of the variance of each trait and of co-variance among the traits.

The Theory of Cognitive Acuity: Extending Psychophysics to the Measurement of Situational Judgment

J. Peter Leeds, Ph.D., Research Psychologist, peter.leeds@mspb.gov
U.S. Merit Systems Protection Board

This paper presents a Theory of Cognitive Acuity (TCA) as a means for understanding and measuring practical intelligence in the context of critical incident decision-making on situational judgment tests (SJT) using psychophysical underpinnings. Specifically, I borrow from the Weber-Fechner law of stimulus and response to propose a method for measuring cognitive acuity on SJT item response options while presenting an approach to more effective SJT item development. In TCA I define cognitive acuity as the capacity to discern correctness and distinguish between correctness differences among simultaneously presented situation-specific response options.

While true score theory focuses on tests scores as the unit of analyses, and item response theory emphasizes the test item as the unit of analysis, TCA examines the response options within items as the unit of analysis and attempts to explain the mechanisms by which response choices are made. TCA provides a method for developing SJT response options having strongly predicted response attractiveness and hence allows for variance optimization through judicious item response option composition. Further, TCA proposes measuring respondents' sensitivity to the absolute and contrasted correctness signals emitted by ambiguously correct (or valent) response options in a two-parameter model of signal detection. TCA states that a respondent's ability to select correct responses is based on 1) the respondent's level of signal sensitivity (i.e., cognitive acuity) and 2) the magnitude of that signal (measured as absolute or contrast correctness valence as estimated by subject matter experts). Where both are maximal, probability of correct response discernment (i.e., p value) is unity. Where both are minimal, p values will be chance or .5. The sign of the valence is assumed to be irrelevant and in the present study I show that a negatively valenced response option of a given magnitude is equally as discernable as a positively valenced response option of the same magnitude.

I applied TCA to two SJT data sets involving nurses (study 1) and security officers (study 2). In Study 1, SJT response option p values (N = 72) were predicted by response valence contrast (r = .75) and absolute valence level (R increment = .80). Subject matter expert agreement as to valence level was shown to moderate the valence-p value relationship.
In addition to replicating the finding of study 1, Study 2 showed that, consistent with the Weber-Fechner law, the relation between sensation (i.e., valence signal detection as measured by p) is strongly logarithmically related to stimulus (i. e., response option valence magnitude) with R square = .82. Using this function, it was possible to estimate SJT respondents' level of cognitive acuity. I used the obtained logarithmic formula, $p = b_0 + (b_1 * \ln(valence))$ to estimate the function-determined p value (or *functional p)* associated with each of the 11 signal valence magnitudes (ranging between .1666 and 2 on a ± 2 valence scale) found among the 415 response options distributed among 53 SJT items. An *observed p* value was computed for each respondent (N = 146) on each of the 11 valence levels. The degree to which each respondents' *observed p* was above or below (errors) the *functional p* served as a measure cognitive acuity. Critical incident management ratings obtained from respondents immediate supervisors were regressed on these acuity scores. In a concurrent criterion validation study, results show that acuity scores contributed incrementally to both traditional dichotomous scoring and valence-weighted SJT scoring methods. Implications are discussed for measuring acuity and SJT item construction.

Scoring Emotional Intelligence Tests Using Profile Similarity Metrics

Peter Legree(1), Dan Putka(2), Richard Roberts(3) and Joe Psotka(1)
(1)U.S. Army Research Institute, (2)Human Resources Research Organization, (3)ETS
Pete.Legree@us.army.mil

Measures of emotional intelligence and tacit knowledge often present examinees with scenarios, and then ask examinees to rate potential options for addressing those scenarios on a common Likert scale. Scoring rubrics for EI and TK measures are often developed by surveying experts and using their mean ratings to specify scoring keys (cf. Wagner & Sternberg, 1985; Mayer, Caruso, Salovey & Gill, 2003). Distance scores, endorsement ratios and other metrics of absolute profile similarity have then been used to compute an overall score that reflects the level of absolute agreement between examinee ratings and the scoring key across items.

One limitation of this scoring approach is that measures of absolute agreement may confound meaningful differences between examinees and experts with potentially irrelevant examinee response rating tendencies. For example, an examinee may achieve a poor overall score if the individual tends to rate all the options highly (or lowly), even if the examinee's item ratings are highly correlated with the scoring key (i.e., the mean expert item ratings). Previous analyses of EI and TK test data have not investigated these potential confounding effects. In this session, we mathematically decompose measures of absolute agreement (distance) into measures of association (correlation), elevation (respondent rating mean) and dispersion (respondent rating standard deviation). We then explore implications of these confounding effects on the construct validity evidence for the MSCEIT.

In the current study, we model MSCEIT subscale scores (which are based on absolute profile agreement) to assess the degree to which they are saturated with variance reflecting individual differences in response tendencies. Most of the variance in the eight MSCEIT subtest scores can be accounted for using metrics based on association (correlation), elevation and dispersion ($R2$ ranged from .73 to .93). However, the regression analyses also show that the four MSCEIT subscales underlying the *MSCEIT Experiential Factor* primarily reflect individual differences in elevation and dispersion, while the four subscales that form the *MSCEIT Strategic Factor* primarily reflect individual differences in association (i.e., correlations between the individual respondent rating profiles and the expert key). In fact, when elevation and dispersion effects are removed from MSCEIT subscale scores, no clear evidence for the MSCEIT Experiential and Strategic factors emerged. Therefore, the view that the experiential and strategic factors are driven by substantive content, as opposed to method effects, may be incorrect. Discussion and further analyses focus on the implications of these findings for construct validity evidence for measures of EI and TK.

The intelligence - word frequency interaction effects for word and pseudoword stimuli in lexical decision task

Ekaterina Lapteva, Institute of Psychology of Russian Academy of Science,
ek.lapteva@gmail.com

The aim of the study was to examine influence of intelligence on word frequency effects in lexical decision task (LDT). An experiment was constructed according to the following premises of the model of parallel letter recognition in reading: there are three factors that determine performance in word recognition: 1) number of relevant features of a word, 2) word frequency, 3) intelligence.

One hundred and eighty subjects (50% female, mean age 15.3, SD=0.95) performed a LDT on 30 words and 30 pseudowords made up of the real words by replacement of one letter. Stimuli were 5-7 letters length. Frequency (high vs. low) and type of stimuli (word vs. pseudoword) were varied. The task was to distinguish if the stimulus was a real word as fast and accurate as it was possible.

Standard Progressive Matrices and verbal subscale of Amthauer's IST were used to measure intelligence. The mean z-score of both tests was used as general IQ score. The 3 levels of intelligence were defined on the basis of 33 and 67 percentiles of IQ score. For LDT performance, the mean overall accuracy, mean accuracy and reaction time (RT) in each condition, differences in accuracy and difference in RT between low- and high-frequency words and pseudowords were registered. Only the cases with mean overall accuracy higher than 75% were used for analysis. High intelligence is supposed to be related to better performance in ambigious cases: for low-frequency words and pseudowords made up of high-frequency words.

The two three-way ANOVAs for repeated measures were computed with RT and accuracy as dependent variable respectively. In both analyses frequency (low vs. high) and type of stimuli (word vs. pseudoword) were taken as within-subjects factors; level of intelligence was taken as a between-subjects factor.

The main effects of frequency and type of stimuli were significant both for RT or for accuracy: high-frequency words compared to low-frequency ones, words compared to pseudowords were recognized faster and more accurately. Besides that, the threefold interactions between frequency, type of stimuli and intelligence factors were revealed. In general, higher intelligence is characterized by smaller difference between accuracy for high- and low- frequency words as the accuracy for low-frequency words increases with intelligence. With respect to pseudowords we can see the opposite effect: the difference in accuracy for high- and low-frequency words increases with intelligence level. This effect is due to accuracy increase for high-frequency pseudowords as a function of intelligence. The difference between RT for high-frequency and low-frequency words grows with increase of intelligence. This is because of both decrease in RT's for high-frequency words and increase of RT's for low-frequency words on the higher level of intelligence. Such effect was not revealed for pseudowords.

According to our model, the response in LDT appears if the activation of appropriate node of a semantic network reaches its threshold. If a node is characterized by high but still subliminal level of activation, cognitive system gives it some extra time to increase (or not to increase) the activation till its threshold level. Thus, people with high intelligence are at an advantage in RT's for high-frequency stimuli and also they are more accurate but slower when processing the low-frequency stimuli. An alternative explanation of observed phenomena is metacognitive strategies.

The Dynamic Relationship Between Health and Cognition: Findings From the Seattle Longitudinal Study

Tara Madhyastha(1),(3) (madhyt@uw.edu), Sherry L Willis(1), Paul R. Borghesani(1),(3), Anne Richards(1),(3), Elizabeth H. Aylward(2), K. Warner Schaie(1)
Departments of (1)Psychiatry and Behavioral Sciences, University of Washington School of Medicine, Seattle WA, USA
(2)Center for Integrated Brain Research (CIBR), Seattle Children's Research Institute, Seattle WA, USA
(3)Integrated Brain Imaging Center, University of Washington Medical Center, Seattle WA, USA

A strong association exists between intelligence and health, and both factors have been found to be predictors of longevity.   Many potential explanations for this association have been proposed. The directionality of the relationship between change in health and change in cognition is debated and it is quite possible that the dynamics of these relationships changes throughout the lifespan. For example, greater childhood intelligence associated with higher education might lead to developing knowledge of successful health behaviors. However, a person affected by vascular disease may experience a decline in memory caused by the disease process. Using data from the Seattle Longitudinal Study, a cohort sequential study begun in 1956, we model the relationship between health, as indexed by a sum of diagnosed vascular diseases (hypertension, diabetes, cardiovascular disease), and three abilities (memory, executive function, and perceptual speed) using a bivariate dual change model. Our emphasis is on ages 53-74, with four occasions of assessment. This series of models allows us to test hypotheses about whether change in health precedes change in cognition or vice versa.

We find that for each of the three cognitive domains, change in cognition precedes changes in the number of disease diagnoses. Controlling for gender, education, and smoking behavior does not change this dynamic association. However, body mass index is a significant predictor of midlife vascular disease, and controlling for BMI at each measurement occasion results in the dynamic link between cognition and health to become insignificant in all models except for perceptual speed. The dynamic relationships are identical in earlier born and later born cohorts, and in midlife and in old age.

Cognitive decline may occur during the preclinical phase of a disease prior to disease diagnosis. Factors such as BMI would serve as predictors during this preclinical disease phase. This would support the theory that intelligence may be linked to health dynamically in midlife to old age through practice of healthful behaviors and early treatment of chronic vascular conditions.

Creative achievement, intelligence, and personality

Guy Madison(3), Örjan de Manzano(1), Patrik Magnusson(2), Nancy L. Pedersen(2), and Fredrik Ullén(1)

(1)Dept of Women's and Children's Health and Stockholm Brain Institute, Karolinska Institutet;
(2)Dept of Medical Epidemiology and Biostatistics, Karolinska Institutet
 (3)Dept of Psychology, Umeå University.

Real life creative achievement is related to a large set of variables, each of which typically predicts only a small proportion of the total inter-individual variance in creative output 1-3. These variables include properties of the individual (abilities, personality traits etc) as well as numerous environmental factors.

Here, we explored associations between creative achievement, intelligence and personality in two samples. Sample 1 included 153 individuals (age 18-47 yrs) for whom intelligence was measured with either the Wiener Matrizen Test (WMT) or the Raven SPM Plus; personality was measured using NEO PI-R, and creative achievement using a newly developed Creative Achievement Questionnaire (CAQ). The CAQ , which is a Swedish adaptation and development of similar questionnaires from Carson and coworkers, measures actual achievement in seven domains (Visual arts and design; Music; Dance; Writing; Invention; Science and research; and Theater and acting). Activity in each domain is self-rated on a scale from 0 (no involvement) to 6 (professionally active and nationally or internationally recognized); estimates of number of produced works in each domain are also recorded. Sample 2 consisted of a cohort of twins (age 50-65 yrs) in which the WMT and the CAQ were administered over the Internet. We present preliminary analyses based on 2360 twin individuals.

Intelligence was positively correlated to Creativity in Science (Sample 1: $r = .22$, p =.01; Sample 2: $r = .22$, p = .000) and Invention (Sample 1: $r = .17$, p = .04 ; Sample 2: $r = .11$, p = .000). A weaker correlation was found between intelligence and creativity in music (Sample 1: r =.13, n.s.; Sample 2: $r = .11$, p = .000). For the visual arts, dance, writing and theater, correlations with intelligence were very weak (r values < .1) or non-significant in both samples. However, significant correlations were found between intelligence and creative versatility, operationalized as the number of domains in which the participant was active (Sample 1: $r = .19$, p =.02; Sample 2: $r = .14$, p = .000). Among personality traits (Sample 1 only), Openness showed positive relations with creativity in all domains (r values between .08 and .27) as well as with creative versatility (r =.28, p = .004). Neuroticism had negative correlations with creativity in science ($r = -.19$, p = .055), creativity in invention ($r = -.37$, p = .000), and with creative versatility ($r = -.23$, p = .000). Multiple regressions showed that intelligence, openness, and stability (low neuroticism) together explained 19% of the variance in creativity for invention , and 16% for science.

These preliminary analyses show that intelligence as well as the Big Five personality traits have substantial correlations with real-life creative output. Intelligence has strongest correlations with creativity in science and invention, as well as with creative versatility. Further analyses will focus on genetic and non-genetic components of creative achievement and its associations with intelligence and personality.

The dependability of the general factor of intelligence: Why *g* is not a first principal component

Jason T. Major (The University of Edinburgh), Wendy Johnson (The University of Edinburgh), Thomas J. Bouchard Jr. (University of Minnesota)
Emails: J.T.Major@sms.ed.ac.uk (correspondence email), Wendy.Johnson@ed.ac.uk, Bouch001@umn.edu

In a replication of a psychometric study by Floyd, Shands, Rafael, Bergeron & McGrew (2009), generalizability theory was used to isolate and compare three different sources of error in general-factor loadings: the test battery size, test battery composition, factor-extraction technique, and their interactions. Subtests from the Minnesota Study of Twins Reared Apart (MISTRA) were randomly selected to form independent and overlapping batteries of 2, 4 and 8 tests in size. Eight "probe" tests were then inserted into each of the batteries, and principal components analysis, principal factors analysis and maximum likelihood estimation were used to obtain their general-factor loadings. Results of the generalizability theory analysis initially indicated that the general-factor loadings were more dependable than in Floyd et al. (2009), but subsequent examination revealed this outcome to be largely a function of the greater diversity of probe tests selected in the present study. As in Floyd et al. (2009) the characteristics of the probe tests constituted the largest source of variance in general-factor loadings, followed by the effects of psychometric sampling, the factor-extraction method and test battery size. Our interpretation of these results differs from that by Floyd et al. (2009), however, in consideration of the standard errors of the factor loadings, and the correlation of general-factor scores to those for an estimated "true *g*". These indices demonstrate that general-factors from small non-hierarchical test batteries are not accurate enough estimates of *g* for the purposes of theoretical research, in particular when they are derived from principal components analysis.

Political orientations, religiosity and their relationship with intelligence/education in a Brazilian sample.

Marcela Mansur-Alves(1), Carmen E. Flores-Mendoza(1), Heiner Rindermann(2), & Michael A. Woodley(3)

1. Universidade Federal de Minas Gerais, Brazil
2. Chemnitz University of Technology, Germany
3. School of Biological Sciences, Royal Holloway, University of London, UK

Corresponding author:
Av. Antônio Carlos, 6627. FAFICH – Depto. de Psicologia - Gab. 4042. Universidad Federal de Minas Gerais - Brazil.CEP: 31270-901, e-mail: marcelamansuralves@yahoo.com.br

Social sciences have assumed an effect of education on citizens' political orientation and behavior of religiosity. On the other hand, several studies have also shown an impact of intelligence. If intelligence is a burgher (middle-class, civil) phenomenon by its support to civil attitudes, habits and norms like diligence, order and liberty, then political orientations and degree of religious belief should be related to intelligence. That means: More intelligent people tend to have less extreme political orientations. Their affinity is with center positions. In addition, more intelligent people tend to be less religious. In a Brazilian sample (N=586) persons were given the SPM and a questionnaire measuring age, sex/gender, income, education, political orientations, and level of religiosity. High IQ was found for center-right followed by center category, even after correcting for gender, age, education and income. In a path-analysis predicting center (vs. extreme) political orientation only intelligence (depending on education) had a positive impact on political centrality, while education led directly more to the wings. The same direction is found for religiosity. The results are discussed on the background of different theoretical models assuming an intelligence-politics-religiosity-relationship.

Intelligence and the Resting Brain

Kenia Martínez (1), Ana Beatriz Solana (2), Miguel Burgaleta (1), Juan Antonio Hernández-Tamames (2,3,4), Juan Álvarez-Linera (4), Mª Ángeles Quiroga (5), Roberto Colom (1)

(1)   Universidad Autónoma de Madrid (2) Centro de Tecnología Biomédica -Universidad Politécnica de Madrid, (3) Universidad Rey Juan Carlos de Madrid, (4) Fundación CIEN-Fundación Reina Sofía, (5) Universidad Complutense de Madrid

kenia.martinez.r@gmail.com

Neuroimaging studies provide evidence for a fronto –parietal network relevant for intelligence and several cognitive functions. Recently, spontaneous brain activity at rest has been related to individual differences in intelligence. Frontal and parietal areas show the greatest local connectivity efficiency in high IQ people. Here the relationship between individual differences in intelligence and the efficiency of independent functional brain subsystems or automatically connected brain networks at rest is analyzed. The consistency and stability of these brain networks taken into account intelligence differences and videogames training are also studied. The sample comprised twenty females who completed a battery of four reasoning tests (DAT-AR, DAT-VR, DAT-SR and APM) and they were submitted to a 6 min resting-state fMRI in a 3T MR scanner in two blocks (intelligence measures – rsfMRI scan) separated by four weeks. Between these blocks, ten females (experimental group) were trained on a pack of reasoning puzzles (Professor Layton 2 by Nintendo). In order to control for retest effects, performance of the experimental group was compared with the remaining females (control group). A positive relationship between intelligence and efficiency at the puzzles was observed. Further, high IQ females showed greater intelligence gains at the posttest. A group independent component analysis (GICA) using multi-session temporal concatenation of pre-post rsfMRI for all the scans was computed in MELODIC-FSL. After visual identification of the independent components representing real functional subsystems, we applied a dual-regression algorithm to obtain the individual spatial maps related to those functional subsystems. Note that we obtain two spatial maps for each female (pre and post rsfMRI scans). Finally, we obtained the overall connectivity scores per subnetwork and block (pre – post) for each subject. These scores were related to intelligence measurements and used to study how the training in a cognitive task interacts with intelligence to modify the consistency and stability of functional connectivity efficiency.

The Jensen Mental Chronometer

Frank Miele

Institute of Mental Chronometry

As described in the presentation, "Ratio Scale Measurement of Mental Processes by Means of Mental Chronometry," any advance in Mental Chronometry (MC) required the construction of a new apparatus that would eliminate the numerous sources of method variance. Consequently, Arthur Jensen commissioned a major electronics firm to construct a Mental Chronometer, a standardized apparatus to administer, record, analyze, and archive experiments in MC. The test administration portion of the apparatus provides a uniform stimulus panel and a uniform response panel, thus ensuring comparability of measurements by eliminating any method variance. Like Jensen's original device, it clearly separates cognitive decision making time (RT) and motor movement time (MT). Surprisingly, this is still not done in all mental chronometry experiments, despite the well documented differences between the two measures.

Since the R&D to build such an apparatus is beyond the means of most laboratories, once produced and thoroughly tested, the Institute of Mental Chronometry (IMC) will sell, lease, and, in some cases, donate their Mental Chronometer, IMC/MC, to behavioral science departments in colleges and universities, medical schools, and research institutes in the U.S. and around the world. Further, IMC will solicit proposals for both basic and applied research grants that will use the IMC/MC in approved projects. IMC will review proposals and possibly provide funding for the researchers as well as instrumentation for the duration of the project.

To that end, in the near term, all devices that ATSI produces will be produced for IMC, which will distribute them as described.

Tests include Binary Reaction Time, Choice Reaction Time, Inspection Time, and the Odd-Man-Out (OMO) Test. (For a complete and detailed list of test paradigms, see CTM, pp. 20-39). Statistics: Mean, median, range, standard deviation, and the Mean Square Successive Difference (MSSD or von Neumann ratio, which separates any systematic linear trend from random variation over successive trials; CTM, p. 67, 124), as well as factor analysis and principal components analysis (the latter providing mathematically exact numerical results uninfluenced by the researcher's interpretation). The MSSD statistic is far less used in behavioral science research than it should be as is Principal Components Analysis (PCA) relative to Factor Analysis. Again, by providing PCA as part of the JMC it further standardizes the reporting of research results.

Data Storage and Internet Archiving: Storage of test results by subject, mental chronometry test, and trial, ID number to maintain privacy, subject demographic variables (such as age, sex, ethnicity, IQ, GPA, SES, medical conditions, medication). Each data set can transmitted to an IMC master data base for cooperative research.

The Accuracy of Intelligence Judgments: Stranger Ratings of Photographs

Lyndsay Nelson1, Rose Mary Webb1, April Bleske-Rechek(2)
(1)Appalachian State University
(2)University of Wisconsin-Eau Claire
nelsonla@appstate.edu, webbrm@appstate.edu, bleskeal@uwec.edu

From an evolutionary perspective, the detection of an individual's intellect may serve an adaptive function for reproductive success and survival. The current study examines the accuracy of intelligence judgments based only on physical appearance, specifically still photographs. Although this idea was pursued in the early twentieth century, with mixed results (e.g., Anderson, 1921; Cook, 1939; Gaskill, Fenton, & Porter, 1927; Markey, 1934), this area of study has been largely neglected since that time. Rather, short video or audio segments of targets have been used more recently for judging this construct. Only one recent study has documented above chance accuracy in strangers judgments of intelligence (Zebrowitz et al., 2002).

The current investigation examines the accuracy of judgments of intelligence completed by strangers based on facial photographs. Participants include 166 targets who self-reported both objective and subjective indicators of intellect and 166 friends of the targets who served as knowledgeable "others" rating the intellect of the targets. Finally, photographs of the targets were viewed by 166 "strangers" who rated the intellect of the targets in both objective and subjective terms.

Objective measures of intelligence included the targets' self-reported SAT scores and grade point averages and stranger estimates of those indicators. Frey and Detterman (2004) concluded that SAT scores are a sufficient measure for general intelligence by demonstrating a correlation of .82 between the two measures. Furthermore, past research has provided support for the use of self-reports of these measures for intelligence assessment by documenting correlations of .97 between self-reported and actual GPAs and .88 for SAT scores (Cassady, 2001). We hypothesize that the strangers' estimates of these indicators of intellect will be positively correlated with targets' self-reported scores.

Additionally, intelligence was assessed in a more subjective manner using an intellect scale from the International Personality Item Pool (IPIP, Goldberg et al., 2006), completed by targets, friends, and strangers. Self-reported intellect scores serve as the first criterion for evaluating the accuracy of stranger ratings of intellect. Further, because self-reports are a limited criterion (Kolar, Funder, & Colvin, 1996), ratings of intellect completed by the friends of the targets serve as a second criterion variable. Positive correlations are hypothesized between stranger ratings and both criterion variables.

The current study contributes to an understanding of human intelligence by illuminating the relationship between actual and perceived intelligence. It extends the current literature in multiple ways. First, it includes both objective and subjective measures of intelligence. Second, whereas prior studies have not sufficiently controlled for potential prior acquaintance of the targets and judges, the current investigation limits this bias by utilizing a two-campus approach. Finally, reliance upon two criterion variables—self-reported and knowledgeable other-reported constructs—provides an opportunity for deeper examination of the convergence between various perceptions of intellect.

Time-saving from acceleration and the effect on STEM productivity in adulthood

Gregory Park, David Lubinski, Camilla P. Benbow
Vanderbilt University
greg.park@vanderbilt.edu, david.lubinski@vanderbilt.edu, camilla.benbow@vanderbilt.edu

Students who learn at rapid rates can benefit greatly from educational acceleration such as grade-skipping, a widely used intervention offered to intellectually precocious adolescents in order to place them in developmentally appropriate learning environments (Benbow & Stanley, 1996; Stanley, 2000). Beyond the positive effects on educational achievement, socio-emotional status, and self-esteem, for years educational acceleration has been suggested as a mechanism that can increase adult productivity, by decreasing the time spent in training at a critical period in early adulthood (Pressey, 1949; Seashore, 1922; Terman, 1954). This hypothesis is tested using data from a longitudinal study of mathematically precocious students (in the top 1% of ability) and propensity score matching to create balanced comparison groups. These students (N=895) were identified by age 13 and subsequently tracked for over 25 years. The analysis aims to answer the following questions: (a) are accelerated participants more likely than their non-accelerated intellectual peers to reach educational and occupational milestones related to productivity in science, technology, engineering, and mathematics (STEM; e.g., STEM Ph.D.s, scientific publications, or patents)?; (b) do accelerated students achieve these accomplishments at an earlier age?; (c) if so, is this time-saving effect of acceleration associated with increased productivity in their early scientific careers? Answering these questions advances current understanding of the benefits of acceleration for mathematically precocious adolescents in terms of fostering STEM productivity, suggesting a desirable developmental course for such individuals and potential benefits to society at large.

Sex Differences in Second Language Reading Comprehension

Tabitha W. Payne(1) & Richard Lynn(2)

(1)Kenyon College; Gambier, OH, USA;   (2)University of Ulster; Northern Ireland
1paynet@kenyon.edu; 2LYNNR540@aol.com

To examine sex differences in second language ability, it is of utmost importance that participant groups are given assessments for factors that may contribute to second language processing, such as experience with the second language, native language ability, and even working memory (Payne, Kalibatseva, & Jungers, 2009). Without record of such participant variables, differences found in second language ability could potentially be due to pre-existing group differences on any one or several of these factors that were not identified in the samples. This approach of assessing and equating male and female groups on variables found to effect second language processing has been reported in a number of studies using children, but not adults. A female advantage in second language ability has been reported among 13 year olds in England (Burstall, Jamieson, Cohen, & Hargreaves, 1974), among 12 year olds in Ireland (Lynn & Wilson, 1993), among 13year olds in Ireland), among 12 year olds in Israel (Lewy & Chen, 1974), among 12 year olds in Sweden (Ljung, 1965), among 14 year olds in Lebanon (El Hassan, 2001), and among 11 year olds in Mauritius (Lynn, 2010). In all these studies, all school students learned the second language at school, females did not perform better than males in first language ability, and the female advantage in second language ability was statistically significant. We further investigated this issue by examining potential sex differences in second language ability in adult college students matched for a larger subset of variables than previous research, such as the age of acquisition of the second language (Spanish), the number of classes taken, working memory capacity, and English Reading Comprehension. The results showed that females performed significantly better than males in second language reading comprehension for Spanish when they are matched on all these variables, suggesting that females have a stronger module for second language processing than do males.

Differential Epidemiology: IQ, Neuroticism and Chronic Disease by the 50 U.S. States

Bryan J. Pesta, Cleveland State University(1)
Sharon Bertsch, University of Pittsburgh at Johnstown(2)
Michael A. McDaniel, Virginia Commonwealth University(3)

(1)b.pesta@csuohio.edu; (2)bertsch@pitt.edu; (3)mamcdani@vcu.edu

Current research shows that geo-political units (e.g., the 50 U.S. states) vary meaningfully on psychological constructs like personality and / or intelligence (IQ). A new scientific discipline has emerged-- differential epidemiology-- focusing on how psychological variables affect health outcomes. Here we show that state IQ and neuroticism (N) strongly predict variables ubiquitous in epidemiologic research. We hypothesized that IQ and N influence health-related behaviors (e.g., smoking), which then affect chronic disease rates. Path analysis showed that the linear combination of IQ, N, and health-related behaviors explained 80% of the variance in state chronic disease. Both IQ and N produced strong direct and indirect effects as disease predictors (e.g., they alone explained 57% of the state variance in chronic disease). In sum, adding psychological variables to the epidemiologist's arsenal shows promise for predicting, understanding, and controlling chronic disease in the USA and abroad.

Of valid concerns and invalid effects: Meta-analyzing associations of in-vivo brain volume and IQ

Jakob Pietschnig, Michael Zeiler, & Martin Voracek
Department of Basic Psychological Research, University of Vienna, Austria
(jakob.pietschnig@univie.ac.at)

Positive associations between intelligence and brain size have been suspected for more than 50 years (e.g., Hamilton, 1935). Empirical evidence for these associations has been established initially by correlating head circumference and intelligence test performance. By means of Magnetic Resonance Imaging (MRI), a more sophisticated and reliable method for assessment of brain volume is available nowadays, thus leading to more accurate and valid estimations of associations of IQ and brain volume. In a meta-analysis, McDaniel (2005) demonstrated a rather strong positive correlation of in-vivo brain volume and intelligence in 37 samples of healthy participants. However, as McDaniel (2005) pointed out, data points were considered too sparse to conduct analyses for publication bias or subgroup analyses for potentially moderating variables, thus raising concerns about validity of estimated strength of effects. In the present study, we present the so far biggest meta-analysis on this topic, examining correlations of IQ and in-vivo brain volume of 68 independent studies in 117 healthy and patient-based mixed-sex samples (5,679 individuals). The resulting overall correlation of $r = .24$ ($k = 94$) for Full-Scale IQ turned out to be remarkably differentiated in respect to moderating variables. The overall pattern revealed higher correlations for healthy than patient-based samples, higher correlations for measures of performance IQ than verbal IQ, but contrasting previous findings of McDaniel (2005) no evidence for differing correlations regarding sex.

When we specified inclusion criteria according to criteria of McDaniel (Full-Scale IQ as dependent measure and healthy participants only), we found a significant positive but substantially smaller correlation of $r = .25$ ($k = 60$). When correlations were compared by whether or not they had been included in the meta-analysis of McDaniel, subgroup analysis indicated significant lower correlations of samples that had not been included in the original study (studies of McDaniel's analysis vs other studies: $r = .31$ vs $r = .21$; $p < .05$). Of note, correlations that had been reported in research articles were significantly higher than correlations obtained from personal communications with study authors of articles that did not report correlations (reported correlations vs personal communications: $r = .31$ vs $r = .16$; $p < .01$), thus indicating reporting bias as a cause for previous observed inflated effects.
On the whole, our results show that associations of intelligence and in-vivo brain volume are robust, differentiated, but significantly smaller than assumed until now. These results corroborate concerns regarding validity of strength of effects (Ioannidis, 2008) and demonstrate importance of scrutiny in respect to moderating variables and potential bias in meta-analyses.

Heritability of Fluid and Crystallized abilities across the lifespan: A Meta-analysis

John Protzko and Clancy Blair, New York University

Does heritability increase with age for *all* cognitive abilities? Aging research has shown different patterns of growth and decline for different cognitive abilities. We conducted a meta-analysis on the behavior genetics research to explore the trends in heritability of fluid and crystallized abilities across the lifespan. The sample was composed of 9,736 subjects for fluid abilities and 10,215 subjects for crystallized abilities, ranging from 6 to 83.5 years old. Crystallized abilities continue to increase in heritability and shared-environment effects to decrease with age. However, the heritability of fluid abilities demonstrated a parabolic trajectory with heritability decreasing in the second half of life. Shared-environment effects for fluid abilities did not show a quadratic pattern. Implications for the effects of aging on cognitive abilities is also discussed.

Practical Intelligence and Self Awareness: An evaluation of alternative scoring procedures for Situation Judgment Tests (SJTs)

Joseph Psotka, PhD US Army Research Institute, Alexandria, VA 22202
Peter J. Legree, PhD USARI

Previous research has demonstrated the validity of an SJT as a measure of Army leadership, showing that it assesses practical intelligence and differentiates experts (senior officers) from journeymen (junior officers) and novices/apprentices (ROTC cadets) (Hedlund, Sternberg, and Psotka, 2000). This study explores alternative scoring procedures for SJTs and demonstrates a serious advantage that using factor scores for Consensus Based Assessment (CBA) scores has over the traditional SJT measures of test means, distance scores, standardized distance scores, and correlation scores.   Legree and others (ISIR 2010) have carefully analyzed the statistical relationships among these traditional measures and proposed explanations why standardized distance scores are identical to correlation scores and superior to simple distance scores. Although the traditional methods usually are computed by collecting expert scores as a standard, factor scores must be computed from the test population itself, and so are also a consensus based measure. Not only is it possible to interpret the factors and thus the skills of individual officers, but the factors are orthogonal and can be combined in multiple ways to interpret others' ratings. In this paper, we show that factor scores yield stronger relationships between the objective test score and self awareness of leadership ability. A re-analysis of the original validity data for 160 Captains using these factor CBA scores shows stronger validity data. A new experiment using a more detailed self assessment procedure based on Transformational Leadership (Bass & Avolio, 1991) and revised SJTs using only positive questions, rather than a mix of good and bad alternatives, confirms the superiority of the factor CBA scores. The results also confirm that self awareness depends on knowledge not just of oneself, but of the general, in this case, military culture. Although this makes a good deal of common sense, it has never before been shown so clearly with objective methods. As a continuing attempt to relate objective measures of practical intelligence and leadership with subjective ratings of leadership, this report provides novel conclusions, and raises many new questions that could not have been asked before.

Videogames as tools for testing intelligence

M.A. Quiroga(1), J. Privado(1), F.J. Román(1) y R. Colom(2)

(1)Universidad Complutense de Madrid
(2)Universidad Autónoma de Madrid
m.angelesquiroga@psi.ucm.es

This poster shows the obtained results from two studies designed to examine the possibility of using videogame performance as a tool to test intelligence. Two kinds of videogames were used to check this goal: (a) a cognitive training game (*Big Brain Academy* for the Wii console by Nintendo ®) and (b) an entertainment game (*Professor Layton and the Curious Village* for Nintendo DSI®). In both studies, participants play the videogames in the laboratory, thus in a controlled setting. The first study focused on the Cognitive Training Game, in which 27 females completed a cognitive ability battery prior to playing with three of the games from *Big Brain Academy* (Calculus, Backward Memory and Train) for an hour and a half. In the second study, 47 university students completed a cognitive ability battery prior to play with a videogame designed only to entertain, for 15 hours spread over 7 weeks. For both studies, IQ scores were obtained from raw ability scores. Obtained results show: (a) high reliability index for game performance [rxx = .95] except for the Calculus game from the *Big Brain Academy* videogame [rxx = .76]; (b) medium size correlations between IQ and games' performance [Backward Memory r = .50; Train r = .55; Professor Layton r = .57]; (c) medium size correlations between ability tests scores and videogame performance only for the Train game from *Big Brain Academy* [Solid Rotated Figures r = .47; DAT-NR = .53] and medium size correlations for performance in *Professor Layton* and ability tests scores [DAT-VR r = .43; DAT-SR r = .55 and DAT-AR r = .52]. From these results the main conclusion that arises is that videogames performance correlates with intelligence (IQ) and ability tests. The magnitude of the correlation is similar to convergent validity coefficients provided by some published ability batteries (for instance, *Differential Aptitude Test Battery* by Bennet et al., 1990). Videogames could be used for testing intelligence and/or abilities but with cautiousness due to correlation sizes obtained.

The Utility of CHC Taxonomy in Identifying the Factorial Composition of Intelligence Subtests: A Joint Confirmatory Factor Analysis.

Matthew R. Reynolds(1), Timothy Z. Keith(2), Dawn P. Flanagan(3), Vincent C. Alfonso(4)

(1)University of Kansas, (2)University of Texas at Austin, (3)St. John's University, (4)Fordham University

mreynolds@ku.edu, tim.keith@mail.utexas.edu, flanagad@stjohns.edu, alfonso@fordham,edu

A CHC taxonomy is often used to classify mental ability tests. Such classification is based on the assumption that the factorial composition of mental ability tests is independent of the test battery from which it was developed (Thurstone, 1940). Similarly, if different sets of indicators (tests) are sampled from the same domain, the same common factors should be found (i.e., invariance of selection of variables). The factorial composition of a test should thus remain invariant when factor analyzed with tests from different batteries given those other batteries were designed to measure the same common factors. Joint factor analysis of different intelligence test batteries is a method that may be used to test this assumption. Such research is costly and time-consuming, however, due to the amount and the breadth of data that need to be collected. One cost-effective method to overcome such limitation is to incorporate a planned missingness (reference variable) approach (McArdle, 1994). Here, a variant of this approach was used to jointly factor analyze test scores obtained from the Kaufman Assessment Battery for Children—2nd Edition (KABC-II) concurrent validity studies. In these studies, participants were administered the KABC-II along with one other intelligence or achievement test. All participants were administered the KABC-II. These KABC-II scores were used to link scores across batteries, allowing for analysis of an increased breadth of tests spanning several intelligence batteries.

The purpose of this research was to factor analyze data from popular individually measures of intelligence, jointly across multiple batteries. Confirmatory factor analysis was used to analyze tests from the Woodcock-Johnson Tests of Cognitive Abilities—3rd Edition, Wechsler Intelligence Scales for Children—3rd and 4th Editions (WISC-III/IV), Kaufman Assessment Battery for Children—2nd Edition, and the Peabody Individual Achievement Test—Revision/Normative Update (PIAT—R/NU). Although some of the tests were designed explicitly using a CHC framework, others, such as the WISC-III, were not. Regardless, a CHC measurement model fit the data well. Six first-order factors (Gf, Gv, Gs, Gsm, Gc, MA) consistent with broad and narrow CHC ability factors were indicated by four to twelve subtests each. The factor loadings were generally very strong within each factor.

CHC-based predictions regarding the factorial composition of cognitive ability tests were accurate. The findings were consistent with factorial invariance under selection of variables; moreover, they support the notion that the factorial composition of mental ability tests is reliably predicted using the CHC taxonomy.

Parents' education, less so their money, nurtures the intelligence of their children: Results of 19 studies in six countries at different development levels

Heiner Rindermann(1), James Thompson(2)

(1)Department of Psychology, Chemnitz University of Technology, Germany
(2)Department of Psychology, University College London, UK

heiner.rindermann@psychologie.tu-chemnitz.de
james.thompson@ucl.ac.uk

Sixteen cross-sectional and three longitudinal studies in six countries (USA, Austria, Germany, Costa Rica, Ecuador, Brazil) analyzed the relative impact of parental behavior compared to SES, or parental education compared to wealth, on the cognitive ability of children (aged 2 to 23, total N=13591). The social background ranged from welfare recipients and poor indigenous people in remote villages to professional (academic) families in developing and developed countries. Children's cognitive ability was measured with different tests (mental speed tests, CFT, the Ravens, Stanford-Binet, PPVT-R, WET, CogAT, Piagetian tasks, ASVAB, PIRLS, TIMSS, PISA). Parental wealth was estimated through questionnaires by directly asking for income, indirectly by self-assessment of wealth compared to others, and by evaluating assets. Parental education comprises school education and professional training.

The mean direct effect of parental education is βEd=.40, of income/wealth βIn=.13 (N=13457, 16 studies). In all path analyses parental education shows a stronger impact on intelligence than economic status (total effects: βEd=.45, βIn=.13, N=13457, 16 studies). The effects on mental speed are smaller than for crystallized intelligence, but still larger for parental education (βEd→MS=.26, βIn→MS=-.03, βEd→CI=.37, βIn→CI=.07, N=394, 3 studies).

Parental behavior is more important than SES for intelligence (βPB=.54, βSES=-.02, N=134, 3 studies). Further important factors for children's cognitive ability which depend on parental education are number of books (βBo→CA=.20), marital status (βCF→CA=.17), educational behavior of parents (βEB→CA=.15), smoking (βSm→CA=-.18) and behavior of children themselves (βBo→BC=.15).

Environmental vs. hidden genetic effects are discussed.

IQ, Pigmentocracy, Crime, and Income in 50 U.S. States

J. Philippe Rushton(1) and Donald I. Templer(2)

(1)Department of Psychology, University of Western Ontario
(2) Alliant International University, Fresno, CA

rushton@uwo.ca, donaldtempler@sbcglobal.net

In 50 U.S. states, we found a positive manifold across measures of IQ, skin color, violent crime, birth rate, infant mortality, life expectancy, HIV/AIDS, and GDP with the first principal component accounting for 47% of the variance (median factor loading = .78). The correlation with total violent crime was higher with skin color (r = .55), a more biologically influenced variable, than with GDP (r = -.17), a more culturally influenced variable. These results corroborate those we reported at the international level using INTERPOL crime statistics. We interpret the cross-cultural consistency of the relationships from an evolutionary life history perspective in which hierarchically organized traits culminate in a single, heritable, super-factor. Traits need to be genetically organized to meet the trials of life—survival, growth, and reproduction. We discuss brain size and the g nexus as central to understanding individual and group differences. Skin color emerged as an important life history variable. We also discuss *pigmentocracy* and/or *colorism* (racial hierarchies in intelligence and socio-economic status across societies) as well as cross-species adaptations in temperament based on melanin-based coloration.

A Comparison of the Gray-Matter Correlates of Vocational-Interest and Cognitive-Ability Scales

David H. Schroeder(1), Richard J. Haier (2), & Cheuk Y. Tang(3)

(1)Johnson O'Connor Research Foundation, Chicago, USA
(2)University of California, Irvine, USA (Emeritus)
(3)Mt. Sinai School of Medicine, New York, USA

schroeder@jocrf.org

A continuing issue in the field of vocational guidance is the role of interests versus objectively-measured abilities. In this study, we report regional gray-matter correlates for vocational-interest scales and compare them with corresponding correlates for cognitive abilities with g removed.

Twenty-one male and 19 female young-adult clients of a vocational-guidance service took a battery of cognitive-ability tests and Holland's Self-Directed Search (SDS), a measure of vocational interests. The clients also received structural magnetic-resonance imaging (sMRI), and we used voxel-based morphometry to produce measures of regional gray-matter volume. Because of the modest sample size, these findings should be regarded as preliminary.

The Realistic scale (outdoor, blue-collar, some engineering areas) of the SDS showed significant positive correlations with several large brain areas, including ones in the superior frontal gyrus and cingulate gyrus. If one compares these findings with the corresponding findings for the Spatial factor in the ability battery, one finds a moderate amount of overlap, including sizable clusters in the inferior gyrus and middle gyrus of the left frontal lobe.

Outside of the Realistic area, the interest scales showed only small, isolated correlates with regional brain volume. For the Investigative scale, this pattern contrasts with those of the corresponding ability factors (g and Spatial), which show numerous brain correlates.

The findings for the SDS Realistic scale and the Spatial ability factor suggest that there may be common brain mechanisms that lead to the development of both spatial ability and Realistic interests. We would conjecture that the ability develops first and then influences the development of the interests. Outside of the Realistic area, it appears that there is little relationship between regional gray-matter volume and vocational interests.

A Meta-Analysis of the Flynn Effect Among Adults

William Shiu, Alex Beaujean, Ph. D.

Baylor University

William_Shiu@baylor.edu; Alex_Beaujean@baylor.edu

The Flynn Effect is the rise of IQ scores over time (Flynn, 2007) and has no clear consensus on its cause. There is clear evidence that the Flynn Effect is an average gain of approximately .3 IQ points per year although it is more prevalent in fluid instruments rather than on tests of crystallized intelligence (Flynn, 1987). Researchers have conducted studies into plausible reasons for this effect. These include nutrition (Lynn, 2009), heterosis (Mingroni, 2007), family size (Sundet, 2008), and education (Blair, Gamson, Thorne, & Baker, 2005). Other empirical studies suggest that the Flynn Effect is a measurement artifact and not an actual rise in "g" intelligence (Sundet, Barlaug, & Torjussen, 2004). A measurement artifact could mean that the instruments, not the examinees, are changing over time (Beaujean & Osterlind, 2008). However, a combination of factors may be attributed to the rise in IQ scores (Jensen, 1996). Current trends indicate that the Flynn Effect has ceased in developed nations, but has shown continuance in developing countries (Dickens & Flynn, 2001). In our study we attempt to focus a meta-analysis of the Flynn Effect on empirical studies conducted on adults.

We conducted a meta-analysis on existing empirical studies that investigated the causes of the Flynn Effect on adults (n= 130). The Cohen's d effect size was calculated from the comparisons of means and variances of the IQ scores from different time points. Effect sizes were weighted to account for number of studies per study. Preliminary effect sizes ranged from -3.5 to 1.3. The results will be discussed.

Development of scientific excellence in top STEM graduate students as a function of the adviser-advisee relationship

Stijn J. Smeets, David Lubinski, Camilla P. Benbow

Vanderbilt University

e-mail addresses: stijn.smeets@vanderbilt.edu, david.lubinski@vanderbilt.edu, camilla.benbow@vanderbilt.edu

This study examines the role graduate advisers play in the development of scientific excellence in their students. First- and second-year graduate students attending top 15 STEM graduate training programs in the U.S. were identified in 1992 (male N = 368; female N = 346), and subsequently tracked for 15 years. Predictor variables include the level of research productivity and sex of the adviser, as well as the quality of the advisor-advisee relationship from the student's point of view, as measured by the Advisory Working Alliance Inventory (AWAI; Schlosser & Gelso, 2001). Outcome variables will include academic milestones such as earning a STEM PhD, as well as number of patents, number of publications, and securing a tenure track position at a research university or a commensurate position in a nonacademic setting. We investigate if the adviser-advisee relationship variables have incremental validity in the prediction of these outcomes, beyond the joint influences of abilities, interests, and values.

Educational achievement and attitudes: the individual and contextual national level

Karin Täht (corresponding) University of Tartu, e-mail: Karin.taht@ut.ee,
Olev Must, University of Tartu,
Rainer Kattel, Tallinn University of Technology,
Kätlin Peets, University of Turku.

General educational performance (GEP) like intelligence has a clear co-variation with the economic development of nations. This paper demonstrates that this phenomenon has also attitudinal components: science learning motivation (SM) and self-evaluation in science learning (SE).   A similar pattern of co-variation of GEP and SM and SE revealed itself in the responses of the 15-year old students from all the 57 countries that participated in PISA (Program for International Student Assessment) 2006 (N= 398 750). The correlation between GEP and SM was higher in socio-economically more developed countries, and very small or even negative in less developed countries.

The multilevel modelling of the co-variation of GEP and its attitudinal counterparts revealed significant differences in the variability between individuals and between nations. The model assumed the existence of a latent GEP, SM and SE on the individual and national level. The most striking finding was the difference in correlations between latent variables at different levels. The correlation between GEP and SM at the national level was: -.83 and at the individual level: .26. This means that the attitudinal counterparts of GEP may have significantly different meaning for different levels. The latent developmental covariate (LDC) was added to the model on the national level. The LDC has a strong covariation both with GEP (r=.90) and with attitudinal SM (r=-.90), but a weaker covariation with SE (r=.51). The correlations between the attitudinal latent variables (SM and SE) and the latent GEP are similar to the correlations with LDC. The declared high motivation in learning at the national level does not indicate high educational results and is not an indicator of a developed society.

BIOLOGICAL CORRELATES OF IQ AND LATITUDE IN DISTRICTS OF ITALY

Donald I. Templer, Ph.D.

Alliant International University, Fresno, CA

donaldtempler@sbcglobal.net

The present study was intended to clarify and expand the IQ differences reported by Lynn (2010) between northern and southern Italians. Lynn also found positive correlation between IQ and per capita income, correlations that could be explained by both biological and economic interpretations. Lynn favored the former because southern Italians are more genetically similar to Mediterranean (North African, Greek, and Middle Eastern) people in contrast to northern Italians, who are more similar to central Europeans. The present study used biological variables that have the same sort of northern vs. southern frequency difference. As predicted, northern Italians had a greater cephalization index, a higher rate of multiple sclerosis, and a higher percentage of persons with blonde hair. These variables significantly correlate with both latitude and IQ. Schizophrenia rate correlated positively with latitude but the correlation with IQ did not reach significance. The present findings support the conceptualization of Lynn.

Ability Factors Underlying the National Assessment of Educational Progress (NAEP) Grade 8 Reading, Mathematics, and Science Assessments

William C. Tirre
US Department of Education, Institute for Education Sciences (William.Tirre@ed.gov)

Young Yee Kim
American Institutes for Research, NAEP Education Statistical Services Institute (YKim@air.org)

The lion's share of individual differences in cognitive task performance has been attributed to general intelligence. This observation has been made for a variety of cognitive tasks including elementary cognitive and perceptual-motor tasks (Chaiken, Kyllonen, & Tirre, 2000), occupational aptitude tests (Tirre & Fields, 2002), and Piaget-inspired measures of cognitive development (Humphreys & Parson, 1979). Would g also play a dominant role in explaining variation in student performance on NAEP Reading, Mathematics, and Science assessments?

NAEP tests are designed to measure what American students in the fourth, eighth, and twelfth grades know and can do in a variety of academic subjects. Detailed assessment frameworks developed by subject matter experts are used to derive test specifications. While it is generally understood that the subscales of a given assessment will be strongly intercorrelated, and probably indicate a substantial subject factor such as reading, mathematics, or science knowledge and skill; it is unknown whether a general factor underlies a collection of distinct subject matter assessments such as reading, mathematics, and science. In fact, until this study, it has been impossible to assess whether a general factor underlies these subject area assessments because in NAEP, a given student is administered a test for only one subject matter. Thus, only one subject matter assessment composite score and its subscales are available for a given student.

The research questions posed in this study are 1) whether a general factor underlies the performance of the academic tasks in mathematics, science, and reading that make up the NAEP; and 2) whether group factors corresponding to mathematics, science, and reading can be identified such that each factor is orthogonal to g and to each other. This type of factor structure is known in the literature as the bi-factor model or as the nested hierarchical model.

The data for this analysis were mean subscale scores for student groups for the mathematics (number properties and operations, geometry, measurement, data analysis and probability and algebra), reading (reading for literary experience, reading for information, reading to perform a task), and science (earth, life, and physical) assessments for the 2005 NAEP. As discussed above, individual students take only one of these three tests. Thus, individual scores for all three tests and 11 subtests are not available. To overcome this challenge, we created a database with mean scores for student groups where the groups were formed as the product of race/ethnicity (6), gender (2), and jurisdiction (51), resulting in a potential 600-plus cases. The actual number of cases was around 300. These mean scores on the 11 subtests were then intercorrelated, and analyzed using confirmatory factor models.

To verify that the factor analysis results using group-level means, were not different from those we would obtain using individual-level data, we performed several analyses of sets of real data and simulated data where both individual- and group- level data were available. In this paper we will describe the results for the ECLS-K data (at both the individual and aggregate levels) and the simulated and actual NAEP data, and discuss the application of this methodology to the secondary analysis of NAEP data.

Associations between proneness for psychological flow, intelligence and personality

Fredrik Ullén(1), Örjan de Manzano(1), Patrik Magnusson(2), Nancy L. Pedersen(2), and Guy Madison(3)

(1)Dept of Women's and Children's Health and Stockholm Brain Institute, Karolinska Institutet; (2)Dept of Medical Epidemiology and Biostatistics, Karolinska Institutet; (3)Dept of Psychology, Umeå University.

Psychological flow is a subjective experience of enjoyment, sense of control, loss of self-awareness and complete absorption in an activity that typically occurs during performance of tasks that are challenging but matched in difficulty to the person's skill level 1. Since sustained attention to a task is a defining component of flow, we investigated whether a tendency to experience frequent flow experiences (flow proneness) is positively related to intelligence. Tests of sustained attention show substantial positive correlations with intelligence. Secondly, we hypothesized a negative relation between flow proneness and neuroticism: the high reactivity to negative stimuli and negative affect characteristic of this personality trait could be expected to interfere with the positive affective components of flow (enjoyment).
We investigated these hypotheses in two samples. Sample 1 included 153 individuals (age 18-47 yrs) in which intelligence was measured with either the Wiener Matrizen Test (WMT) or the Raven SPM Plus, personality was measured using NEO PI-R, and flow proneness using a Flow Proneness Questionnaire (FPQ), which gives separate estimates of flow during Work, Leisure, and Maintenance, as well as Total Flow. Sample 2 consisted of a cohort of twins (age 50-65 yrs) where the WMT and the FPQ were administered over the Internet. We present preliminary analyses based on 2360 twin individuals.

No significant correlations between Flow Proneness measures and intelligence were found in Sample 1 (Work: $r = -.06$; Maintenance: $r = -.1$; Leisure: $r = .03$; Total: $r = -.06$; all n.s.). Correlations were also very weak in Sample 2 (Work: $r = .10$, p = .000; Maintenance: $r = .01$, n.s.; Leisure: $r = .07$, p = .001; Total: $r = .08$, p =. 000). In Sample 1, we found, as expected, significant negative correlations between flow proneness and neuroticism (r values -.29 – (-.41)) as well as a positive correlation between flow proneness and conscientiousness (r values .23 - .40).

We conclude that the tendency to experience flow is positively associated with certain personality traits (stability, conscientiousness) but essentially unrelated to psychometric intelligence. These findings are in line with recent physiological studies showing that the respiratory pattern during flow differs from that seen during effortful attention4. The findings support hypotheses that flow may be a state of domain-specific "effortless attention" that requires a high level of expertise in a particular task, and relies on different physiological mechanisms from those involved in attention during mental effort.

Empirical Verification of the Model of Relation of Cognitive and Emotional Abilities

Ekaterina Valueva and Dmitry Ushakov
Institute of Psychology, Russian Academy of Sciences, Moscow

ekval@list.ru

Our study wasaimed at empirical verification of the two-factor model of relation of cognitive and emotional abilities. The model includes two parameters: type of information encoding (cognitive vs. emotional) and type of cognitive processes (convergent vs. divergent). One hundred and sixty two participants took part in the study and performed 9 tests. Each of the tests was aimed at evaluation of one of four abilities (cognitive intelligence, cognitive creativity, emotional intelligence, and emotional creativity). The 4-factor linear structural model was constructed with the latent factors corresponding to abilities mentioned above and the manifest variables corresponding to the respective test scores. The model showed a good fit to empirical data (Bollen–Stine bootstrap $\chi 2$ = 30.9 p=0.16, GFI=0.96, AGFI=0.92, TLI=0.96, RMSEA=0.04, CFI=0.98, RMSEA = 0.04). According to the theoretical model predictions, covariations between cognitive intelligence and cognitive creativity, cognitive creativity and emotional creativity, cognitive intelligence and emotional intelligence turned out to be positive and significant. An interesting result was that in our model we had a negative relation between emotional intelligence and emotional creativity. This result corresponds to some previous studies (i.e. Ivcevic et al., 2007, Zenasni, Lubart, 2008).We discuss our findings in terms of information processing means.

An examination of sex differences in the top 5% of cognitive abilities: 1981-2010

Jonathan Wai, Megan Cacchio, Martha Putallaz, Matthew C. Makel
jon.wai@duke.edu

Duke University

mkm20@duke.edu, putallaz@duke.edu, mmakel@tip.duke.edu

One factor in the debate surrounding the underrepresentation of women in math and science is sex differences in the right tail of mathematical ability. In this study we examine male-female ratios from over 1.6 million 7th grade students in the top 5% of ability on multiple measures of math, verbal, writing, and science reasoning from the SAT and ACT across 30 years (1981-2010). Male-female ratios in the right tail of math reasoning are substantially lower than three decades ago, but have been fairly stable over the last two decades and still favor males. Additionally, male-female ratios in science reasoning, potentially a new factor in the discussion, have also been fairly stable over the last two decades and currently favor males. Also important is that female-male ratios in verbal reasoning and writing currently favor females. The potential role of sociocultural factors on changes in male-female ability ratios is discussed. The potential implications of continued sex differences in math and science reasoning representation is discussed within the context of the many factors that operate in combination surrounding the debate on the dearth of women in math and science.

Meta-analysis Predictors of Clerical Performance: A Pearlman, Hunter and Schmidt Update

Deborah L. Whetzel and Rodney A. McCloy, Human Resources Research Organization
Amy Hooper, Gettysburg College
Teresa L. Russell and Shonna D. Waters, Human Resources Research Organization
Wanda J. Campbell and Robert A. Ramos, Edison Electric Institute

In 1980, Pearlman, Schmidt, and Hunter published a seminal paper on the validity of various measures for predicting performance in clerical jobs. The increased use of computers and technology in the office environment has changed the nature of clerical work considerably since that time. Therefore, updating the research on the validity of predictors is warranted. This paper describes our effort to conduct a meta-analysis using studies conducted since 1980 to determine if the validity of predictors has changed.

We gathered studies from several sources, including two test reference sources—the *Mental Measurements Yearbook* and *Tests in Print*—to identify clerical measures that are available for purchase and/or those test publishers that might have data on clerical measures. We sent out several calls for papers via industrial-organizational (I-O) psychology and human resources (HR) newsletters and e-mail solicitations, including the Society for Industrial and Organizational Psychology (SIOP), the International Personnel Management Association Assessment Council (IPMAAC), and several local organizations (e.g., Personnel Testing Council of Metropolitan Washington [PTC/MW]). We also requested papers through listservs such as IPMAACtalk. With regard to publicly available research, we first searched the computerized databases, such as *PsycINFO*. With regard to the non-publicly available research, we conducted a computerized search of papers presented at the annual SIOP conference (1998-2008) using the SIOP website (www.SIOP.org). We also engaged in an intensive effort to contact large governmental and private organizations that might have access to validation data for clerical occupations.

The psychometric meta-analytic procedures recommended by Hunter and Schmidt (2004) were used in this study. Hunter and Schmidt's most recent meta-analytic program was used to analyze the data (Schmidt & Le, 2005). After identifying or computing the final validity coefficients to be used in the meta-analysis, we corrected for several statistical artifacts. All validity estimates were weighted by sample size. In addition, validity estimates were corrected for criterion unreliability distribution used by Pearlman et al. (1980)

We applied publication bias methods to the data to determine the extent to which our results might be distorted estimates of population values. The publication bias method used in this study was "trim and fill" (Duval & Tweedie, 2000a, 2000b). The software used to compute the indices was Comprehensive Meta-Analysis (Borenstein, Hedges, Higgins, & Rothstein, 2005).

Our results showed that the validity estimates obtained in 1980 were consistent with those obtained in the current study. Our validity estimates were higher than those obtained by Pearlman et al. (1980) for verbal ability (.54 vs. .39), reasoning (.51 vs. .39), perceptual speed (.54 vs. .47) and performance tests (.59 vs. .44). The validity estimates were the same, or nearly so, for general mental ability (.52), quantitative ability (.47), and clerical aptitude (.51 vs. .48). These results must be interpreted with caution due to the low number of studies (k) compared to Pearlman et al.'s analysis.

Introducing the cognitive differentiation-integration effort hypothesis: A coherent evolutionary explanation for SLODR and related effects

Michael A. Woodley

Royal Holloway, University of London, School of Biological Sciences.
M.A.Woodley@rhul.ac.uk

The positive manifold (*g*-factor) varies in strength with age and ability. The most well known of these phenomena is the differentiation effect (Spearman's Law of Diminishing Returns) which is associated with a tendency for the *g* factor to weaken and abilities to differentiate as a function of increasing age and/or IQ (Jensen, 1998). Studies have also observed integration effects (a strengthening of the positive manifold with age) and periods of differentiation followed by integration amongst longitudinal samples (Reinert, 1970). These phenomena (here collectively referred to as the *g* inconstancy effect) have been known to psychologists since 1927 and have subsequently been the subject of a tremendous degree of controversy, a coherent explanation for the effect is however lacking (Facon, 2006). Here a novel integrative evolutionary hypothesis is presented in the form of the cognitive differentiation-integration effort (CD-IE) hypothesis, which is based on the idea that genes and environmental factors regulating life history speed (individual differences in the fundamental pattern of bioenergetic resource allocation) control the degree to which either (CDE – a specialized form of somatic effort) is invested into the development of separate abilities, or (CIE – a specialized form of mating effort) is invested into strengthening the positive manifold. This represents one of two independent sources of genetic and environmental variance in *g*; the other is mediated by general fitness and is associated with cognitive reserve. These two sources combine to give rise to a variety of cognitive phenotypes characterized by different combinations of high or low cognitive reserve and cognitive specialism or generalism. Amongst those with high reserve, this arrangement is favored by sexual selection, as a strong *g*-factor signals high genetic fitness for short-term mates amongst those with fast life histories, whereas ability differentiation advertises slow life history for long-term mates. Furthermore, natural selection also operates on the basis that a diversity of cognitive phenotypes within populations enhances divisions of labor and boosts inclusive fitness through competitive release.

The framework stemming from this bringing together of two currently unconnected phenomena (the *g* inconstancy effect and life history theory) not only permits new questions to be asked about the role of *g* in the human life history matrix, but also accounts for a variety of phenomena that have puzzled psychologists, such as the failure of *g* to substantively aggregate with life history variables at individual differences scales (e.g. Gladden et al. 2008), despite predictions to the contrary (Rushton, 1985); the IQ paradox or 'Flynn Effect' and the relationship between development and general intelligence, a subject that appears to have received scant attention (van der Maas et al. 2006).

Working memory and intelligence in language processing: the computational complexity predictions

Marcin Zajenkowski(1) and Jakub Szymanik(2)

(1)Faculty of Psychology, University of Warsaw
(2)Department of Philosophy, Stockholm University

zajenkowski@psych.uw.edu.pl

Many studies suggest that working memory plays a crucial role in the language comprehension. Despite the existence of long tradition of linking WM with language processing, only recently experiments basing on the computational model posited by many linguists and logicians (see e.g. van Benthem, 1986) were published. The studies were devoted mainly to quantifiers. For example, McMillan et al. (2005) examined the pattern of neuroanatomical recruitment while subjects were judging the truth-value of statements containing natural language quantifiers. They showed that only higher-order quantifiers (e.g. 'more than half') recruit the prefrontal cortex associated with executive resources, like working memory.

In our studies we refer to automata theory, which in computer science is the study of abstract machines and the problems which they are able to solve. We believe that the cognitive difficulty of quantifier processing might be assessed on the basis of complexity of the minimal corresponding automata (see van Benthem, 986; Szymanik, 2007). We differentiated four classes of quantifiers: Aristotelian quantifiers (e.g. 'some', 'all'), numerical quantifiers of high rank ('more than 7', less than 8'), parity quantifiers ('an even number of', 'an odd number of') and proportional quantifiers ('more than half', 'less than half').

Among others, the computational model predicts that the most difficult to process are proportional quantifiers, because they demand a recognition mechanism with unbounded internal memory, like a stack in pushdown automata (see e.g. van Benthem, 1986). It involves tracking and comparing the relative sizes of two sets. For instance, to verify a sentence "More than half of the cars are red", one has to count and hold in the short-term memory a number of red cars and then compare it with a number of all cars. No such memory storage is necessary in the processing of other quantifiers, where subject needs to only focus on counting elements of just one set. Therefore, to verify the proportional quantifier, simultaneous processing and storage are required. In the psychological literature, these two elements are parts of working memory (e.g. Daneman and Carpenter, 1980; Oberauer et al., 2008).

We show our data from a series of experiments that tested the model described above (Szymanik and Zajenkowski, 2010a,b). We used various sentence verification tasks, in which subjects were asked to decide if the proposition containing a quantifier accurately described the presented picture. The results support our hypotheses, indicating that the minimal automata is a good predictor of the quantifiers performance. Moreover, the data shows that only in proportional quantifiers simultaneous processing and storage are involved.
In the discussion, we refer to empirical evidence of strong correlation between general intelligence and working memory. We discuss an option that the computational model explaining WM engagement may be also be a good predictor of intelligence. We outline the possible relationships and assume that the intelligent behavior would be to use minimal adequate automata, which on the psychological level means appropriate strategy or cognitive structure.