INTERNATIONAL SOCIETY FOR INTELLIGENCE RESEARCH (ISIR)

16th Annual Conference

September 18–20, 2015
Albuquerque, NM (United States)
Hotel Andaluz

www.isironline.org

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rex.jung@runbox.com

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Department of Psychology
University of New Mexico
ryeo@unm.edu

CONFERENCE VENUE

Hotel Andaluz
125 2nd St NW,
Albuquerque, NM 87102,
United States

Layout and design: Christophe Landais (christophe@criteriainternational.com)

Day 1: Friday 18th September 2015

7:45–8:20	Registration
8:20–8:30	Opening remarks *Michael A McDaniel*
8:30–8:40	Lifetime Achievement Award: John Loehlin
8:40–9:40	Keynote Address *Roberto Colom*
9:40–10:40	Talks: Session1 – Genetics *Johnson, Rodgers, Rimfeld*
10:40–11:00	Break
11:00–12:00	Talks: Session 2 – Education *Kell, Rindermann, Protzko*
12:00–13:30	Lunch
13:30–14:30	Talks: Session 3 – Psychometrics *Bailey, Conway, Debes*
14:30–15:15	Lightning Talks *Nyborg, Penke, Englehardt, Giofrè, Malanchini, Woodley of Menie*
15:15–15:45	Break
16:00–17:00	ISIR Business Meeting / How to get your paper published *Fraser*
17:00–18:00	David Lubinski interview with Robert Plomin
18:00–20:00	Poster Session & Elsevier Reception

Day 2: Saturday 19th September

7:30–8:30	Student Breakfast with John Loehlin
8:30–9:30	Invited Presidential Symposium *Paul Sackett & Nathan Kuncel*
9:30–10:50	Talks: Session 4 – Personality *von Stumm, Bates, Revelle, Ritchie*
10:50–11:10	Break
11:10–12:30	Talks: Session 5 – Psychometrics *Wicherts, Benson, Westrick, Jacobucci*
12:30–14:00	Lunch
14:00–14:35	Lightning Talks *Arden, Euler, Davis, Richmond, Houser-Marko*
14:35–15:30	Talks: Session 6 – Genetics *Plomin, Lee, Shroeder*
15:30–16:00	Break
16:00–17:00	Talks: Session 7 – Neuroimaging *Neubauer, DeYoung, Ryman*
17:00–18:00	President's Invited Address *Steven Pinker*
19:30	Conference Banquet

Day 3: Sunday 20th September 2015

9:00–10:00	Holden Memorial Address *Alice Dreger*
10:00–11:00	Talks: Session 8 – (Misc) *Wilmer, Coyle, Primi*
11:00–11:30	Break
11:30–12:30	Talks: Session 9 – Evolution *Briley, Arslan*
12:30–14:00	Lunch
14:00–15:20	Talks: Session 10 – Education *Hart, Dang, White, Caemmerer*
15:20–15:50	Break
15:50–16:00	Student Awards

Note. The order of names reflects the order of presentations.

Day 1: Friday 18th September 2015

8:20–8:30	Opening Remarks *Michael A McDaniel*
8:30–8:40	Lifetime Achievement Award: John Loehlin. *Presented by Michael A McDaniel*
8:40–9:40	Keynote Address: *Roberto Colom*. *Introduced by Rex Jung*
9:40–10:00	Genetic and environmental pathways linking SES, educational attainment, and IQ *Wendy Johnson et al.*
10:00–10:20	Do intelligent girls delay age at first intercourse? Different results within-families versus between-families *Joseph Rodgers et al.*
10:20–10:40	Genetic and environmental underpinnings of spatial abilities and their role in predicting academic achievement and success in STEM *Kaili Rimfeld et al.*
10:40–11:00	Break
11:00–11:20	Beyond human capital: Civic engagement and community involvement among intellectually precocious youth at midlife *Harrison Kell et al.*
11:20–11:40	Future US intelligence: IQ prediction until 2060 based on NAEP *Heiner Rindermann et al.*
11:40–12:00	Is the Fadeout Effect real? *John Protzko*
Noon–13:30	Lunch
13:30–13:50	Does reading cause later intelligence? Accounting for stability in models of change *Drew Bailey et al.*
13:50–14:10	The domain-generality of working memory: A matter of ability. *Andrew Conway presenting for Kristof Kovacs*
14:10–14:30	The effects of methylmercury on general intelligence in children and young adults *Fróði Debes et al.*
14:30–14:37	Modeling sex and race differences in IQ and other traits with no social reduction or category errors *Helmuth Nyborg*
14:37–14:44	Male general intelligence (*g*) does not increase female sexual attraction *Lars Penke et al.*
14:44–14:51	Genetic and environmental structure of self-regulation: Executive functions and conscientiousness *Laura Englehardt et al.*
14:51–14:58	The etiology of spatial anxiety and its relationship with mathematics anxiety, general anxiety and spatial ability *Margherita Malanchini et al.*

14:58–15:05	The estimation of genomic-level heritabilities or genetic "transmissibilities" of cognitive mental (IQ) abilities and conative life history traits *Michael Woodley of Menie et al.*
15:15–15:45	Break
16:00–17:00	ISIR Business Meeting / How to get your paper published *Adam Fraser*
17:00–18:00	Distinguished Interview: Robert Plomin *Interviewer: David Lubinski* *Introduction Doug Detterman*
18:00–20:00	Poster Session & Elsevier Reception

Day 2: Saturday 19th September 2015

7:30–08:30	Student Breakfast with John Loehlin
08:30–09:30	Invited Presidential Symposium. What do college admissions tests predict, and for whom? Insights from a large scale research program *Paul Sackett & Nathan Kuncel (Introduced by Michael A. McDaniel)*
09:30–09:50	Day-to-day variability in IQ and mood *Sophie von Stumm*
09:50–10:10	Testing alternatives to trait-IQ: Dweck's Mindset, Woolley's Emotional Collective, and Baumeister's Depleted Will models *Timothy Bates*
10:10–10:30	Ability, temperament, and interests: Their joint predictive power for job choice *William Revelle et al.*
10:30–10:50	Polygenic risk for schizophrenia is associated with steeper general cognitive decline *Stuart Ritchie et al.*
10:50–11:10	Break
11:10–11:30	More psychometric problems with the method of correlated vectors *Jelte Wicherts*
11:30–11:50	Examining the Flynn Effect in the Wechsler Adult Intelligence Scale *Nicholas Benson et al.*
11:50–12:10	Reliability estimates for undergraduate GPA *Paul Westrick*
12:10–12:30	An application of exploratory data mining in Project TALENT *Ross Jacobucci et al.*
12:30–14:00	Lunch
14:00–14:07	The association between intelligence and lifespan is mostly genetic *Rosalind Arden et al.*

14:07–14:14	Effects of Response Alternatives on CNV amplitudes in the Hick Paradigm: Relations to Reaction Time and Fluid Intelligence *Matt Euler et al.*
14:14–14:21	Spatial cognition and learning among children and adults in two traditional and transitioning populations *Helen Davis et al.*
14:21–14:28	*g* and non-*g* Predictors of Academic Performance in Hispanics and Whites *Miranda Richmond et al.*
14:28–14:35	Shedding light on intelligence, creative fluency, and creative achievement *Linda-Houser Marko et al.*
14:35–14:55	A genome-wide analysis of putative functional and exonic variation associated with extremely high intelligence *Robert Plomin et al.*
14:55–15:15	86 genomic sites associated with educational attainment provide insight into the biology of cognitive performance *James Lee et al.*
15:15–15:35	Heritability of Specific Cognitive Abilities *David Schroeder*
15:35–16:00	Break
16:00–16:20	The influence of transcranial alternating current stimulation (tACS) on fluid intelligence performance. An fMRI study *Aljoscha Neubauer et al.*
16:20–16:40	Subcortical intelligence: The role of the caudate nucleus in general cognitive ability *Colin DeYoung*
16:40–17:00	Fronto-parietal gray matter and white matter efficiency differentially predict intelligence in males and females *Sephira Ryman et al.*
17:00–18:00	President's Invited Address: Intelligence Research and the Craft of Writing *Steven Pinker. Introduced by Rich Haier*
19:30	Conference Banquet

Day 3: Sunday 20th September 2015

09:00–10:00	Holden Memorial Address. Understanding Science Journalists and Why They Misunderstand You *Alice Dreger. Introduced by Ronald Yeo*
10:00–10:20	Dissecting human ability into core mechanisms: Multiple object tracking (MOT) in a sample of 19,000 *Jeremy Wilmer et al.*
10:20–10:40	Sex Differences in Ability Tilt *Thomas Coyle et al.*
10:40–11:00	Creativity and fluid intelligence: Mixture growth modeling of intra individual patterns of performance during a divergent thinking task of figural drawing *Ricardo Primi et al.*

11:00–11:30	Break
11:30–12:30	Genetic and Environmental Structure of Self-Regulation: Executive Functions and Conscientiousness *Daniel Briley et al.*
	Paternal age as an indicator of new mutations: Children of older fathers have lower evolutionary fitness, but not lower intelligence *Ruben Arslan et al.*
12:30–14:00	Lunch
14:00–14:20	Using intelligence to predict response-to-intervention: An application of Integrative Data Analysis in Project KIDS *Sara Hart*
14:20–14:40	N-Back Cognitive Training Improves Executive Function, Working Memory and Fluid Intelligence *Cai-ping Dang et al.*
14:40–15:00	Cross-cultural investigation into teacher/classroom effects on academic progress in relation to motivational factors *Elaine White et al.*
15:00–15:20	Effects of general and broad cognitive abilities on academic achievement: Testing bifactor and hierarchical models with the mew WISC-V and WIAT-III *Jacqueline Caemmerer et al.*
15:20–15:50	Break
15:50–16:00	Student Awards *Introduced by Yulia Kovas*
16:00	End of Conference

Abstracts

The first set of abstracts are those of the invited speakers and are arranged by order of presentation. Abstracts for the remaining papers follow in alphabetical order by first author's last name.

KEYNOTE ADDRESS

Understanding Human Intelligence: The Brain Connection

Professor Roberto Colom[1]

[1] Universidad Autonoma de Madrid, roberto.colom@uam.es.

'*The Brain Connection*' designates the fact that genetic and non-genetic factors influencing intelligence play on the brain. Understanding this psychological factor requires deep knowledge regarding brain structure and function. Psychometrics and cognitive neuroscience should work in tandem to find the most likely biological foundations of individual differences in human intelligence. This keynote discusses (1) the reproducibility of brain-intelligence relationships, (2) the relevance of the measured phenotype, (3) lessons derived from large-scale lesion studies, (4) the relationship between intellectual ability and cortical development, (5) the connectome and intelligence, and (6) how can we improve our brains. The brain is a general-purpose, highly dynamic, device. We, scientists, should focus our research resources on the brain, asking how it produces intelligence. Technological devices still unavailable will be of great help for that main purpose. These tech advances will contribute to overcome our current lack of knowledge regarding human intelligence.

PRESIDENT'S INVITED SYMPOSIUM

Determinants of College Success: Data from a Million Students

Paul R Sackett and Nathan R Kuncel[1]

[1] University of Minnesota, psackett@umn.edu, kunce001@umn.edu

Student success in higher education is a critical and fascinating topic. Student success is multifaceted; stakeholders emphasize different outcomes such as degree completion, work skills and critical thinking. Multiple individual characteristics are associated with different facets of success. College admissions use numerous measures ranging from interviews to standardized tests. Here we will discuss decades of our research on these issues including many studies that have come out of our joint research laboratory. We make use of a still-growing primary database now following over 1,000,000 students through college, combined with meta-analyses on hundreds of thousands of students. Higher education policymakers need to know about test validity, the role of SES on student admissions and performance, linearity of test-performance relationship, and predictive bias by race and gender. Our very large N delivers robust answers to these and other key questions.

PRESIDENT'S INVITED ADDRESS

Intelligence Research and the Craft of Writing

Steven Pinker[1]

[1] Department of Psychology, Harvard University.

As a user, promoter, and occasional practitioner of intelligence research, I discuss a little-appreciated aspect of scientific practice that has significant implications for the future of the field: writing. Most academics are terrible communicators. Why do the world's most cerebral people find it so hard to convey their ideas? And how can we learn to do better? The classic style manuals are based on the personal intuitions of journalists and writing instructors and tend to mix some helpful hints with some harmful folklore. I suggest that the modern sciences of mind and language can provide sounder and more systematic guidance to writers today. Thoughtful writers should begin with a clear idealization of the simulated scenario in which they are communicating with their readers. They must overcome The Curse of Knowledge – the inability to imagine what it's like not to know what they do know. They should understand how syntax works and thus how best to deploy the grammatical resources of the English language. And they should know how to think about the rules of correct usage, distinguishing the ones that enhance clarity and grace from the shibboleths and superstitions.

HOLDEN MEMORIAL ADDRESS FOR DISTINGUISHED JOURNALISM

Understanding Science Journalists and Why They Misunderstand You

Alice Dreger

For many scientists whose work touches on identity politics, dealing with science journalists can be a fraught endeavor. Work with them, and you risk being misrepresented. Decline to work with them . . . and you risk being misrepresented. This lecture will draw on the speaker's 20 years' experience working with and within science journalism to explore how the field has changed in the last two decades and how scientists can protect themselves today in the media. The speaker, an historian of science, science writer, and patient rights activist, will draw several cautionary tales from her latest book,*Galileo's Middle Finger: Heretics, Activists, and the Search for Justice in Science*.

THE ASSOCIATION BETWEEN INTELLIGENCE AND LIFESPAN IS MOSTLY GENETIC

Rosalind Arden[1], Michelle Luciano[2], Ian J Deary[2],
Chandra A Reynolds[3], Nancy L Pedersen[4], Brenda L Plassman[5],
Matt McGue[6,7], Kaare Christensen[8], Peter M Visscher[9]

[1] CPNSS London School of Economics, arden.rosalind@gmail.com.
[2] University of Edinburgh,
[3] University of California, Riverside,
[4] Department of Medical Epidemiology and Biostatistics Karolinska Institutet Stockholm, Sweden.
[5] Department of Psychiatry and Behavioral Sciences Duke University Medical Center, Durham, NC.
[6] Department of Psychology, University of Minnesota.
[7] The Danish Aging Research Center, University of Southern Denmark.
[8] The Danish Twin Registry and The Danish Aging Research Center University of Southern Denmark, Odense, Denmark.
[9] Queensland Brain Institute The University of Queensland Diamantina Institute, Translational Research Institute (TRI) Woolloongabba, QLD 4102 Australia.

Several studies in the new field of cognitive epidemiology have shown that higher intelligence predicts longer lifespan. This positive correlation might arise from socio-economic status influencing both intelligence and health; intelligence leading to better health behaviors, and/or some shared genetic factors influencing both intelligence and health. Distinguishing among these hypotheses is crucial for medicine and public health, but can only be accomplished by studying a genetically-informative sample.

We analyzed data from three genetically-informative samples containing information on intelligence and mortality: 1) 377 pairs of male veterans from the NAS-NRC US World War II Twin Registry, 2) 246 pairs of twins from the Swedish Twin Registry and 3) 784 pairs of twins from the Danish Twin Registry. The age at which intelligence was measured differed between the samples. We used three methods of genetic analysis to examine the relationship between intelligence and life-span: we calculated the proportion of the more intelligent twins who out-lived their co-twin; we regressed within-twin-pair life-span differences on within-twin pair intelligence differences; and we used the resulting regression coefficients to model the additive genetic covariance.

The combined (and all three individual samples) showed a small positive phenotypic correlation between intelligence and lifespan. In the combined sample observed r=.12 (95% confidence interval .06 to .18). The additive genetic covariance model supported a genetic relationship between intelligence and lifespan. In the combined sample the genetic contribution to the covariance was 95%; in the US study, 84%; in the Swedish study, 86%, and in the Danish study, 85%.

The finding of common genetic effects between lifespan and intelligence has important implications for public health and those interested in the genetics of intelligence, lifespan or inequalities in health outcomes including lifespan.

PATERNAL AGE AS AN INDICATOR OF NEW MUTATIONS: CHILDREN OF OLDER FATHERS HAVE LOWER EVOLUTIONARY FITNESS, BUT NOT LOWER INTELLIGENCE

Ruben C. Arslan[1], Kai P. Willführ[2], Emma M. Frans[3], Mikko Myrskyla[4], Catarina Almqvist[3] & Lars Penke

[1] Georg August University Göttingen, Germany, ruben.arslan@gmail.com.
[2] MPI for Demographic Research, Rostock, Germany.
[3] Karolinska Institut, Stockholm, Sweden.
[4] MPI for Demographic Research, Rostock, Germany.

Paternal age at offspring conception seems to be the main driver of single nucleotide de novo mutations (Kong et al.., 2012). Different theories posit that intelligence is linked to mutation load as a fitness indicator or simply owing to its genetic complexity. Based on evolutionary genetic theory we predicted negative paternal age effects on offspring fitness and intelligence in the normal range.

To investigate effects on fitness, we used church records from three pre-industrial Western populations and governmental data from 20th century Sweden. We used a sibling control design and accounted for confounds including maternal age, birth order and parental loss. Main analyses had an aggregate $N > 1.3$ million. To investigate effects on intelligence, we compared siblings in the German Socio-Economic Panel ($N = 1479$). Furthermore we were the first to directly adjust for measured parental intelligence, the most obvious confound, in data from the Minnesota Twin Family Study ($N = 1898$ twin pairs).

We found clear support for mutational paternal age effects on offspring survival, mating and reproductive success. Weaker effects were found in 20th century Sweden, possibly indicating a diminished strength of purifying selection. However, we found no mutational paternal age effect on offspring intelligence, which was corroborated further by a Swedish study of half a million men (D'Onofrio et al.., 2014).

Although paternal age effects seem to be an appropriate way to characterize the effect of de novo mutations on fitness, no effect was found on intelligence in the normal range. Genomic research supports this result. The inferred genetic architecture of intelligence does not seem to make it fragile and vulnerable to increases in paternal age-driven mutation or to decreases in purifying selection.

DOES READING CAUSE LATER INTELLIGENCE? ACCOUNTING FOR STABILITY IN MODELS OF CHANGE

Drew H. Bailey[1] and Andrew K. Littlefield[2]

[1] University of California, Irvine, dhbailey@uci.edu.
[2] Texas Tech University, USA.

Understanding the genetic and environmental pathways in the development of children's cognitive skills has important implications for theories of cognitive development and for educational practice. Findings from studies combining genetically informed datasets and longitudinal data analysis have led to important progress in our understanding of these pathways. However, the assumptions we make about the development of intelligence influences the estimated effects of simultaneously developing characteristics on intelligence. We argue that cross-lagged panel regression models make particularly unrealistic assumptions about the development of intelligence and likely lead to over-estimates of the effects of other characteristics on intelligence during development.

We re-analyze the correlation matrix supplied by Ritchie, Bates, and Plomin (2014), who used a cross-lagged monozygotic-differences design to test whether reading ability caused changes in intelligence. The authors used data from a sample of 1890 monozygotic twin pairs tested on reading ability and intelligence at 5 occasions between the ages of 7 and 16, regressing twin differences in intelligence on twin differences in prior intelligence and twin differences in prior reading ability.

We estimate a cross-lagged panel regression model using the same correlation matrix, assuming a single lag autoregressive correlation structure. We find that the model fits the data fairly well, and leads to conclusions very similar to those provided by Ritchie, Bates, and Plomin (2014). We then estimate a state-trait model to account for the stability of individual differences in environmentally determined intelligence and reading achievement over time. We find that this model fits the data substantially better than the standard cross-lagged regression model, that the correlation between these two latent variables is very high, and that the cross-lagged paths are no longer apparent once the stable factors influencing individual differences over time are controlled.

Findings have important theoretical and methodological implications for the study of individual differences in cognitive development. They do not support a simple autoregressive model of children's cognitive development. Further, they highlight the overlapping stable factors contributing to children's intelligence and reading achievement throughout development. Finally, they highlight the limitations of the cross-lagged panel regression model for studying the development of individual differences in intelligence and suggest a plausible alternative model: the state-trait model (Steyer, 1987).

TESTING ALTERNATIVES TO TRAIT-IQ: DWECK'S MINDSET, WOOLLEY'S EMOTIONAL COLLECTIVE, AND BAUMEISTER'S DEPLETED WILL MODELS

Timothy C. Bates[1]

[1] University of Edinburgh, tim.bates@ed.ac.uk.

Numerous theories seek to account for differences in reasoning without recourse to trait-IQ. Among these are Dweck's (Mueller & Dweck, 1998) Incremental Mindset, Baumeister's Resource Depletion Theory (Vohs, Baumeister, & Schmeichel, 2012) and, for working in groups, Woolley's Collective IQ (C: Woolley, et al.., 2010).

In this presentation, we test the extent to which these models predict performance independent of *g* (if at all).

The Baumeister and Dweck models of will power are tested in a repeated measures design involving 80 students.

The Woolley Collective IQ model is tested in three experiments with 28 to 80 groups of individuals. In addition manipulations of empathy-equality are contrasted with manipulations of authority-obedience to test non-cognitive origins of group performance.

The Dweck incremental versus fixed mindset model of IQ test performance was tested in three experiments of between 80 and 400 subjects, testing the predicted link of beliefs about performance to actualized performance both observationally and via belief priming.

We found no significant support for willpower depletion as a cause of cognitive decrements during testing. Moreover we find no support for incremental beliefs about will-power on measured cognitive test scores.

Group-IQ performance showed a strong *g*-factor, but this was almost completely explained by individual differences in IQ. We found no support for empathizing, or for the role of women as factors raising group IQ scores.

Study three showed, instead, support for authority/group morality manipulations in raising collective performance.

We found no support for incremental versus fixed mindset on grades.

We further found no significant effect of mindset priming on IQ scores post a performance setback challenge in either of two replications.

Across multiple studies, we were unable to support empathizing, will-power conservation, or mindset (typical or primed) as factors affecting IQ or cognitive control.

EXAMINING THE FLYNN EFFECT IN THE WECHSLER ADULT INTELLIGENCE SCALE

Nicholas F. Benson[1], A. Alexander Beaujean[1] and Gordon E. Taub[2]

[1] Baylor University, Nicholas_Benson@baylor.edu.
[2] University of Central Florida.

The Flynn effect (FE: i.e., increase in mean IQ scores over time) is commonly viewed as reflecting population shifts in intelligence, despite the fact that most FE studies have not investigated the assumption of score comparability. Consequently, the extent to which these mean differences in IQ scores reflect population shifts in cognitive abilities versus changes in the instruments used to measure these abilities is unclear.

This study used participants from the Wechsler Adult Intelligence Scale's revised (WAIS-R; n = 1,800), third (WAIS-III; n = 2,450), and fourth (WAIS-IV; n = 2,200) editions' standardization samples. First, WAIS subtest scores were equated using data obtained from participants who were administered two editions of the WAIS, either the WAIS-R and WAIS-III (n = 192) or the WAIS-III and WAIS-IV (n = 284). Each WAIS-R and WAIS-IV subtest was equated to the corresponding subtest raw score on the WAIS-III. Score equating enabled the combination of scores from all three instruments into 1 of 13 age groups before converting raw scores into Z scores. The second part of the study involved examining invariance of the WAIS structure across standardization samples via multi-group latent variable models.

Some factor loadings and all of the subtest intercepts were found to be non-invariant when comparing the WAIS-R and WAIS-III samples on the equated scores. Thus, score changes reflect, at least in part, a recalibration of the instrument's metric or scale. Conversely, when comparing the WAIS-III and WAIS-IV samples on the equated scores, strict invariance was tenable. Thus, score changes between the WAIS-III and WAIS-IV most likely reflect changes in psychometric g rather than changes to the instrument. These results suggest that there is some evidence for an increase in intelligence, but also call into question many published FE findings as presuming the instruments' scores are invariant when this assumption is not warranted.

Even though score comparability across instruments depends on a minimum level of invariance, FE studies do not typically examine this assumption. Thus, any difference reported in manifest scores from these instruments (e.g., FSIQ) could just as easily be due to changes in the instrument as due to changes in the examinees. Our use of score equating and assessment of invariance in the present study allows for a more direct test of whether the FE arises from genuine secular changes in intelligence or simply reflects changes to the test. It appears that there is evidence for a rise in the level of psychometric g from between the time the WAIS-III and WAIS-IV were normed, but little is known about the period between the WAIS-R and WAIS-III as the scores are not comparable.

GENETIC AND ENVIRONMENTAL STRUCTURE OF SELF-REGULATION: EXECUTIVE FUNCTIONS AND CONSCIENTIOUSNESS

Daniel A Briley,[1] Laura E Engelhardt, Frank D Mann,
K Paige Harden, Elliot M Tucker-Drob

[1] University of Texas at Austin, daniel.briley@utexas.edu.

Self-regulation refers to the ability and general tendency to maintain alignment between desired and actual psychological states. This core psychological task is thought to guide behavior and depend on the joint input of several cognitive systems. For example, executive functions refer to high-level cognitive control mechanisms that direct lower-level processes necessary for attention, learning, and decision making. Similarly, conscientiousness refers to general tendencies toward disciplined, self-controlled, responsible, and achievement-oriented behavior. Although these constructs appear similar on the surface, the psychometric relation between self-regulatory ability (i.e., executive functioning) and general self-regulatory behavior (i.e., conscientiousness) is not well known.

The current project uses data from the Texas Twin Project to test the structure of self-regulation in a genetically informative sample. Participants (N = 509 individuals, 82 MZ pairs and 195 DZ pairs, mean age = 11.0 years, 46.2% male) completed an extensive battery of twelve executive functioning tasks, and a hierarchical factor model was constructed. Participants self-reported on their levels of conscientiousness, and one of the participants' parents provided an informant-report of conscientiousness. We tested the association between executive functioning and self- and informant-report of conscientiousness, as well as two facets. We used behavior genetic methodology to decompose this association into genetic and environmental pathways.

A hierarchical factor model of executive functioning fit the data well. We specified a general executive functioning factor that was indicated by four subfactors, working memory, updating, switching, and inhibition. Phenotypically, conscientiousness was weakly associated with executive functioning (r's approximately.15). Convergent validity was somewhat larger for informant-report variables and for facets related to self-discipline (as compared to order). These associations were primarily genetically mediated.

Higher levels of executive functioning and conscientiousness are both associated with a host of beneficial life outcomes, such as academic achievement, health, and occupational success. One possible explanation for this common result is that individuals who are able to better self-regulate can use cognitive resources to accomplish goal-directed tasks. The current results indicate that executive functioning and conscientiousness primarily index different self-regulatory mechanisms, despite the high similarity of the motivating theoretical background for each construct. Identifying the causal processes that link self-regulation and intelligence with beneficial life outcomes needs to consider both levels of ability and typical patterns of behavior.

EFFECTS OF GENERAL AND BROAD COGNITIVE ABILITIES ON ACADEMIC ACHIEVEMENT: TESTING BIFACTOR AND HIERARCHICAL MODELS WITH THE NEW WISC-V AND WIAT-III*

Jacqueline M. Caemmerer[1], Timothy Z. Keith[1], Danika L. S. Maddocks[1], Elizabeth G. Walsh[1] and Matthew R. Reynolds[2]

[1] The University of Texas at Austin, j.caemmerer@utexas.edu.
[2] University of Kansas.

Standardized cognitive and achievement batteries are often used to determine appropriate academic placement and interventions. The presumed effects of students' intelligence test performance on their academic achievement, however, may shift as intelligence tests are revised. Furthermore, there is considerable debate about the hierarchical structure of intelligence and the extent to which broad cognitive abilities affect achievement, beyond the effect of g. Therefore, the continued analysis of these possible effects is important to assess the external validity of modern intelligence tests. This study compares the relationships between students' intelligence and achievement using higher-order and bifactor models of intelligence.

Participants were drawn from the standardization linking sample of the WISC-V and WIAT-III (N = 181). Students ranged in age from 6 to 16 (M = 11.82) and there were 81 girls and 100 boys. Half of the sample was White, 21% Hispanic, 20% Black, 7% Other, and 2% Asian.

Structural equation modeling will be used to test the effects of two cognitive models on achievement—a higher-order and a bifactor model. Both include *g* and five broad cognitive abilities (Gc, Gf, Gv, Gsm, and Gs) measured by 16 WISC-V subtests. These cognitive models will be used to explain students' reading, math, and writing performance (measured by 14 WIAT-III subtests). To account for developmental differences, interactions between age and the latent broad abilities will be tested.

Preliminary results suggest some areas of agreement between the two models of intelligence and the effects of the broad abilities on achievement. Gc and Gsm showed significant effects on reading achievement in both the higher-order and bifactor models. Math achievement was significantly influenced by Gf, Gsm, and Gs in both models. In contrast, writing achievement was significantly affected by Gc and Gsm in the higher-order model, but by no broad abilities in the bifactor model. Preliminary analyses showed *g* to have only indirect effects in the higher-order model. Additional models will be tested, including interactions between significant latent cognitive broad abilities and age.

The majority of studies investigating the likely effects of students' cognitive test scores on academic achievement have analyzed data from the Woodcock-Johnson tests, and thus there is a need for research with other cognitive tests. Because the Wechsler scales are the most commonly used cognitive tests with school age children, research investigating the relations between the recently-released WISC-V and measures of achievement may provide important information to guide interpretation of students' test results.

Previous research has examined differences in effects separately by age group, but has often done so qualitatively. We will address this gap by testing differences quantitatively. This research also contributes to the field by comparing effects for bifactor and higher-order models.

* Presentation is eligible for a Student Award.

POSTERS IN ALPHABETICAL ORDER BY AUTHOR LAST NAME

USING THE RESULTS OF GENOME-WIDE ASSOCIATION STUDIES TO ESTIMATE THE AVERAGE GENOTYPIC IQS OF POPULATIONS: AN EARLY-STAGE REGRESSION ANALYSIS

Gregory B Christainsen[1]

[1] California State University, East Bay, gregory.christainsen@csueastbay.edu.

This paper outlines and extends research that shows promise in the years ahead. The research takes alleles that have been found to have a statistically significant association with cognitive ability and enters a measure of their population frequencies into regressions for the determination of a population's average phenotypic IQ. Measures of living conditions at or near the test-takers' time of birth are included in the regressions as control variables. Average genotypic IQs are then defined and estimated for various populations around the world. In light of its low phenotypic IQ scores and explosive population growth, the development of genotypic IQ estimates for the genetically diverse peoples of sub-Saharan Africa is of special concern.

Since many alleles may influence intelligence, regressions are kept manageable by characterizing a population's allele frequencies with a single number, referred to as an intelligence-allele factor score for that population. The international collaboration known as the 1000 Genomes project has thus far yielded genomic data for 26 population groups worldwide. Data from Yale's ALFRED project are available for 50 population groups. Data for the control variables are based on standard international statistics. IQ data have been collected for hundreds of studies referenced by Lynn and Vanhanen (2012). Multicollinearity issues are addressed through the use of stepwise regressions. The paper includes an effort to adjust for spatial autocorrelation in the data.

For the genomic data collected thus far, the finding is that there are statistically significant differences in intelligence-allele factor scores across macro-races. These differences are strongly correlated with phenotypic IQ scores, with East Asian scores being especially high and sub-Saharan African scores being uniformly low, regardless of the specific ethnic group examined. Using the genomic findings that have been replicated, the early-stage estimate is that East Asians have average genotypic IQs that are a few points higher than those of northern Europeans. Sub-Saharan Africans are found to have average genotypic IQs that are close to the average phenotypic IQ of today's African-Americans. These genotypic IQs are about 14 points lower than those for northern Europeans.

The results for Latinos, non-European Caucasoids, and Southeast Asians -- excluding Vietnamese -- are less clear-cut thus far. Recent – but unreplicated – genomic findings imply less-pronounced differences in average genotypic IQs between sub-Saharan Africans and other population groups. The findings highlight the fact that we are still at an early stage of this kind of research. Even if, as the paper finds, the average genotypic IQ-difference between northern Europeans and sub-Saharan Africans could be as small as 7 points, the differences are important in the context of the United Nations' projection that the population of Africa will reach 4 billion by the end of the 21st century.

SEX DIFFERENCES IN ABILITY TILT

Thomas R. Coyle, Miranda C. Richmond and Anissa C. Snyder[1]

[1] University of Texas at San Antonio, thomas.coyle@utsa.edu.

Although *g* is the best predictor of life outcomes (academic achievement), non-g factors may also predict such outcomes. One non-g factor with predictive validity is ability tilt, the difference in math and verbal scores on tests (SAT). There are two types of tilt: math tilt (math>verbal) and verbal tilt (verbal>math). Whereas prior studies have examined tilt in the profoundly gifted (1 in 10,000 in ability), the current study examines sex differences in tilt in nongifted subjects. Nongifted subjects show flatter ability profiles (less tilt), which may lower the predictive validity of tilt. Unlike prior studies of nongifted subjects, the current study is the first to examine sex differences in tilt for outcomes after college (occupations, but also college majors and specific abilities).

Subjects (866 males and 1084 females) were drawn from the National Longitudinal Survey of Youth, a representative sample in the U.S. Tilt was based on math minus verbal scores on the SAT, ACT, and PSAT (in high school). College majors were STEM majors (science, technology, engineering, math) and humanities majors (English, history, languages). Occupations (around age 30) were STEM jobs (chemist, biologist, engineer) and verbally-loaded jobs (media, law, counseling). Specific abilities (math, verbal) were based on the Armed Services Vocational Aptitude Battery (ASVAB). Sex differences in levels (or frequency) of tilt were examined with ANOVAs (chi-squares), and tilt relations with specific abilities were examined with structural equation modeling. Significant effects are reported at $p<.05$.

Tilt was unrelated to *g* (based on the ASVAB) for males and females ($r < .10$), confirming its non-g status. Math tilt (math>verbal) on all tests (SAT, ACT, PSAT) was more common for males, whereas verbal tilt (verbal>math) was more common for females. In addition, STEM majors and jobs were more common for males, whereas humanities majors and verbally-loaded jobs were more common for females. For both sexes, STEM majors and jobs were associated with math tilt, and humanities majors and verbal jobs were associated with verbal tilt ($r \sim .35$). Also for both sexes, math tilt predicted math ability (on the ASVAB), and verbal tilt predicted verbal ability (betas ~ .30), confirming the construct validity of tilt. The results were confirmed for all tests (SAT, ACT, PSAT).

This study is the first to examine sex differences in tilt for nongifted subjects. Tilt was unrelated to g, confirming its non-g status, but still differentiated males and females. Males tended to show math tilt, which predicted STEM outcomes, whereas females tended to show verbal tilt, which predicted verbal outcomes. The absence of sex differences in tilt relations (with jobs and majors) suggests that males and females with math tilt prefer STEM whereas those with verbal tilt prefer humanities. An important question for public policy is why fewer females show math tilt (which may reduce STEM participation). Future research will examine tilt at earlier ages (elementary school) and also examine other abilities (spatial ability) that may contribute to sex differences in tilt and STEM.

N-BACK COGNITIVE TRAINING IMPROVES EXECUTIVE FUNCTION, WORKING MEMORY AND FLUID INTELLIGENCE

Cai-Ping Dang and Yushi Bai[1]

[1] Guangzhou Medical University,China, dcp619@163.com.

Recently, training results from children, adults, and people with attention deficit/hyperactivity disorder, and alcohol spectrum disorders have demonstrated that an individual's working memory (WM) ability is plastic. Updating is an essential component in the central executive component of WM, which recently has attracted great attention in the WM study field. The major function of updating is to continuously and simultaneously change the contents in the working memory load according to newly presented information. This study explores if the N-back training can improve executive function, working memory and fluid intelligence.

Subjects: 60 college students from China were randomly assigned unique ID codes for use on pre- and post-test measures and for program use tracking. Among them, 30 students were in experiment group with training, and another 30 were in control group without any training.

Training procedure: Students in the intervention group spent 20–30 minutes each day (excluding school closure days) for four weeks using an interactive N-back training program.

Tests: All the participants were tested on executive function, working memory and fluid intelligence in pretest and posttest. Statistic: To compare the difference of executive function, working memory, and fluid intelligence in pretest and posttest.

1) Two components of executive function--- updating and transfer were improved by N-back training, but not inhibition.
2) Two components of working memory--spatial and verbal working memory were improved by training, but not digit working memory.
3) All the components of Fluid intelligence were improved by N-back training.

Based on recent work, there was reason to believe that intensive and adaptive N-back training is a viable vehicle to boost some key cognitive abilities, especially fluid intelligence, and as a result, achievement in school-related skills. But the contribution of N-back training is limited in executive function and working memory.

SPATIAL COGNITION AND LEARNING AMONG CHILDREN AND ADULTS IN TWO TRADITIONAL AND TRANSITIONING POPULATIONS

Helen Elizabeth Davis, Karen Kramer, Elizabeth Cashdan[1]

[1] University of Utah, helen.davis@anthro.utah.edu.

Across a wide range of societies, males range farther than females, are more confident in their abilities to navigate and do better at many spatial activities. While these gender differences are well-documented in the west, much less is known about spatial exploration and cognition among people, especially children, in traditional societies. To address this empirical gap, the proposed research focuses on three main questions. 1) What is the age and gender patterning of spatial abilities among Maya and Tsimane adults and adolescents? 2) How do differences in harm avoidance perceptions shape boys' and girls' spatial behavior and cognitive reasoning? 3) How do these patterns vary across children whose families are experiencing novel socioeconomic changes in subsistence and education?

Using data collected in a remote rural community in the Yucatan peninsula of Mexico (N=130) and among the Tsimane forager-horticulturalists of central Bolivia (N= ~120) this project assesses the developmental processes that underlie spatial learning in a non-western context among adults and children (during the juvenile period (8-18)). Path analysis and multi-level modeling help to evaluate data collected through interviews, tests of cognitive performance and spatial ability between boys and girls.

Preliminary results among the Maya suggest that among adults, females report significantly higher levels of spatial anxiety (mean = 2.62, sd = .474) than males (mean = 2.45, sd = .486; t= −2.158, df=152, p = .033). Males were also more proficient at spatial ability tasks (t = −3.601, df=139, p <.001). However, early comparative results among the Tsimane suggest that environmental and social variation may play a significant role in the degree of difference found between sexes in these two populations.

This project presents a unique opportunity to learn whether age and gender differences in spatial cognition and anxiety, as documented in the west, are a generalizable feature of human ontogeny or are conditioned by specific aspects of growing up in a protected environment (Blackwell et al. 2011; Barkley and Gabriel 2007).

Analyses of Maya and Tsimane activity data suggest that, compared to people living in a market-based society, boys and girls are more independent and explore a broader physical environment at younger ages. However, recently, activities and behaviors have shifted as groups transition into the market economy, which offers a unique look at the cultural and behavioral impacts that shift will have on traditional child development within and across age groups.

SUBCORTICAL INTELLIGENCE: THE ROLE OF THE CAUDATE NUCLEUS IN GENERAL COGNITIVE ABILITY

Colin G. DeYoung[1]

[1] University of Minnesota, cdeyoung@umn.edu.

Most models of the neurobiological substrates of intelligence have focused on the cortex. This is understandable given that the cortex appears to have evolved to facilitate more complex information processing than what is afforded by the phylogenetically older subcortical structures. However, certain subcortical structures, such as the caudate nucleus and the hippocampus, are crucially involved in learning and could reasonably be expected to contribute to intelligence conceived as general cognitive ability (the positive manifold of performance on any sufficiently challenging cognitive task). I will present evidence from both structural and functional magnetic resonance imaging (MRI) studies implicating the caudate in intelligence.

Study 1 involved three healthy, adult samples ($N = 517$). High resolution structural brain images from 3T MRI scanners were analyzed using FreeSurfer to assess volume of subcortical structures. IQ was assessed using the four subtests of the WASI and regressed on volumes of subcortical brain structures, controlling for sex, age, and total brain volume. Study 2 involved 94 healthy, male subjects completing an fMRI task, in which they guessed whether a computer-generated number would be high or low, received feedback on whether their guesses were correct, and won or lost money based on accuracy. Neural reward-prediction error signals following feedback were assessed in the anterior caudate. Indices of behavior in the task and neural signals were regressed on IQ.

In Study 1, the caudate nucleus was the only subcortical structure for which volume was significantly associated with IQ across all 3 samples (incremental r-squared ranged from 2.4 to 4.2). In Study 2, IQ predicted guessing behavior in a manner suggesting that high IQ participants were influenced by more previous information and concluded more quickly that the sequence of numbers was random. Neural signals in the caudate were consistent with this pattern, as low IQ participants showed prediction-error signals to losses longer, as if they expected to be able to guess correctly, implying they had not learned the sequence was random. This implicates learning processes involving the caudate in IQ.

Although previous neurobiological theories of intelligence have focused on the cortex, the present research suggests that at least one subcortical structure deserves to be considered for its role in intelligence. The caudate nucleus is crucially involved in learning, especially trial and error learning, and this may link it to intelligence. Future research needs to be aimed at determining the specific mechanisms that account for the association of IQ with caudate structure and function.

THE EFFECTS OF METHYLMERCURY ON GENERAL INTELLIGENCE IN CHILDREN AND YOUNG ADULTS

Fróði Debes[1], Arne Ludvig[1], Esben Budtz-Jørgensen[2],
Pál Weihe[1], Philippe Grandjean[3]

[1] The Faroese Hospital System, kontakt@frodidebes.dk.
[2] Dep. of Biostatistics, University of Copenhagen.
[3] University of Southern Denmark, Odense.

The research question is if prenatal exposure to methylmercury, from the mother's diet, originating from the accumulation of methylmercury in the marine food chain, has an adverse effect on the development of the nervous system of the subjects.

A birth cohort (N = 1022) was assembled in the Faroe Islands during a 21-month period in 1986–1987. The primary indicator of intrauterine exposure to MeHg was the mercury concentration in cord blood. Concentrations of MeHg in maternal hair at parturition were also determined. The frequency of maternal intake of fish and of pilot whale meat was available from a questionnaire administered shortly after parturition. Information about PCBs and lead was obtained from cord blood. Presented are SEM-analyses of neuropsychological examinations at age 7, 14 and 22 years. The three waves of examinations will be modelled in accordance with CHC-theory and will then be combined in a longitudinal design, testing the effect of methylmercury on the general factors of intelligence.

Results have been published from the studies at age 7 years and 14 years, and a paper reporting the results from age 22 years is in press. Negative effects of methylmercury were found on several single tests from different domains at all three ages. At age 14 years negative effects were also found on first-order factors. At age 22 years a negative effect was found on the general factor of intelligence. Reanalyses of the data, testing the effect of methylmercuriy on a g-factor for all the three waves in a longitudinal design are in progress.

This work examines the effects of an environmental pollutant on human cognitive abilities. It may contribute to our understanding of a preventable adverse effect on intelligence, and be of importance for public health. Important is also the question about which measurement methods psychology should suggest medical epidemiology to apply, i.e. multiple single tests grouped into broad functional domains, first-order factors alone or in combined models, higher-order models with a g-factor or or the method of correlated vectors.

THE SKEWNESS OF INTELLIGENCE DISTRIBUTION AS A NATURAL MECHANISM FOR ALLOCATING POPULATION INCOMES

Yury S. Dodonov[1]

[1] High school №15, Electrostal, physics teacher, ys.dodonov@gmail.com.

Increasing populations continue to reduce the per capita availability of natural resources. The key question of the present study is how this trend (local or global) influences intelligence distribution.

Basic assumptions:

– Function income/intelligence has a positive first derivative;
– The intelligence distribution does not necessarily imply a symmetric distribution;

Researchable issues:

– How does a lack of resources impact intelligence distribution?
– How can shape of function income/intelligence impact intelligence and income distribution?
– Is there a critical point of intelligence skewness?

Mathematical and computer modelling. Simulation study.

Income distribution is always more right-skewed than intelligence distribution regardless of the growth rate of the income/intelligence function.

– The lack of resources inevitably leads to positive deformation of intelligence distribution regardless of the growth rate of the income/intelligence function.

– Regulating the allocation of incomes can be realized by changing the bias of the intelligence distribution, by changing the growth rate of the income/intelligence function, or by changing both factors.

– In the case of a serious lack of resources, future right biasing does not matter.

The normal shape of the intelligence distribution is not greater than our mathematic illusion. The positive biasing of intelligence distribution is a natural process in situations where the per capita availability of resources is reduced; it seems unlikely that we can significantly impact this process. One of the main dangers we deal with is the probability of the critical bias of intelligence distribution. How can we detect this occurrence? What can we do about it? If we are trying to alter the shape of the intelligence distribution, perhaps we are trying to swim against the current? Can we keep track of low biasing intelligence distribution? Can we predict its biasing on macroeconomic indicators? This study produced more questions than answers.

EXECUTIVE FUNCTION AS A DEVELOPMENTAL ENDOPHENOTYPE FOR INTELLIGENCE AND ACADEMIC ACHIEVEMENT*

Laura E. Engelhardt, Daniel A. Briley, Frank D. Mann,
K. Paige Harden, and Elliot M. Tucker-Drob[1]

[1] The University of Texas, lauraeng@utexas.edu.

Executive functions (EFs) are supervisory cognitive processes that monitor, coordinate, and control the execution of other cognitive operations necessary for learning and everyday functioning. Individual differences in children's EFs have been linked consistently with individual differences in intelligence and academic achievement, leading many to suggest and that EFs serve as foundations onto which higher-order cognitive abilities are scaffolded. In early adulthood, EF factors are nearly entirely heritable, but the genetic basis for developing EFs has largely gone unexplored.

A racially and socioeconomically diverse sample of over 600 3rd-8th grade twins from the Texas Twin Project completed an in-lab battery of tests tapping cognitive ability, executive functions, and academic achievement. Behavioral genetic analyses were employed to estimate genetic and environmental influences on a common, higher-order EF factor and on variance unique to four core EF domains: Inhibition, Switching, Working Memory, and Updating.

We find that the common EF factor is 100% heritable, indicating that correlations among the four EF domains are entirely attributable to shared genetic etiology. We go on to examine the extent to which this genetically influenced common EF factor mediates genetic influences on a number of measures of intelligence and academic achievement.

General EF may serve as an early life marker, or endophenotype, of genetic propensity for a range of functions and pathologies later in life, including those linked to deficits in cognition and academic achievement.

* Presentation is eligible for a Student Award.

EFFECTS OF RESPONSE ALTERNATIVES ON CNV AMPLITUDES IN THE HICK PARADIGM: RELATIONS TO REACTION TIME AND FLUID INTELLIGENCE

Matthew J. Euler, Hannah M. Schryver, Douk Chon, Eleonora D. Vaccariello[1]

[1] University of Utah, matt.euler@psych.utah.edu.

A large body of research has examined correlations between reaction time (RT) and intellectual ability, though the neural correlates of that relationship and its potentially moderating task effects are comparatively understudied. Markers of anticipatory neural activity such as the EEG Contingent Negative Variation (CNV) represent compelling possible mediators of RT-ability relations, and provide a means to study neural processes that may drive task-specific effects. The goal of this study was to assess the effect of increasing numbers of response alternatives on CNV amplitudes preceding RT, and to evaluate relations therein to fluid intelligence (Gf).

Forty-three, right-handed, undergraduate psychology majors were administered the WAIS-IV and performed a version of the Hick paradigm during EEG recording. The Perceptual Reasoning Index served as the measure of Gf. The Hick paradigm consisted of 96 trials each of simple, 2-choice, and 4-choice RT conditions, which were randomized within blocks. Each trial involved a cue indicating the condition, followed by a warning stimulus, a variable inter-stimulus interval (range 1-2.4 sec.), and a reaction stimulus. Participants responded with their right hand. EEG data were epoched time-locked to the onset of the warning stimulus. CNVs were quantified as the average amplitude from 875-1000 msec. post-stimulus at the central electrode Cz, and neighboring left (C3) and right-central electrodes (C4).

RT increased while CNVs generally decreased as a function of increasing response alternatives. Linear and quadratic trends were significant for both variables, indicating a smaller condition effect between the choice RT conditions. CNVs were larger overall at Cz relative to C3 and C4. This effect interacted with condition where activation decreased from simple to choice RT at Cz and C3, with no condition effect at C4. Gf significantly predicted overall, 2, and 4-choice RT ($r \geq -.36$, $p < .02$), and the latter effects were significantly stronger than that for simple RT ($z \geq -2.0$, $p < .05$). Last, in the 4-choice condition, CNVs showed differential effects such that only C4 activation predicted RT ($r = .41$, $p = .006$), whereas only Cz showed a trend toward predicting Gf ($r = -.29$, $p = .06$).

RT and anticipatory neural activation showed similar effects of increasing response alternatives. Detrimental trends of increasing alternatives on both RT and CNVs were negatively accelerated, indicating a larger difference between simple and choice RT than between different numbers of choice alternatives. The study also replicated findings of stronger RT-ability relations for choice than simple RT (e.g., Deary, Der, & Ford, 2001), but suggested complex effects on CNVs. Taken together, the results suggest that identifying the mechanisms involved in simple vs. choice RT performance may help shed light on the neural substrates of RT-ability relations. Follow-up analyses of response-locked trials will clarify the time course and topography of activation most central to variation in RT and Gf.

THE STRUCTURE OF INTELLIGENCE EMERGING FROM THE WISC-IV IN CHILDREN WITH SPECIFIC LEARNING DISABILITIES: SPECIFICITIES AND GENERALITIES

David Giofrè and Cesare Cornoldi[1]

[1] Department of General Psychology, University of Padua, Italy, david.giofre@gmail.com.

Children with specific learning disabilities (SLD) are characterized by poor academic achievement despite an average intelligence. They are typically assessed not only with achievement tests, but also with intelligence tests, usually the Wechsler Intelligence Scale for Children (WISC). The assumption of a discrepancy between IQ and achievement in children with SLD has been questioned, however, and the implications of using different measures in batteries of intellectual subtests have not been thoroughly investigated.

Under the auspices of the Italian Association for Learning Disabilities (AIRIPA), we invited a group of clinicians to provide data obtained by administering the WISC-IV to children with a certified clinical diagnosis of learning disorder, based on the ICD-10 International Coding System. For the present study, we collected information on 910 children and adolescents between 7 and 16 years of age who underwent a WISC-IV assessment on the 10 core subtests, and were diagnosed clinically with SLD (M age = 10.92 [SD = 2.41]; females = 40%). These children were compared with the children considered for the Italian national standardization.

The present study showed that children with SLD and typically-developing controls have partly similar and partly different intellectual patterns, as measured by the WISC-IV. This scale proved useful, but not all the tests had the same g-content in the two groups. When assessing intellectual abilities in children with SLD, it therefore seems reasonable to prefer a less biased measure or other non-verbal measures of intelligence.

Our findings may have important theoretical implications because they confirm that children with SLD can be of average intelligence even though they struggle with the WMI and PSI, and these factors are not associated with the g-factor in the same way as in typical development. Our results can also have clinical implications, indicating that it may be very difficult to assess intelligence in children with atypical development, so examiners will need to test their own "intelligence" when interpreting the results of such scales.

USING INTELLIGENCE TO PREDICT RESPONSE-TO-INTERVENTION: AN APPLICATION OF INTEGRATIVE DATA ANALYSIS IN PROJECT KIDS

Sara A. Hart[1]

[1] Florida State University, hart@psy.fsu.edu.

There has been a growing body of work, which suggests that the individual traits that a child brings into an intervention project have an interactive effect on literacy learning. Even within intervention studies shown to be impactful at the mean level, there are individual differences in how children responded to the intervention. I contend that there are numerous (typically unmeasured) sources of these individual differences, and for this talk I will present data examining the role of both crystallized and fluid intelligence in predicting individual differences in response-to-intervention, with data pooled across multiple projects allowing for generalization beyond any given intervention protocol.

Integrative Data Analysis (IDA; Curran & Hussong, 2009) was used to create a pooled source of Project KIDS raw data of 545 kindergarten and first grade children (age M = 5.6yrs) who had previously participated in one of three literacy-based randomized control trial interventions in the treatment group. IDA allows for raw data from each project to be combined and heterogeneity, such as age and project, controlled for. Reading was measured as pre- and post-intervention scores on the Woodcock Johnson Tests of Achievement Letter-Word Identification (LWID) subtest, crystallized intelligence was measured using a pre-test mean raw score across the KBIT-2 Verbal Knowledge and Riddles subtests, and fluid intelligence was measured using a pre-test raw score from the KBIT-2 Matrices subtest.

As a first step of IDA, a moderated nonlinear factor analysis was used to create scale scores which are project invariant for the constructs of interest. I then used Proc Mixed to calculate covariance adjusted scores to model change from pre-test to post-test for LWID, operationalizing "response-to-intervention". Quantile regression was then used to model both crystallized and fluid intelligence predicting response-to-intervention. The models indicated that both crystallized and fluid intelligence were statistically significant predictors across the distribution of response-to-intervention, although for both, the effect was statistically greater for the students who made the greatest gains due to the intervention.

These results indicate that brighter children do even better in an intervention that is impactful for most students. Although certainly not surprising for the audience of ISIR, child traits such as intelligence are not often included in determining response-to-intervention in education studies, and I argue that it is important moderator that should be considered. Beyond these specific findings, I will discuss how we will use these pooled data to exploring many other sources of moderation of response-to-intervention, including other cognitive traits, behavioral traits, the environment and family history. This work will expand the understanding of how and why some children are more successful when receiving gold-standard educational interventions.

SHEDDING LIGHT ON INTELLIGENCE, CREATIVE FLUENCY, AND CREATIVE ACHIEVEMENT

Linda S. Houser-Marko and David H. Schroeder[1]

[1] Johnson O'Connor Research Foundation, Lhmarko@jocrf.org.

The question of the relationship between creativity and intelligence is an intriguing one. Some have found that general intelligence correlates with measures of creativity and with creative achievement. Many researchers have found that there might be a threshold above which intelligence has less of an effect on creativity, and creativity (as measured), perhaps, has more of an effect on actual achievement.

We wanted to know more about the relationship between intelligence, creative fluency, and creative achievement. For example, we wanted to know more about creative achievement. Also, might the group factors of intelligence correlate differently with creative achievement? Likewise, we will consider the sub-areas of creative achievement as well.

Our sample consisted of 511 adults who had completed all of the measures of interest. Age ranged from 22 to 76 years old, with a mean age of 32.4 years old, and a median of 28 years old. Notably, the sample was made up of clients of the Johnson O'Connor Research Foundation (JOCRF), who are generally more highly educated, with 80% of the sample being college graduates or greater. Participants completed a battery of cognitive tests administered by JOCRF. The tests reflect the group factors of reasoning, numerical abilities, spatial ability, and memory, which can be combined as intelligence, as was done in Haier et al. (2009). Participants also completed the JOCRF measure of creative fluency (c-fluency), as well as a measure of creative achievement (c-achievement, CAQ, Carson et al., 2005).

Regarding the threshold hypothesis, for higher levels of *g* (M + 1 SD), the relationship between c-fluency and c-achievement was $r = .23$, but not significant between c-fluency and *g*, or *g* and c-achievement. For values of *g* that were between the mean and mean + 1 SD, the c-fluency and c-achievement relationship was $r = .22$, for *g* and c-achievement it was $r = .16$, but not significant between c-fluency and *g*. For *g* below the mean, the relationship between c-fluency and c-achievement was $r = .18$, for c-fluency and *g* it was $r = .17$, and not significant for *g* and c-achievement. Considering four factors of intelligence as they relate to c-achievement, the spatial factor was related ($r = .10$) and the reasoning factor was related ($r = .09$). Partial correlations will be examined further.

This study shows that: 1) The JOCRF measure of creative fluency was a consistently strong predictor of creative achievement. 2) There was a threshold above which intelligence did not factor in to creative achievement. There was also an inverted U effect where intelligence was related to creative achievement for the middle level of intelligence, but not for the cases where intelligence was lower than the mean level of g. 3) When looking at the group factors, spatial ability and reasoning were related to creative achievement. Relationships between creative fluency and intelligence and the domains of creative achievement will be discussed.

AN APPLICATION OF EXPLORATORY DATA MINING IN PROJECT TALENT*

Ross C Jacobucci[1], John J McArdle[1], John J Prindle[2]

[1] University of Southern California, jacobucc@usc.edu.
[2] Max Planck Institute for Human Development.

Even though the factor structure of the numerous cognitive measures have been evaluated in previous and current research, less is known about how many of the 1,000+ non-cognitive variables included in PT relate to the factor structure of intelligence. PT represents an ideal opportunity to conduct an exploratory search, using SEM Trees, to find both individual items and clusters of similar items that separate individuals into subgroups. Our question was how can we use SEM Trees to find demographic, information, interest, or other types of items that are important predictors of intelligence, and may be worth further study. Although methods for assessing the factor structure of intelligence have existed for over 100 years, statistical models for searching large numbers of the data were collected as part of the Project TALENT (PT) experiments in 1960. The resultant data includes scores on 2,105 items from the Base Year of PT with almost N~377,000 individuals. Only 10,000 of these cases were used for reasons of computational speed, and facilitated validation of model results. Using 22 cognitive variables, five different factor structures were tested. These include a one factor first-order model, a second-order one factor, a two-factor model, 8 factors, and finally a bifactor model with one general and 8 specific factors. Using these factor structures as outcomes with Structural Equation Model Trees (SEM Trees), 1,478 covariates were used to identify hierarchical subgroups.

Five separate trees were created across the five different tree structures. Covariates that were important in creating subgroups were in some cases expected, and in some cases surprising. Separating cases on gender proved to be rather important, resulting in large discrepancies between genders in both intelligence factor mean and variance, even when including the thousand plus other covariates. Additionally, differences between ethnic groups were found in the upper 3 levels of multiple trees. Regarding interest and information variables, two that were used to create subgroups at the top levels of the trees were a question that asks: "An allergy is an abnormal" , as well as splitting between different types of high school curriculums.

The study demonstrated two things. One was how a new machine-learning algorithm, SEM Trees, can be used to conduct exploratory search in relation to the factorial structure of intelligence. The second was how through our analysis in PT, we found a number of non-cognitive variables that showed a significant relationship with the factor structure of intelligence, ultimately deriving theoretically meaningful subgroups. All analyses were conducted with the open source R statistical environment and with the publicly available PT dataset, therefore, the analyses could be replicated by other researchers or tailored to answer more specific questions than our broad target.

* Presentation is eligible for a Student Award.

GENETIC AND ENVIRONMENTAL PATHWAYS LINKING SES, EDUCATIONAL ATTAINMENT, AND IQ

Wendy Johnson[1], William G. Iacono[2], Matt McGue[2]

[1] University of Edinburgh, wendy.johnson@ed.ac.uk.
[2] University of Minnesota.

As in many samples, childhood SES moderated genetic influences on IQ at age 17 in the younger cohort of the Minnesota Twin Family Study (MTFS), with greater genetic variance independent of SES at higher levels of SES. Despite .44 correlation between IQ at 17 and educational attainment at 25, childhood SES was associated with less genetic variance independent of SES in educational attainment at higher than lower levels of SES. Childhood SES has consistently been associated with both (IQ .33, educational attainment .41 here), and, aggregating across studies, there is considerable evidence for reciprocal associations between IQ and educational attainment; can these contrasting moderating influences of SES help identify involved genetic and environmental transactions?

The younger MTFS cohort, which has 1260 twin pairs recruited at age 11, followed approximately every three years through age 25. It was recruited from population records, so is quite population-representative, with 80+% participation and 90+% retention over time. We evaluated whether and how childhood SES moderated genetic and environmental variance in school engagement independent of SES at age 17, and whether and how this engagement moderated genetic and environmental influences on IQ and educational attainment at age 25. We are not aware of other studies that have explored the moderating influences of SES on educational attainment, or observed the IQ-educational attainment SES moderation contrast.

Childhood SES and school engagement at age 17 correlated .28. SES moderated both genetic and non-shared environmental influences on school engagement, with less variance independent of SES in both at higher than lower levels of SES. School engagement moderated educational attainment at age 25, with less genetic but more shared environmental variance at higher than lower levels of school engagement, with very high positive correlation of shared environmental influences. School engagement also moderated IQ at age 25, but there was more genetic and non-shared environmental variance at higher than lower levels of SES. Moreover, the shared environmental influences were completely negatively correlated.

School engagement appeared to mediate associations between childhood SES and both IQ and educational attainment in this sample. Those more genetically inclined to 'like school' tended to have higher-SES backgrounds and/or higher SES did more to maintain engagement, despite genetic inclinations. Interpretation is similar for engagement's influences on genetic variance in educational attainment, but the opposite for its shared environmental influences, and for genetic influences on IQ. Moreover, shared environmental influences on engagement appeared to undermine IQ. This suggests that a major aspect of childhood SES in this sample involved attitude to educational achievement, and SES stratification by genetic influences on IQ. Schools appeared to undermine the attitudes and their influences.

HYPER BRAIN/HYPER BODY – THE TROUBLE WITH HIGH IQ*

Ruth, I, Karpinski[1]

[1] Pitzer College, ruth_karpinski@pitzer.edu.

Having a high IQ is touted as predictive of positive outcomes such as educational success and income level. Yet, less is understood about the complicated dilemmas found within this population. Those with high IQ may be at risk for disorders that involve dysregulated immune and inflammatory responses (e.g., Autism, ADHD, and depression) which are a delicate interplay between genetic predisposition and environmental factors.

The present study first asks if there is a relationship between high IQ and physical and/or emotional sensitivities elsewhere in the body including autoimmune disease. Does this, along with environmental factors, genetically pre-dispose offspring to various neuro-immune disorders? Lastly, does the level of parental IQ correlate with disorder severity in their offspring?

This cross-sectional study contained two groups (n = 200) used to compare those within the upper 2% of intelligence against those who fall within an average range.

The first group consisted of 100 members of MENSA who each qualified for membership by receiving a minimum score at or above the 98th percentile on an approved IQ test. Participants were recruited from MENSA's research volunteer database.

Those in the average IQ group were comprised of 100 individuals recruited from Amazon Mechanical Turk (MTurk). It was assumed that only 2% of this population would have IQ scores which would qualify them for MENSA membership.

Subjects responded to 70 questions regarding various auto and neuro-inflammatory conditions along with other physiological, psychological, and environmental factors.

Results and conclusions: [PENDING]

We believe these questions are extremely relevant due to the current epidemic proportion of neuro-inflammatory disorders being diagnosed in children with the number continuing to rise at an alarming rate. The present paper will cast a wide net in order to establish significant relationships between suspected variables found within high cognitive ability that may contribute to this phenomenon. The ultimate goal is that any significant results will be used as a springboard for more focused experiments on the impact that a hyper brain (high IQ) can have on the body and mind.

* Presentation is eligible for a Student Award.

BEYOND HUMAN CAPITAL: CIVIC ENGAGEMENT AND COMMUNITY INVOLVEMENT AMONG INTELLECTUALLY PRECOCIOUS YOUTH AT MIDLIFE

Harrison J. Kell[1], David Lubinski[2], Camilla P. Benbow[2]

[1] Educational Testing Service (ETS), hkell@ets.org.
[2] Vanderbilt University.

It is well-established that intelligence is associated with human capital development, including educational attainment, income, and creative production (Kell, Lubinski, & Benbow, 2013; Lubinski & Benbow, 2006). Much less attention has been paid to intelligence's role in the development of social capital, such as participation in civic life through voting and community involvement. This study fills this gap by examining community engagement in two samples of individuals in the top 1% of cognitive ability. This research simultaneously informs the debate about the deterioration of social capital in the United States, a concern expressed by academic and popular figures of all political viewpoints (Bishop, 2009; Freeland, 2012; Murray, 2013; Putnam, 2001).

A cohort of intellectually talented 13-year-olds was identified from 1972 to 1974 as being in the top 1% of mathematical reasoning ability using above-level testing. About four decades later (mean age = 53), data on many aspects of 1,159 (61% male) of their lives were gathered using a comprehensive survey (Lubinski, Benbow, & Kell, 2014). Participants' responses to a wide variety of questions about civic engagement (e.g., voting) and community involvement (e.g., organizations volunteered for, hours volunteered per week) were examined as a function of sex and education. A second cohort of 491 gifted 13-year-olds (top .5%), also longitudinally assessed (mean age = 48), served as a replication sample. Results from both samples were compared to normative U.S Census civic engagement data.

Among the top 1% over 80% voted in presidential elections; female participation exceeded male (92% vs. 84%). Volunteering was common, with 71% of females and 55% having volunteered during the year prior to completing the survey. Females volunteered slightly more weeks per year than males (12 vs. 11) but males volunteered slightly more hours per week than females (6 vs. 5). For both sexes voting increased slightly with educational attainment but hours volunteered increased greatly; individuals with doctoral degrees volunteered over twice as much as those with bachelor's degrees. Patterns were consistently replicated in the second cohort (e.g., over 95% participation in presidential elections). Results compared highly favorably with Census data (e.g., 55% voting rate, 25% volunteering rate).

This is the first large-scale study examining intelligence's role in the development of social capital and participation in civic life since Terman's (1925-1959). Results reveal that many highly able individuals are actively engaged in their communities. Results show that the influence of cognitive ability is pervasive across life domains and that it is a general psychological resource supporting adaptive functioning across multiple contexts (Gottfredson, 1997, 2004). Through its influence on social capital, a high degree of intelligence not only promotes the well-being of those who possess it but also the well-being of those around them. Studies of the top 1% in ability often focus on academic and economic outcomes, but these data put a more "human face" on them and their contributions.

THE DOMAIN-GENERALITY OF WORKING MEMORY: A MATTER OF ABILITY

Kristof Kovacs[1], Dylan Molenaar[2], Andrew R. Conway[3]

[1] Eszterhazy Karoly College, Hungary, kristof340@gmail.com.
[2] University of Amsterdam, The Netherlands.
[3] Princeton University.

Working memory (WM) refers to the processes that enable one to hold goal-relevant information in mind in the face of concurrent processing.

Individual differences in WM are studied with complex span tasks of different domains (spatial, verbal, etc.). There is a positive manifold of such tasks, thus a general factor of working memory capacity (WMC) can be extracted. Yet this conclusion is controversial: there are studies that support domain-specific models.

In intelligence research, the question of domain-generality has been informed by research on differentiation: the phenomenon that across-domain correlations are inversely related to ability. Since WM and fluid intelligence are strongly related constructs which share about half of their variance, differentiation might exist in WM, too.

We investigated differentiation in WMC with the method of moderated factor analysis in two studies with large and already available data sets. The first sample (N= 5316) is from the study by Redick et al. (2012), which used three WM tasks: Operation span, Reading span, and Symmetry span. This study looked for internal moderation by WMC itself on the loadings of the three measures on WMC.

The second sample (*N*=249) is from the study by Kane et al. (2004), which used three spatial WM tasks, three verbal WM tasks, and also measured verbal and spatial short-term memory (STM) with three tasks each. The participants also took five spatial (Gv), five verbal (Gc), and three fluid (Gf) reasoning tests, which makes it possible to investigate external moderation by these factors on WM and STM.

The results demonstrate the existence of differentiation in WM. Results obtained in the first study demonstrate an internal moderation: the loadings of the three complex span measures on a domain-general WMC factor are inversely related to WMC capacity itself. That is, as capacity increases, WMC becomes domain-specific.

The second study demonstrates external moderation by fluid reasoning (Gf) in WM. This means that when fluid reasoning ability is lower, variance in complex span task performance is more domain-general. There was no significant external moderation of crystallised (Gc) and spatial (Gv) intelligence. Moreover, Gf was only a significant moderator for working memory. That is, differentiation only appears to exist in WM, but not in STM.

This is the first set of studies to demonstrate differentiation in WMC. These results inform the debate about the domain-generality of WMC, which appears to be a question of ability: in higher ability samples it is more likely for correlational and latent variable studies to find domain-specific variance and thus identify separate domain-specific components. In samples of lower fluid intelligence a larger portion of the variance is across-domains.

Our results also highlight the importance of the capacity level of the samples studied. Researchers focusing on WM or its relation to intelligence should be cautious about the importance of the ability of the selected sample in general, and using samples consisting of college students in particular.

74 GENOMIC SITES ASSOCIATED WITH EDUCATIONAL ATTAINMENT PROVIDE INSIGHT INTO THE BIOLOGY OF COGNITIVE PERFORMANCE

James J Lee[1], (at least 200 co-authors)[2]

[1] University of Minnesota Twin Cities, leex2293@umn.edu.
[2] Social Science Genetic Association Consortium.

Genome-wide association studies (GWAS) have revealed much about the biological pathways responsible for phenotypic variation in many anthropometric traits and diseases. Such studies also have the potential to shed light on the developmental and mechanistic bases of behavioral traits. Toward this end we have undertaken a GWAS of educational attainment (EA), an outcome that shows phenotypic and genetic correlations with cognitive performance, personality traits, and other psychological phenotypes.

We performed a GWAS meta-analysis of ~293,000 individuals, applying a variety of methods to address quality control and potential confounding. We estimated the genetic correlations of several different traits with EA, in essence by determining whether single-nucleotide polymorphisms (SNPs) showing large statistical signals in a GWAS meta-analysis of one trait also tend to show such signals in a meta-analysis of another. We used a variety of bio-informatic tools to shed light on the biological mechanisms giving rise to variation in EA and the mediating traits affecting this outcome.

We identified 74 independent SNPs associated with EA ($p < 5E-8$). The ability of the polygenic score to predict within-family differences suggests that very little of this signal is due to confounding. We found that both cognitive performance (0.82) and intracranial volume (0.39) show substantial genetic correlations with EA. Many of the biological pathways significantly enriched by our signals are active in early development, affecting the proliferation of neural progenitors, neuron migration, axonogenesis, dendrite growth, and synaptic communication.

We nominate a number of individual genes of likely importance in the etiology of EA and mediating phenotypes such as cognitive performance.

INTELLIGENCE AND PARENT-CHILD RATER-DISCREPANCIES

Justin A Low[1]

[1] University of the Pacific, jlow1@pacific.edu.

The ability to assess one's competencies and deficiencies plays an important role in any domain of learning. In regards to the assessment of behavior, rating scales completed by adolescents and their parents often yield different results. That is, adolescents often see the severity and frequency of their behavior problems differently than their parents. This research will examine whether intelligence influences the degree to which parent and adolescent ratings are congruous. It was hypothesized that adolescents with higher intelligence scores would rate their behavior more congruously with parent ratings than adolescents with lower intelligence scores.

This study used data from 1,364 families from Phase IV of the NICHD-SECCYD. Behavior problems were measured at age 15 using the Child Behavior Checklist (CBCL). Only items that were similar on the parent and self-report forms were retained. Intelligence was measured using the Wechsler Abbreviated Scale of Intelligence at 4th grade. A CT-C(M-1) model of the CBCL was analyzed using mother, father, and self-ratings. Adolescents served as the referent informant. Intelligence was added to the model to determine its effect on rater discrepancies between adolescents and their mothers and fathers.

Results indicated that intelligence significantly predicted rater effects and self-rated behavior problems. Intelligence positively predicted mother-child rater discrepancies in regards to somatic complaints ($p = .049$) and anxiety/depression ($p = .047$). Intelligence negatively predicted mother-child rater discrepancies in regards to hyperactivity ($p < .001$), delinquency ($p < .001$), and aggression ($p < .001$). Intelligence negatively predicted father-child rater discrepancies in regards to delinquency ($p < .001$) and aggression ($p < .001$). Intelligence also significantly predicted self-rated anxiety/depression ($p < .001$).

Intelligence predicted rater-discrepancies differently for internalizing and externalizing behaviors. Consistent with expectations, higher intelligence predicted smaller rater discrepancies between adolescents and their parents when rating the adolescent's externalizing behaviors. Contrary to expectations, however, intelligence predicted larger discrepancies between adolescents and their parents when rating the adolescent's internalizing behaviors. Accordingly, intelligence may only aid in self-assessment when the construct being rated is more observable.

CONCEPTUAL ABILITIES AND THEIR IMPACT TO PSYCHOMETRIC IQ AND EXPERTISE*

Daria N. Makarova and Olga V. Shcherbakova°

[1] Saint Petersburg State University, d.makarova23@gmail.com.

The concept of expertise is usually discussed within the framework of concrete and highly specialized areas of knowledge (Grabner et al., 2006, 2007; Ruthsatz, 2014). However, there is an idea of conceptual abilities as a source for expertise development (Kholodnaya, 2012). We aimed to test the hypothesis that there are correlations between level of expertise, psychometric IQ and conceptual abilities.

Participants (technical support department staff in an internet provider company, $n = 16$, aged 19 – 39) solved 2 cases related to their professional skills and aimed to assess their level of expertise. During the solving process, we conducted deep interviews in order to make expert knowledge more explicit. The interviews ($n = 32$) were audio-recorded and then transcribed. The results of each case were scored 0, 1, 2 or 3. We also used 5 tasks to assess conceptual abilities of the experts: "Generalization of Three Words" (GW), "Concept Synthesis" (CS), "Problem Formulation" (PF), "Imagery Interlocutor" (II), "Verbal to Imagery Conversion" (VIC) (by Kholodnaya, 2012) and J. Raven's "Standard Progressive Matrices" test (SPMT) to measure their baseline IQ.

After the first multiple regression analysis (sum of the scores for cases solving was a dependent variable; scores for the tasks GW, CS, PF, SPMT were independent variables) GW, PF and SPMT were excluded from the regression model and only CS remained: $r = 0{,}648$; $r2 = 0{,}42$; $p = 0{,}007$. As a result of second multiple regression analysis (sum of the scores for cases solving was a dependent variable; scores for the tasks GW, CS, PF, II and VIC were independent variables) GW, PF, II and VIC were excluded from the model and again only CS remained: $r = 0{,}648$; $r2 = 0{,}42$; $p = 0{,}007$.

In another regression model SPMT was a dependent variable and the tasks GW, PF, II, CS, VIC were independent variables. VIC, II, PF, GW were excluded from the model and CS remained: $r = 0{,}666$; $r2 = 0{,}444$; $p = 0{,}005$.

These results go well with the idea of concept synthesis (requiring the capacity to reveal generalized and implicit categorical links between different domains of experience; to generate a new semantic context when there is a lack of information) as a new potential candidate for being a core mechanism for expertise which was proposed earlier (Kholodnaya, 2012; Shcherbakova, Makarova, 2014). The capacities underlying successful conceptual synthesis relate both to the level of expertise and baseline psychometric IQ.

* Presentation is eligible for a Student Award.

THE ETIOLOGY OF SPATIAL ANXIETY AND ITS RELATIONSHIP WITH MATHEMATICS ANXIETY, GENERAL ANXIETY AND SPATIAL ABILITY*

Margherita Malanchini[1], Nicholas Shakeshaft[2], Kaili Rimfeld[2], Maja Rodic[3], Kerry Schofield[2], Robert Plomin[2], Yulia Kovas[1,3]

[1] Goldsmiths University of London, m.malanchini@gold.ac.uk.
[2] King's College London.
[3] Tomsk State University.

Emotion regulation factors are consistently found to be negatively associated with performance in cognitive tasks and academic settings. For example, mathematics anxiety predicts low mathematics performance cross-sectionally and longitudinally. Mathematics anxiety is believed to be domain specific as only modestly correlated with general anxiety. The present study focuses on investigating the etiology of spatial anxiety, a largely unexplored emotion regulation construct, and the origins of its association with other emotion regulation factors (mathematics and general anxiety) and with performance in a test of spatial ability.

Our sample included 1,450 18-20 year-old twin pairs (588 MZ and 862 DZ), part of the Twins Early Development Study (TEDS). The twins completed an online battery involving three self-report questionnaires: spatial anxiety (a newly developed measure), mathematics anxiety (an adapted version of the AMAS; Hopko et al., 2003), and general anxiety (the GAD-7; Löwe et al., 2008). The same online battery included a newly developed spatial task examining the ability to mentally manipulate 2D and 3D shapes by rotating them and visualizing their occluded parts.

Spatial anxiety was found to be substantially heritable (60%) and the rest of the variance was explained by non-shared environmental factors. Spatial ability was also substantially heritable (68%). A moderate negative correlation was observed between spatial ability and general anxiety (r = -.13). However a more substantial correlation was found between spatial ability and spatial anxiety (r = -.21). These correlations were largely mediated by genetic factors. The relationships remained significant after accounting for *g*. All measures of anxiety correlated modestly (average r = .42). However, multivariate genetic analyses showed that spatial anxiety was largely independent etiologically from mathematics and general anxiety.

Findings from the present investigation contribute to our understating of the relationship between emotion regulation and performance in cognitive tasks. Specifically, this is the first study investigating the association between spatial anxiety and spatial ability using a genetically sensitive design. Multivariate genetic results suggest that the relationship between spatial anxiety and spatial ability is largely explained by genetic factors with no evidence of shared environmental influences. These findings enhance our understanding of the complex relationship between anxiety and spatial ability.

* Presentation is eligible for a Student Award.

RE-EXAMINING RELATIONS BETWEEN BROAD COGNITIVE ABILITIES AND READING ACHIEVEMENT ACROSS THE SCHOOL AGE AFTER CONTROLLING FOR THE EFFECTS OF THE GENERAL FACTOR

Ryan J. McGill[1]

[1] Texas Woman's University, rmcgill@twu.edu.

Previously, Evans and colleagues (2001) examined relationships between Cattell-Horn-Carroll (CHC; Schneider & McGrew, 2012) cognitive abilities and reading achievement across the school age. Although their findings suggested that several broad abilities had significant effects on reading achievement they failed to account for the potential effects of the general factor. Recent factor analytic studies (e.g., Dombrowski, 2013) suggest that many CHC measures contain large proportions of *g* variance that has to be accounted for when interpreting such first-order measures as singular entities. To account for these effects, the current study examined relationships between CHC cognitive abilities and reading achievement after controlling for the effects of the general factor.

Participants were drawn from the nationally representative Woodcock-Johnson III (WJ-III; Woodcock, McGrew, & Mather, 2001) standardization sample. The sample for the current study included children and adolescents ages 6-0 to 18-11 ($N = 4{,}722$) who were administered relevant cognitive and achievement measures. Hierarchical multiple regression analyses were conducted to assess the proportions of reading score variance accounted for by the general factor score and broad cognitive ability scores. These analyses allow for higher order and lower order predictive effects to be apportioned correctly as suggested by Carroll (1995). In the present study, the squared multiple correlation coefficient was interpreted as an effect size reflecting the proportion of incremental reading variance explained.

Results from the present study indicate that the general factor accounted for statistically significant and large effects across the age span for all reading achievement variables that were assessed (coefficients ranged from .49 to .61). While several broad abilities accounted for statistically significant effects across the age span, the magnitude of these effects was mostly trivial to small (.00 to .06) after controlling for g. However, non-trivial relationships were observed between several cognitive variables (e.g., Crystallized Ability, Fluid Reasoning, and Delayed Recall) and various reading measures (Basic Reading Skills and Reading Comprehension) across the age span.

The present study is the first to examine the incremental validity of cognitive-achievement relationships across the age span. Previous incremental validity studies (e.g., Canivez, 2014; McGill, 2015) have largely suggested that broad cognitive abilities are of little consequence when predicting achievement. The present results suggest that these conclusions may be overstated. These findings are consistent with those reported in recent latent variable modeling research (e.g., Beaujean, Parker, & Parkin, 2014). Nevertheless, these results suggest that researchers that fail to account for sources of multidimensionality in first-order cognitive measures when examining cognitive-achievement relationships risk over-interpreting predictive effects.

THE INFLUENCE OF TRANSCRANIAL ALTERNATING CURRENT STIMULATION (TACS) ON FLUID INTELLIGENCE PERFORMANCE. AN FMRI STUDY

Aljoscha C. Neubauer[1], Martin Wammerl[1], Mathias Benedek[1],
Emanuel Jauk[1], Norbert Jausovec[2]

[1] University of Graz, aljoscha.neubauer@uni-graz.at.
[2] University of Maribor.

Recently, the issue was raised whether fluid intelligence can be increased through (mostly working memory) training. Despite some initial supportive evidence (Jaeggi, et al., 2008) more recent studies did not find support for training effects (e.g. Colom et al., 2013; Owen et al., 2010). Moreover, the method is critically discussed for methodical problems (Shipstead, et al., 2012). It seems questionable whether intelligence can be enhanced through cognitive training in a consistent and long-lasting manner (Haier, 2014).

We tested whether fluid intelligence (gf) could be enhanced by directly influencing brain activity through transcranial alternating current stimulation (tACS) applied to the parietal cortex and at the same time measuring concomitant changes in brain activity by fMRI.

In a double-blind, sham-controlled experiment 20 participants performed two fluid intelligence tasks (matrices task, and paper folding & cutting, PFC) after either transcranial alternating current stimulation (tACS) at theta frequency or sham stimulation was applied. The stimulation site was the left parietal cortex (P3), because of its key role for intelligence and intelligence-related functions (e.g., working memory capacity, verbal memory, spatial working memory). Sham and verum conditions were realized within-participants (using parallel test versions of both tests) with the two sessions separated by 28 days. While working on the two tasks stimulation-induced brain activity changes were recorded using fMRI.

Results indicated task- and difficulty-specific stimulation effects: When solving difficult items of matrices test verum tACS significantly increased gf performance, as compared to sham. No difference emerged for easy items. In the second gf task (PFC), tACS had no effect. For Raven matrices test whole-brain analyses showed that left parietal brain stimulation was accompanied by less right sided activation in areas of the frontal lobe, fusiform gyrus and occipital lobe, as well as left sided middle occipital gyrus. Additional ROI analyses revealed a tendency for less activation in the left inferior parietal lobule. We conclude that left parietal theta tACS could enhance performance in a reasoning task but only for difficult items; and not for a gf task requiring mental rotation.

We presume that theta frequency resembles a general cognitive control process, which might be of importance for gf performance. Neurophysiologically, the tACS-induced reductions of brain activation primarily concerned brain areas that partly overlapped with the task-negative network (e.g., precuneus). This seems in line with the neural efficiency hypothesis, that higher gf is related to lower activation, mainly in task-negative brain regions (Basten et al., 2013; Dunst et al., 2014; Neubauer & Fink, 2009). But so far, the current findings can only be interpreted as transient increases in gf test performance rather than in gf per se. Though the enhancement could be intelligence-specific, also other processes might account for tACS induced increases in gf performance (cf. Haier, 2014).

MODELING SEX AND RACE DIFFERENCES IN IQ AND OTHER TRAITS WITH NO SOCIAL REDUCTION OR CATEGORY ERRORS

Helmuth Nyborg

[1] Aarhus University (1968-2007), helmuthnyborg@hotmail.com.

The origin, size, and robustness of race and sex differences are still debated, but we know for sure that not even nation-wide programs can eradicate them. They are often analyzed in "All-Surface", "Top-Down", or "Bottom-Up" models, each of which are problematic. All-Surface models thus reduce to Social Constructionism, and Top-Down and Bottom-Up models involve category errors. Only All-bottom modeling avoids these errors. Moreover, it facilitates the amalgamation of phylogenetic with ontogenetic models at an equal cause-effect level, and simplifies the identification of major causal agents and receptors acting across very large time-spans in a remarkably conservative non-tinkering evolutionary context.

Practically, the presentation first briefly illustrates the shortcomings of classical models with examples from contemporary research. It then exemplifies an All-Bottom analysis, where a primordial RNA event, initiating the sexual reproductive mode, is combined with the outcome of 200.000 years of geo-climatic selection for "race" differences, and with an ontogenetic model for contemporary body, brain, and behavioral development.

The hard problem is how to realize the entirety of ultimate evolutionary and ontogenetic proximate modeling of race and sex differences within a coherent material model, while not pending on "High" or "Deep" theoretical abstractions. A non-linear, dynamic, multifactor, multiplicative, multidimensional, molecular (ND4M) model is proposed to solve this problem in terms of monitoring testable coordinated mass-molecular actions, conveniently situated midway below the extremely complex level of cells, organs, or the mind, and above the level of the very small world of quantum physics.

The amalgamation of ultimate and proximate models for sex and race differences in terms of a Bottom-Level material model will be discussed.

MALE GENERAL INTELLIGENCE (*G*) DOES NOT INCREASE FEMALE SEXUAL ATTRACTION*

Lars Penke, Ruben C. Arslan, and Juliane Stopfer[1]

[1] Georg August University Göttingen, lpenke@uni-goettingen.de.

Human general intelligence (*g*) has been hypothesized to be an indicator of genomic mutation load and under sexual selection for indirect genetic benefits ('good genes' for the offspring), implying that high *g* should be sexually attractive. People clearly report preferences and assortatively mate for intelligence, but these effects can be due to direct phenotypic benefits of *g* and social homogamy. Only one study (Prokosch et al., 2009) with methodological limitations has directly tested if higher male intelligence increases female initial sexual attraction.

We tested 88 young men (age 19 to 31 years) on six psychometric intelligence subtests and two measures of information processing speed, from which a *g* factor was extracted, and on the Big 5 personality dimensions. Standardized photos, voice recordings and videotapes of three behavioral tasks (reading headlines, charade, tell-a-joke) were also taken. Sixteen women and 14 men judged the intelligence and personality of the target men based on the videos. A second group of 16 women rated the attractiveness of the men as long-term and short-term partners. A third group of 25 women received information about each men in five steps, with intelligence cues being increasingly present over and above physical attractiveness information, and rated long- and short-term attraction after each step.

Both men and women could accurately judge intelligence and extraversion, but not the other Big 5, from the videos. Measured male *g* had no effect on female short-term attraction, but a small positive effect on long-term attraction, though only after extraversion and independently rated physical attractiveness were controlled. When information on male intelligence was presented incrementally, measured *g* did not predict changes in female long-term or short-term attraction ratings formed based on physical attractiveness.

Overall we found no support for intelligence being sexually attractive to women on first encounters, and limited support that it increases initial impression of the potential as a long-term romantic partner. This is only the second study on the attractiveness of measured intelligence at zero acquaintance, and the first one that assessed a true *g* factor, had a sufficiently large sample of target men, and tested whether increasing availability of intelligence information alters women's reported attraction. Taken together with very limited support for an association between *g* and mutation load in the currently available genomic data, these results cast doubt on the hypothesis that *g* is an indicator of genetic fitness under 'good genes' sexual selection.

* Presentation is eligible for a Student Award.

A GENOME-WIDE ANALYSIS OF PUTATIVE FUNCTIONAL AND EXONIC VARIATION ASSOCIATED WITH EXTREMELY HIGH INTELLIGENCE

Robert Plomin[1], Sarah L. Spain[2], Inti Pedroso[2], Neli Kadeva[2], Mike B. Miller[3], William G. Iacono[3], Matt McGue[3], Evie Stergiakouli[4], George Davey Smith[4], Martha Putallaz[5], David Lubinski[6], Emma L. Meaburn[7], Michael A. Simpson[2]

[1] Institute of Psychiatry, Psychology & Neuroscience; King's College London, robert.plomin@kcl.ac.uk.
[2] Division of Genetics and Molecular Medicine, King's College London.
[3] Department of Psychology University of Minnesota.
[4] MRC Integrative Epidemiology Unit University of Bristol.
[5] Duke University Talent Identification Program Duke University.
[6] Department of Psychology and Human Development Vanderbilt University.
[7] Department of Psychological Sciences Birkbeck, University of London.

Although individual differences in intelligence are highly heritable, molecular genetic analyses to date have had limited success in identifying specific loci responsible for its heritability. The present study is the first to investigate exome variation in individuals of extremely high intelligence. Under the quantitative genetic model, sampling from the high extreme of the distribution should provide increased power to detect associations.

We performed a case-control association analysis with 1,409 individuals drawn from the top 0.0003 (IQ > 170) of the population distribution of intelligence and 3,253 unselected population-based controls. Our analysis focused on putative functional exonic variants assayed on the Illumina Human Exome BeadChip.

We did not observe any individual protein-altering variants that are reproducibly associated with extremely high intelligence and within the entire distribution of intelligence. Moreover, no significant associations were found for multiple rare alleles within individual genes. However, analyses using genome-wide similarity between unrelated individuals (Genome-wide Complex Trait Analysis) indicate that the genotyped functional protein-altering variation yields a heritability estimate of 17.4% (SE 0.017) based on a liability model. In addition, investigation of nominally significant associations revealed fewer rare alleles associated with extremely high intelligence than would be expected under the null hypothesis.

A common theme emerging from genetic studies of intelligence, similar to all complex traits and common disorders, is its highly polygenic nature with its heritability explained by many variants of small effect. While the unique extreme sampling design used in the current study provides improved power to detect associations in certain situations it has also provided challenges for direct replication. Nevertheless, the evidence for the contribution of protein-altering variants to the heritability of intelligence and the evidence that rare functional alleles are detrimental to intelligence provides a framework for defining the role of individual rare alleles.

CREATIVITY AND FLUID INTELLIGENCE: MIXTURE GROWTH MODELING OF INTRA INDIVIDUAL PATTERNS OF PERFORMANCE DURING A DIVERGENT THINKING TASK OF FIGURAL DRAWING

Ricardo Primi[1], Nelson Hauck-Filho[1], Tatiana de Cássia Nakano[2]

[1] Universidade São Francisco, rprimi@mac.com.
[2] PUC-Campinas.

This study examines the association of fluid intelligence and creativity. In divergent thinking tests it is common to observe that later responses tend to be more creative than earlier ones – this is called serial order effect. Recent view of the role of executive function on divergent production predicts that high fluid intelligence subjects will have creative responses already in the beginning of divergent thinking tasks. This indicates a central role of executive functions –inhibiting common less creative responses and management interference on idea production. Most studies observing these relationships are done in verbal tasks. This research tests if this relationship can be found on divergent productions of figural drawings.

Participants in the present study were 585 children and high school students with ages from 7 to 17 (mean = 11.11 years, SD = 2.02; 52.5% female). All participants provided demographic information on a self-report questionnaire, and undertook a cognitive assessment battery (verbal, abstract, logic and numeric reasoning) supplemented by a creativity task, whose data we analyzed in the present study. This creativity task consisted of 10 stimuli, which participants were required to complete using paper and pencil. Independent raters subsequently coded each resulting draw in a scale from 1 to 5 to reflect the extent to which it approached a set of criteria defining creative responses. Data analysis was conducted using Mplus 7.11.

Factor growth mixture modeling were performed in order to detect groups of potentially differing patterns of performance (ratings) from the first to the last stimulus of the task. Bayesian Information Criterion (BIC) and the Bootstrap Likelihood Ratio Test (BLRT) suggested that a three-class solution was as better fit to the data (entropy = .77) when compared to alternative 1-, 2-, and 4-class solutions. Latent classes reveled a large group (83.36%) of individuals with initially modest scores and descending performances along the 10 stimuli, as well as and two small groups of individuals with high initial scores—one (12.52%) with a descending performance, and the other (4.12%) with a stable high performance across the whole task. Last two groups have significantly higher scores in Gf.

This study shows that executive processes of top down voluntary control are important components for production of creative responses. This demonstrates a higher role of intelligence on creative idea production. It shows a high role of fluid intelligence in idea production.

IS THE FADEOUT EFFECT REAL?

John Protzko[1]

[1] University of California, Santa Barbara, protzko@gmail.com.

Many theories of the role of the environment and raising IQ have been put forward over the years. Models are put forth to explain patterns seen in changes in environments and changes in individuals IQ and are used to explain as much evidence as possible. However, there has not been an equal amount of effort put towards large-scale falsification of any of these models. In this paper, we test whether the role of the environment in raising IQ is bidirectional/reciprocal. We do this by meta-analyzing the evidence for the fadeout effect of IQ, determining whether interventions that raise IQ have sustained effects. If interventions have sustained effects after they end, this counts as causal evidence for bidirectional/reciprocal models of intellectual development.

We meta-analyze 7584 participants across 44 randomized controlled trials that attempted to raise intelligence in childhood and followed the participants over time after the intervention ended.

Results will be discussed within the context of the fadeout effect.

We will discuss whether the fadeout effect exists and whether changes over time occur in the treatment or control groups. We will discuss how different theories of the development of intelligence may be falsified or upheld by the results of the fadeout effect.

RATIONALITY: DOES QUALIFYING INTELLIGENCE MATTER?*

Venkat Ram Reddy Ganuthula and Lata Dyaram[1]

[1] Indian Institute of Technology Madras, ramganuthula@gmail.com.

The tripartite model of mind (Stanovich, 2009) was advanced to put into perspective the paradigm of individual differences in intelligence and rationality subserving normative decision making. Although, the model construes typical measure of cognitive ability and thinking dispositions to determine rationality, an empirical concern for: exploring relationships among them and examining their cumulative influence on performance in normative decision making tasks is missing. We hypothesize: 1) Need of cognition (a thinking disposition) positively influences absorptive capacity (a typical performance measure of cognitive ability) and 2) Need for cognition and absorptive capacity show cumulative influence on performance in normative decision making tasks that account for belief assessment skill.

Students pursuing post graduate degree in Management in India formed the sample for the study. A total of 251 responses were elicited with 221 participants completing a paper pencil based survey questionnaire in classroom environment, and the rest 30 participants recording their responses through internet based survey questionnaire. The usable responses were 231. The three primary scales of interest were the 18-item version of Need for Cognition Scale (Cacioppo et al., 1984), the Individual Absorptive Capacity Scale (Lowik, 2012) and the Adult Decision Making Competence Scale (A-DMC) (Bruine de Bruin et al., 2007). The normative decision making tasks sampled from A-DMC are resistance to framing, confidence calibration, resistance to sunk costs and consistency in risk perception.

As hypothesized need for cognition showed significant positive influence on absorptive capacity (β = .414, $t(229)=6.874$, $p<.01$). Cumulative influence of need for cognition and absorptive capacity was captured through a mediation analysis. The mediation analysis by bootstrapping confidence intervals approach has shown significant positive indirect effect in the case of consistency in risk perception (95% bias-corrected bootstrap confidence interval for the indirect effect is in the range of .001 to .041) and significant negative indirect effect in regard to confidence calibration (95% bias-corrected bootstrap confidence interval for the indirect effect is in the range of -.037 to -.007). Thus, the results validate the proposed relationships with a qualification.

Empirical studies suggest weak association between intelligence and rationality subserving normative decision making. Dominant paradigm of intelligence in these studies is that of optimal performance measure concerned with efficiency of information processing. Although efficiency of processing is necessary for rational decision making, more important is the goal of such a processing. Typical measures of cognitive ability and thinking dispositions index such high level goal regulation (Stanvoich, 2010). Hypothesized relationships and empirical evidence presented here renders support to this theoretical position. Thus, the question then to reflect upon is not whether intelligence and rationality dissociate, but, whether qualifying intelligence effects performance on normative decision tasks.

* Presentation is eligible for a Student Award.

ABILITY, TEMPERAMENT, AND INTERESTS: THEIR JOINT PREDICTIVE POWER FOR JOB CHOICE

William Revelle and David M. Condon[1]

[1] Northwestern University, revelle@northwestern.edu.

It is well known that occupations may be stratified by cognitive ability. But what about temperament and interests? Are these later two domains redundant with ability or do they make independent contributions? We examine whether individuals sort themselves into occupations based on non-cognitive aspects of personality as much as they do on cognitive ability.

A web-based survey (sapa-project.org) of temperament, abilities, and interests (N=181,675) used a massively missing completely at random technique to synthetically form large correlation matrices from sparsely administered items. Temperament and interest items came from the International Personality Item Pool (IPIP, Goldberg, 1999) and ability items from the International Cognitive Ability Resource (ICAR, Condon & Revelle, 2014). We examined ability, temperament and interest correlates for the 69,165 participants who were employed. Of 968 occupations that could be categorized into 22 broad job fields, 257 occupations had more than 50 participants, 147 had more than 100.

Mean ability scores (using the ICAR) for occupations with more than 50 participants varied (in standard score units) from -.99 (home health aids) to 1.72 (computer software engineers) while temperament, for example, extraversion (using IPIP item based scales), ranged from -.69 (computer programmers) to 1.25 (advertising sales agents). Interests showed similar differences with, for example, leadership varying from -1.52 (dietitian) to 1.82 (chief executive officers). As expected (Revelle & Condon, 2015) correlation structure of the temperament, ability, and interest variables between occupations differed drastically from that of the pooled within occupation correlations.

Although there are large sex differences in the choice of occupation (e.g., construction workers were 99% male, computer system engineers were 90% male, nurses were 91% female and nannies were 98% female), the interest and temperament differences between occupations are consistent within and between sexes. We discuss how temperamental and interest variables provide meaningful additional information beyond standard measures of cognitive ability when describing occupational choice.

G AND NON-*G* PREDICTORS OF ACADEMIC PERFORMANCE IN HISPANICS AND WHITES*

Miranda C Richmond and Thomas R Coyle[1]

[1] University of Texas at San Antonio, miranda.c.richmond@gmail.com.

This study examines relations among *g*, non-*g* factors (unrelated or weakly related to *g*), and academic performance. The non-*g* factors are grit and conscientiousness. Conscientiousness has been shown to predict academic performance beyond *g*, and grit has been shown to predict outcomes beyond conscientiousness. Ethnic differences in *g* and non-*g* factors have been examined primarily for Blacks and Whites. The current study examines ethnic differences in *g* and non-*g* factors for Hispanic and Whites. In addition, the study compares the relative influence of conscientiousness and grit (beyond *g*) in predicting college GPA.

Subjects (215 female, 80 male, mean age = 18.6 (±1.1) years) were drawn from the subject pool at the University of Texas at San Antonio. *g* was estimated using SAT subtest scores (math, verbal, writing), Wonderlic scores, and Raven's Advanced Progressive Matrices scores. Conscientiousness was measured with the Big Five Inventory, and grit was measured with the Grit short form (Grit-S). College GPAs were based on academic records. Ethnic differences in the predictive validity of *g* and non-*g* factors for GPA were assessed using multigroup (182 Hispanic, 83 White) structural equation modeling (SEM).

Grit and conscientiousness were weakly related to *g* (r = -.13, -.06 respectively), confirming their non-*g* status. Multigroup analyses indicated that the direct effect of *g* on GPA (controlling non-*g* factors) was stronger for Whites than Hispanics (Whites: β = .446 (.079), p < .001; Hispanics: β = .398 (.045), p <.001). Although the relation between *g* and conscientiousness was not significant for either group, the relation between *g* and grit was negative for Hispanics (β = -.086 (.026), p < .01) and positive for Whites (β = .144 (.038), p < .001). In addition, conscientiousness reliably predicted GPA (controlling grit) for both groups (Whites: β = .255 (.094), p < .01; Hispanics: β = .294 (.053), p < .001). Indirect effects were non-significant for both groups.

This study examined relations among *g*, non-*g* factors (grit and conscientiousness), and GPA for Hispanics and Whites. *g* predicted GPA (controlling non-*g* factors) better for Whites than Hispanics, suggesting that *g* is differentially predictive for Hispanics and Whites. This pattern is consistent with prior research showing that *g* predicts academic achievement better for higher ability groups (Coyle, Snyder et al., 2011). In addition, conscientiousness predicted GPA for both groups (controlling grit), but grit did not predict GPA for either group (controlling conscientiousness), suggesting that conscientiousness is a better predictor of academic achievement. These results have implications for the identification of non-*g* traits that might enhance student success.

* Presentation is eligible for a Student Award.

GENETIC AND ENVIRONMENTAL UNDERPINNINGS OF SPATIAL ABILITIES AND THEIR ROLE IN PREDICTING ACADEMIC ACHIEVEMENT AND SUCCESS IN STEM*

Kaili Rimfeld[1], Nicholas Shakeshaft[1], Kerry Shofield[1], Margherita Malanchini[2], Maja Rodic[3], Yulia Kovas[2] and Robert Plomin[1]

[1] King's College London, kaili.rimfeld@kcl.ac.uk.
[2] Goldsmiths University of London.
[3] Tomsk State University.

Spatial abilities encompass several factors that are differentiable from general cognitive ability (intelligence). Importantly, spatial abilities have been shown to be significant predictors of many life outcomes, even after controlling for intelligence. Quantitative genetic studies have shown that diverse measures of spatial ability are moderately heritable (30-50%), although some important aspects of spatial ability such as navigation and map-reading have been neglected. Little is known about the factor structure of spatial measures or their links with academic achievement, especially STEM (science, technology, engineering, mathematics) subjects. Here we investigated these issues in a twin design using novel online gamified measures of diverse spatial abilities. The present investigation features an unprecedented number of measures of spatial abilities including mental rotation, spatial visualization, spatial scanning, navigation, and map- reading. We piloted the measures on 100 unrelated individuals; all measures produced good test re-test reliability (.75 on average). A twin analysis of 1000 twin pairs (age19-21) was conducted using twins from the Twins Early Development Study (TEDS).

Phenotypically, the results provided evidence for the multifactorial nature of spatial ability, independent of intelligence. Multivariate genetic analyses indicated that this phenotypic structure is driven by genetic factors. Univariate genetic analyses yielded moderate heritabilities for all tests. We also studied the association between these spatial factors and academic achievement and success in STEM subjects. Spatial factors correlated with these outcomes, even controlling for intelligence, and genetic influences largely accounted for these phenotypic associations.

Understanding the etiology and correlates of composites of spatial abilities using multivariate genetic designs would further our understanding in how this multifactorial cognitive skill predicts life outcomes and success in STEM fields, and which aspects of these abilities are the most important predictors. The findings of this study could have far-reaching implications in developing personalized learning opportunities to improve all components of this important cognitive ability.

* Presentation is eligible for a Student Award.

FUTURE US INTELLIGENCE: IQ PREDICTION UNTIL 2060 BASED ON NAEP

Heiner Rindermann and Stefan Pichelmann[1]

[1] Technische Universität Chemnitz, heiner.rindermann@psychologie.tu-chemnitz.de.

US National Assessment of Educational Progress (NAEP) measures cognitive competences in reading and mathematics of US students (last 2012 survey N=50,000). The long-term development based on results from 1971 to 2012 allows a prediction of future cognitive trends. For predicting US averages, also demographic trends have to be considered. We want to answer the following questions:

(1) Will the Flynn effect be continued?
(2) Will there be a decrease or increase in gaps between ethnic and racial groups?
(3) What effect has the rising share of minorities?
(4) What effect has gap reduction on society's average ability level?
(5) What effect has national ability development on GDP?

The White average 1978/80 set at M=100 and SD=15 was used as a benchmark. Based on two past NAEP development periods for 17-year-old students, 1978/80 to 2012 (more optimistic) and 1992 to 2012 (more pessimistic), and demographic projections from the US Census Bureau, cognitive trends until 2060 for Whites, Blacks, Hispanics, Asians and the entire age cohort were estimated.

Estimated population averages for 2060 are 103 (optimistic) or 102 (pessimistic). White-Black gaps from currently 11 IQ decrease to 6 IQ (op.) or 7 IQ (pe.), White-Hispanic from 9 IQ to 4 IQ (op.) or 3 IQ (pe.), Asian-White gaps increase from currently 3 IQ to 9 IQ (op.) or 12 IQ (pe.) resulting in a distinctive top Asian group at around 114 IQ. The catch-up of minorities (their faster ability growth) contributes around 2 IQ to the general rise of 3 IQ; however, their larger demographic increase reduces the general rise at about the similar amount (-1.4 IQ). Because minorities with faster ability growth also rise in their population proportion the interactive term is positive (around 1 IQ).

Consequences for economic and societal development are discussed. Based on past NAEP trends and population estimations US future IQ is predicted. For the US in 2060 an average IQ of 102-103 points is predicted. General FLynn effects contribute positively to IQ development. Minority catch-ups contribute positively to IQ development. Non-Asian minority population increases contribute negatively to IQ development.

POLYGENIC RISK FOR SCHIZOPHRENIA IS ASSOCIATED WITH STEEPER GENERAL COGNITIVE DECLINE

Stuart J Ritchie, Andrew M McIntosh, Alexandra Bannach-Brown, Toni-Kim Clarke, and Ian J Deary[1]

[1] The University of Edinburgh, stuart.ritchie@ed.ac.uk.

Few predictors of people's differences in ageing-related cognitive decline have been discovered to date. One potential candidate is genetic risk for schizophrenia, which has previously been linked to cognitive change between childhood and old age in individuals with no schizophrenia diagnosis. To date, no studies have investigated the link between polygenic risk for schizophrenia and cognitive decline within older age.

We used data from longitudinal cognitive testing of subjects from the Lothian Birth Cohorts of 1921 (LBC1921; tests performed at mean ages 79, 83, 87, 90, and 92 years; initial $n = 550$) and 1936 (LBC1936; tests performed at ages 70, 73, and 76, initial $n = 1{,}091$). We examined the association between individual differences in polygenic risk for schizophrenia and differences in the trajectory of cognitive ageing. Polygenic risk scores were derived from the Psychiatric Genomics Consortium's most recent Genome-Wide Association Study (GWAS) for schizophrenia.

Meta-analysis across both cohorts showed that individuals with higher polygenic risk scores for schizophrenia declined more steeply in their later-life general cognitive ability. These results were significant in the larger LBC1936 study alone. Although the results were in the same direction in LBC1921, they did not reach statistical significance.

This work describes a new predictor of greater age-associated cognitive decline. It shows how GWAS results can be useful in predicting ostensibly unrelated phenotypes, and raises important theoretical questions about the links between genetic risk for schizophrenia and lowered intelligence.

DO INTELLIGENT GIRLS DELAY AGE AT FIRST INTERCOURSE? DIFFERENT RESULTS WITHIN-FAMILIES VERSUS BETWEEN-FAMILIES

Joseph Lee Rodgers and S. Mason Garrison[1]

[1] Department of Psychology and Human Development, Vanderbilt University, joseph.l.rodgers@vanderbilt.edu

Halpern, Joyner, Udry, and Suchindran (2000) published a study based on early Add Health data with the provocative and interesting title "Smart Teens Don't Have Sex (or Kiss Much Either)." Several following papers reported the same result, a positive correlation between the intelligence of adolescent girls. However, the causal mechanism has not been carefully investigated. Harden and Mendle (2011) also used Add Health data within a biometrical design, and found that the relationship between intelligence and age at first intercourse (AFI) was fully accounted for by shared environmental differences, suggesting at least the location of the causal mechanism — the part of the household environment shared by siblings within the household that influences both child intelligence and AFI. In this study, we use a sibling comparison design to investigate the causal status of the link between intelligence and AFI.

Using the NLSY79 data and the NLSY-Children/Young Adult data, we linked the NLSYC/YA children to the NLSY79 mothers. We measured maternal IQ using the NLSQT, and children IQ using PPVT, PIAT-Math, PIAT-Reading Recognition, PIAT-Reading Comprehension, and Digit Span. We measured both maternal and child age at first intercourse (AFI) using self report from the respondents themselves. We fit these measures using Kenny's (2001) reciprocal standard dyad model. This model supported analyses treating the data as only between-family data (as in past studies), and also allowed us to use within-family comparisons. These included two forms, first a comparison of offspring of mothers in relation to maternal IQ , then a comparison of offspring themselves in terms of offspring IQ.

When we evaluate the relationship between both maternal and child intelligence, using a between-family design, we replicate the earlier results. When we use a within-family design, however, and compare offspring of sisters, and then compare the offspring themselves, the relationship between both maternal and child intelligence and AFI virtually disappears. The finding is robust across gender.

These results suggest that the cause of the intelligence-AFI link is not intelligence per se, but rather differences between families (such as parental education, SES, etc.) that correlate with family-level (but not individual-level) intelligence.

THE RELATIONSHIP BETWEEN SELF-PERCEIVED ABILITY AND PERFORMANCE ON SPATIAL TASKS

Maja Rodic[1], Nicholas Shakeshaft[2], Kaili Rimfeld[2], Margherita Malanchini[3], Kerry Schofield[2], Robert Plomin[2], Yulia Kovas[1,3]

[1] Tomsk State University, majasky@btopenworld.com.
[2] King's College London.
[3] Goldsmiths University of London.

Self-report assessments of cognitive abilities have been found to be reliable predictors of actual cognitive competence and performance; however, this area has been largely neglected in the field of spatial ability. The present study is the first genetically informative investigation exploring the relationship between self-perceived spatial ability (SPA) and performance in spatial tasks.

Our sample included 1,450 18-20 year-old twin pairs, part of the Twins Early Development Study (TEDS). Using the twin method we investigated the etiology of self-reported spatial ability, measured by a questionnaire adapted from Santa Barbara Sense of Direction Scale, and objectively measured spatial ability, using a battery of tasks that included mental rotation, visualisation and navigation). We also investigated the genetic and environmental etiology of the links between them.

Preliminary analyses suggest that both SPA and spatial ability are highly heritable (80% and 68%, respectively). The phenotypic relationship between these two measures (r = .20) was modest, and could be attributed to both genetic (40%) and non-shared environmental (60%) influences, with no evidence of shared environmental influence. The findings remain similar after controlling for general intelligence.

The present findings contribute to our understating of the etiology of the modest relationship between self-reported measures of spatial ability (self perceived ability) and the actual (objectively measured) spatial ability. We found that the link between the two constructs was present even after accounting for general intelligence, and that this link was both genetic and environmental in origin. We discuss practical and theoretical implications of these findings.

INTERINDIVIDUAL DIFFERENCES IN ONSET OF DECLINE IN GENERAL INTELLIGENCE IN OLD AGE: THE ROLE OF SOCIAL NETWORK SIZE, OVERWEIGHT, AND HYPERTENSION

Michael Rönnlund, Anna Sundström[1] and Sara Pudas[2]

[1] Department of Psychology and CEDAR, Umeå University, Sweden, michael.ronnlund@psy.umu.se.
[2] Affiliation Umeå Center for Brain Imaging, Umeå University

The objective of the present study was to investigate predictors of onset of decline in general cognitive ability. The potential predictors included were motivated by prior findings in the literature and included initial ability level, education, sex, social network size, BMI, and blood pressure.

The study included a 15-year longitudinal analyses of a subsample of men in the Betula prospective cohort study (Nilsson et al., 2004) who had been assessed at age 18 (conscript data) and for whom performance on four tests used as markers of "*g*" was available at a mean age of 50 and 65. Latent difference score modelling was used to identify predictors of the 15-year changes in the *g* factor.

Higher baseline age, higher BMI, a small social network, and elevated systolic blood pressure were predictive of a 15-year decline in the *g* factor. Together these variables accounted for about 50% of the variance in change in the *g* factor. A higher initial ability level and formal schooling did not appear to protect against onset of decline in general cognitive ability.

The results is in line with more recent studies showing that initial ability level and higher levels of education are poor predictors of decline in general ability. Instead social network size and medical factors turned out to be critical. Medical treatment and/or changes in lifestyle that serve to avoid hypertension and lower BMI might be important to maintain general cognitive functioning in old age.

FRONTO-PARIETAL GRAY MATTER AND WHITE MATTER EFFICIENCY DIFFERENTIALLY PREDICT INTELLIGENCE IN MALES AND FEMALES*

Sephira G Ryman[1], Ronald Yeo[1], Katie Witkiewitz[1],
Martijn van den Heuvel[2], Marcel de Reus[2], Andrei Vakhtin[1],
Ranee Flores[3], Christopher Wertz[3], Christine Meadows[3], Rex E. Jung[3]

[1] University of New Mexico, sephira.ryman@gmail.com.
[2] University Medical Center Utrecht.
[3] University of New Mexico HSC.

Intelligence is associated with communication efficiency of a widespread neural network as well as variation in gray matter volume, particularly within the fronto-parietal regions of the human brain. Recent reports of gender differences in the relationships between brain measures and intelligence highlight the need to differentiate how the brains of males and females may rely of different neural structures when completing measures of intelligence. The current study utilizes a network approach in conjunction with structural equation modeling to examine potential gender differences in the relationship between white matter efficiency, fronto-parietal gray matter volume, and general cognitive ability.

Two hundred and forty-four (21.77+/−3.29 years; 125 males) subjects participated in the current study. Individual brain networks were modeled on the basis of the set of reconstructed fiber tracts. Network white matter efficiency was calculated as the average inverse shortest path length across the whole network. Two confirmatory factor analyses (CFA) were conducted to identify the factor structure and measurement invariance of a general cognitive factor (GCA) and a fronto-parietal gray matter volume factor (FPG). Lastly, we proceeded to fit a structural equation model relating the GCA latent factor to both the FPG and white matter efficiency. A nested model comparison and examination of the interactions were conducted to determine if the regression coefficients differed in each gender.

Results of the GCA CFA indicate adequate model fit [χ^2 (5) = 6.82, p = 0.23, RMSEA = 0.04 (90% CI [0.00-0.10]), CFI = .98], with the GCA factor exhibiting metric invariance and partial scalar invariance across gender. Results of the FPG CFA indicate adequate model fit [$\chi^2(2) = 0.36$, $p = 0.84$, RMSEA < 0.01 (90% CI [.00-.07]), CFI = 1.00], exhibiting metric, scalar, and residual invariance across gender. A nested model comparison of the model predicting GCA before and after constraining the regression coefficients across gender resulted in a significant χ^2 difference between the models ($\chi^2(2) = 8.33$, $p = 0.01$. There was a significant relationship between FPG and CGA in males and females. In contrast, white matter efficiency significantly predicted GCA in females, but not males.

The current study aimed to identify the relationship between intelligence, fronto-parietal gray matter volume, and white matter connectivity. Results of the structural equation model highlight that the latent factor of fronto-parietal gray matter volume predicts GCA, with greater fronto-parietal gray matter corresponding to greater GCA scores. Of interest, while the relationship between fronto-parietal gray matter and GCA is consistent across males and females (with larger effect sizes in males), white matter efficiency demonstrated differential effects across gender. The current study provides further evidence for this trade off in brain structure seen in males and females, suggesting that women likely rely more on efficient brain organization when performing measures of intelligence.

* Presentation is eligible for a Student Award.

DIFFERENCES IN A FORMAL REASONING STAGE IN ADOLESCENTS WITH DIFFERENT LEVEL OF IQ*

Ekaterina Saulina[1]

[1] Saint-Petersburg state university, saulina.psy@gmail.com.

Academics employ various criteria to determine the stages of cognitive development (Piaget, Demetriou, Glaser, and et.). It is an interesting question what is the best way to determine the stage for children of one age group if they demonstrate different level of IQ. The main point is understanding what kind of differences children have in this case: only quantitative (for ex., intellectual speed) or qualitative too.

The present sample included 249 children aged 14 - 17 years, grades 9 - 11 from about 50 Russian schools. The group was divided into two subgroups: 1) 132 adolescents, 81 girls and 51 boys, with high IQ; 2) 117 teenagers, 66 girls and 51 boys, with average IQ. It was used Universal Test of Intellect "UIT" (11 subtests) developed by Baturin & Kurgansky which includes: Spatial and Verbal abilities, Numerical Reasoning, Working Memory and IQ score. Average group IQ: 90 -119. High IQ group: >119. Two subgroups demonstrate significant differences in IQ and in all subtests.

The structure of intelligence has been analyzed in both groups. Math and logical thinking abilities (the formal reasoning) lead among other abilities in the higher IQ group. The formal reasoning abilities of adolescents with average IQ take the lowest position till the 11th grade.

The comparative analysis shows that formal reasoning score increases between 9th and 11th grade in both groups. According to this data formal reasoning became the dominant ability in the intelligence structure in the higher IQ group earlier than in the average IQ group.

The factor analysis shows different structure of formal reasoning: the logical thinking is included in verbal abilities factor in the average IQ sample and it is a part formal reasoning abilities factor in the high IQ group.

The results show differences in developmental processes in the formal reasoning stage from 9 to 11th form in adolescents with different IQ level. These differences are: 1) Formal reasoning became the dominant abilities in intelligence structure in high IQ group earlier than in average IQ group; 2) Combining abilities in the factors based on different principles depending on the level of intelligence in adolescence. Based on the data we can conclude that the children of the same age with different IQ levels have conceptual differences in 1) the structure of their formal and logical abilities and 2) the dynamic characteristics of this structure of their abilities.

* Presentation is eligible for a Student Award.

LATENT COGNITIVE CORRELATES OF TIMING ABILITIES

Rebecca, S. Schaefer[1], James Broadway[2], John Garcia[2],
Jonathan Schooler[2], John Protzko[2]

[1] SAGE Center for the Study of the Mind, University of California, Santa Barbara.
[2] Psychological and Brain Sciences, University of California, Santa Barbara, Protzko@gmail.com.

Entraining motor output to an auditory rhythm, such as tapping your finger to a metronome, is often considered an easy, automatic process. However, this entrainment is generally not very precise – learning to 'be in time' is an important part of musical training - and individual differences in entrainment abilities are not yet well described. Correlations between specific motor timing parameters and cognitive abilities have been reported, arguing for a bottom-up component that mediates both cognitive and timing abilities.

To further explore the relation between motor timing indices and cognitive measures, a hierarchical g-battery was constructed using cognitive (WAIS subtests Coding, Symbol Search, backwards Digit Span and Similarities, Hawaii Vocabulary, CAB-V Proverbs, Trail-MakingTest and Operation Span) and tapping tests (continuation tapping, paced tapping with stable and tempo-varying metronome). This allowed us to create a hierarchical g-battery with three latent factors (Verbal, Processing Speed, and Executive Functioning). We administered this battery to 113 college undergraduates along with the tapping tasks to investigate the correlates of latent abilities and timing performance.

Drift variability in the tempo of unpaced tapping was significantly related to Executive Functioning (β= -.244, $p < .047$). Contrarily, local variability in unpaced tapping and mean asynchrony in stable auditorily paced tapping was unrelated to Executive Functioning. No other cognitive measures showed a significant correlation with tapping performance, including *g*.

These results imply that timing indices may be distinctly related to specific cognitive measures. The association between continuation tapping and *g* may be related to executive-function-specific abilities instead of *g*.

HERITABILITY OF SPECIFIC COGNITIVE ABILITIES

David H Schroeder[1]

[1] Johnson O'Connor Research Foundation, schroeder@jocrf.org.

Although there have been many studies of the heritability of general intelligence (g), much less attention has been directed at specific cognitive abilities. In this study, data for specific abilities from monozygotic (MZ) and dizygotic (DZ) twins and also siblings were examined.

Samples: All of the participants in this study were clients of the Johnson O'Connor Research Foundation's vocational-guidance program. For twins, there were 94 MZ and 261 DZ pairs and for siblings, 1,641 pairs. There were roughly equal numbers of males and females, and age ranged from 14 to 47 although most of the participants were high-school- or college-age. Effects of age were partialled from all scores. Participants were generally upper-middle-class and college-oriented.

Measures: Participants took 15 tests of specific cognitive abilities, which yield 4 group factors and a *g* factor. They also took 11 tests of non-cognitive abilities including 3 tests of music-related abilities (e.g., Pitch Discrimination).

Heritability estimates for the factors ranged from .85 for the Spatial Ability and *g* factors to .66 for Speed of Reasoning and Memory. For the specific-cognitive-ability tests, many of the values lined up with their factors—e.g., .94 and .62 for the spatial tests and .62 and .52 for the memory tests. Interestingly, Rhythm Memory, one of the musical-ability tests, had a relatively high value, .80. The highest values for the shared-environment component were for the vocabulary test and 2 of the musical-ability tests.

The results with only same-sex DZ twins were generally similar to the results with the full DZ group.

The large sample of siblings revealed a moderating effect for parents' educational level, with higher familiarities for participants with higher levels of parental education.

These results indicate a substantial genetic influence for specific cognitive abilities and group factors in addition to g. The moderating effect for parents' education, which is broadly consistent with previous studies of family SES, adds an important element to our understanding of genetic factors and suggests further avenues for research.

DECREASED INTERHEMISPHERIC ATTENTIONAL NETWORK CONNECTIVITY PREDICTS GENERAL INTELLIGENCE*

Andrei, A, Vakhtin, Ranee, A, Flores, Sephira,
G, Ryman, Christopher, J, Wertz, Rex E. Jung[1]

[1] University of New Mexico; Dept. of Neurosurgery, aavakhtin@gmail.com.

Functional correlates of general intelligence have eluded conventional fMRI analyses examining select regions activated by cognitive tasks. In contrast to such spatially and temporally constrained approaches, independent component analysis (ICA) decomposes the signal to its functional constituents with unique time courses and spatial maps that span the entire brain and scan period. In addition to high levels of intrinsic coherences, such networks display weaker connectivities between each other, which can be examined in terms of correlation strengths and relative lag times, shedding light onto temporally causal inter-network hemodynamics. We examined whether such inter-network dynamics are related to general intelligence during performance of a fluid reasoning task.

Seventy-nine participants (46 M; age = 21.7 ± 3.1 yrs.; FSIQ = 119 ± 14) underwent fMRI scans during rest and while performing problems from the Raven's Advanced Progressive Matrices Test (PRM). Using spatial ICA, 24 functional networks (6 attentional A1-A6, 4 cognitive C1-C4, 6 visual V1-V6, 5 sensorimotor S1-S5, and 3 default-mode D1-D3) were identified separately in both datasets. Maximum lagged correlation coefficients were calculated for each network pair, allowing for ± 2 s temporal shifts in time course alignments. Each network pair's maximum lagged correlation coefficients and lag times from all participants were normalized using Fisher *z* transformation and entered into a correlation analysis using Wechsler's Full Scale Adult Intelligence Quotient (FSIQ) as the predictor variable.

Full-scale IQ was negatively correlated with connectivity strengths between two network pairs during the RPM task: A3-A6 and S2-V2 ($p < 0.001$). None of the network pairs displayed significant relationships between their time lags in connectivity and FSIQ. Three of the involved networks' time courses (A3, S2, and V2) were previously found to be significantly related to the RPM task, and all 4 networks displayed significant activity changes during RPM compared to rest (Vakhtin et al., 2013).

Parietal asymmetry during RPM may be due to shifts between analytical (lPL) and visuospatial (rPL) problem-solving strategies, both of which are required to varying extents by different matrices (Prabhakaran et al., 1997). As networks A3 and A6 represent the right and left parieto-frontal attentional networks, respectively, we hypothesize that the ability to cognitively dissociate the two strategies and apply the proper one may underlie the negative relationship between their connectivity and FSIQ. Analogously, V2 and S2 may increase intrinsic coherency during RPM at the expense of inter-network connectivity. The lack of a relationship between inter-network delays in connectivities and FSIQ further dismisses biological processing speed as a predictor of intelligence.

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DAY-TO-DAY VARIABILITY IN IQ AND MOOD

Sophie von Stumm[1]

[1] Goldsmiths University of London, s.vonstumm@gold.ac.uk.

Intelligence, also known as IQ, has been shown to be subject to systematic developmental changes in childhood and in late life and to be relatively stable from adolescence through most of adulthood. However, little is known about the stability – or in fact variability – of cognitive functioning and intelligence test performance across days. Here, the day-to-day variability across 6 IQ tests was studied and its associations with a) day-to-day variability in mood and b) personality traits.

Overall 98 participants (age range 18 to 75, mean 23 years) were assessed 5 times on 5 consecutive days in the lab, where they completed each day different versions/ items of 6 cognitive ability tests (short-term memory, logical reasoning, image rotation, pattern comparison, working memory, processing speed) and the Positive and Negative Affect Scale (PANAS). On day 1, they also completed the NEO-FFI to assess the Big Five.

All participants completed at least 2 study days, and 77 participants contributed on all 5 study days. Day-to-day variance in mood and cognitive ability tests were adjusted for trial-to-trial variance (i.e. within-test variance/ internal consistency). Day-to-day variability in cognitive ability tests ranged in IQ points (mean 100, SD = 15) from 0 to 20 with an average of approximately 6 IQ points across tests (SD = 3), demonstrating a) considerable day-to-day variability in cognitive function and b) individual differences in day-to-day variability. Associations between individual differences in the extent of day-to-day variability in cognitive function and mood were weaker than their respective correlations with personality traits.

This study demonstrates the extent of day-to-day variability in IQ and mood, thereby highlighting the importance of the individual differences dimension of variability per se. In addition, the findings help understanding the relative importance of more (i.e. mood) and less (i.e. personality) fluctuating factors for variability in cognitive ability test performance.

RELATIONSHIP BETWEEN INTELLIGENCE AND SPATIAL WORKING MEMORY ON RUSSIAN ADOLESCENTS*

Ivan Voronin[1], Viktoria Ismatullina[1], Anna Shelemetieva[2], Sergey B. Malykh[1]

[1] Psychological Institute of Russian Academy of Education, Moscow, Russia, ivan.a.voronin@gmail.com.
[2] Kyrgyz-Russian Slavic University, Bishkek, Kyrgyzstan.

The relationship between working memory and intelligence is well-established. Working memory is a cognitive system aimed to concurrently maintain access to information relevant to a task. Storage and extraction of information are essential components of problem solving, so individual differences in intelligence and characteristics of working memory must be closely related. The meta-analysis shows that the correlation between working memory capacity and non-verbal intelligence is 0.72 (Kane et al., 2005). In this study we investigate the relationship between spatial working memory and general intelligence on the sample of Russian adolescents.

The sample included 113 Russian adolescents (mean age 13.04 years, SD=2.34 years, 46% male). General intelligence was measured by means of Raven's Standard Progressive Matrices (SPM). Spatial working memory was assessed by means of the Spatial Working Memory test from the Cambridge Neuropsychological Test Automated Battery (CANTABeclipse). A participant had to collect tokens searching for them in the boxes on the screen. We used following measures: errors (touching the boxes which were already opened), response time (logarithm of the mean time of the first and last responses in tasks with 8 boxes), and strategy measure.

We found statistically significant correlations between Raven's SPM total score and mean number of total errors (-0.308), logarithm of the mean time of the first response in tasks with 8 boxes (-0.228), and logarithm of the mean time of the last response in tasks with 8 boxes (-0.330). We did not find statistically significant association between Raven's SPM total score and strategy measure (-0.174).

The results of our study show that there are moderate associations between intelligence and characteristics of spatial working memory in adolescents. The correlations are lower than ones from other studies which can be explained by the specificity of the measuring tool. Spatial Working Memory test uses a complex task which may involve many cognitive functions introducing in this way additional variance to the test scores. This result provides ground for the further behavior genetic study of the aetiology of the association between intelligence and working memory. This research is supported by Russian Foundation for Basic Research, grant 15-36-20902.

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RELIABILITY ESTIMATES FOR UNDERGRADUATE GPA

Paul A. Westrick[1]

[1] ACT Incorporated, paul.westrick@act.org.

For undergraduate admission decisions, undergraduate grade point average (UGPA) is often considered a criterion measure, with high school GPA and standardized cognitive assessments (the ACT and the SAT) used as predictors. As the reliability coefficient of the criterion measure places an upper limit on the observed validity coefficient for a predictor, having accurate estimates of the reliability of the criterion and the predictor allows for the calculation of the true-score correlation between the predictor and the criterion. Though numerous researchers have examined the reliability of UGPA, most of these studies have been conducted at single institutions with small samples. Furthermore, the types of reliability estimates (e.g., Spearman-Brown, coefficient alpha) varied across studies.

The current studies used meta-analysis (Hunter & Schmidt, 2014). Study one included 30 published research studies reporting various reliability coefficients. Different reliability coefficients may produce different estimates for the same data, but given the small number of studies for each type of coefficient, for each type of UGPA all reliability estimates were meta-analyzed together. Study two used semester and cumulative UGPA data from 62,122 students at 26 four-year institutions. Up to nine types of reliability coefficients were calculated depending on whether the measure was semester, annual, or cumulative UGPA. Meta-analyses were completed for each type of reliability estimate. Mean reliability estimates and 90% credibility intervals were reported in both studies.

For study one, estimated mean reliabilities for individual course grades (k=14), semester UGPA (k=27), annual UGPA (k=38), and fourth-year cumulative UGPA (k=2) were .300, .649, .759, and .916, respectively. For study two, course grade data were unavailable. The estimated mean reliability for semester UGPA using a correlational approach was .618. For annual UGPA, Feldt's (1989) classical congeneric coefficient produced the highest estimate for annual UGPA (.763). For fourth-year cumulative UGPA, coefficients for models based on classical halves (e.g., Spearman-Brown, .918) and essentially tau-equivalent parts (e.g., Guttman λ2, .890) exceeded Feldt's coefficient (.889). However, Feldt's coefficient is more defensible because it has less restrictive assumptions.

This study contributes to the literature by summarizing 30 published studies on the reliability of UGPA and adding new analyses using data from 26 institutions. An important finding is that estimates of the reliability of UGPA may differ depending on which reliability coefficient is used. The results also have important implications for research studies on the validity of standardized cognitive assessments such as the ACT and the SAT. It is important for researchers to understand that that low reliability estimates for UGPA, especially first-semester and first-year UGPA, place a cap on the observed validity coefficients for standardized cognitive assessments that have much higher score reliability estimates (ACT Composite, .96; SAT Critical Reading, .91-.93, SAT Mathematics, .92-.94).

CROSS-CULTURAL INVESTIGATION INTO TEACHER/CLASSROOM EFFECTS ON ACADEMIC PROGRESS IN RELATION TO MOTIVATIONAL FACTORS*

Elaine White[1,2], Margherita Malanchini[1,2], Dina Zueva[2],
Olga Bogdanova[2], Yulia Kovas[1,2]

[1] Goldsmiths, University of London, UK, e.white@gold.ac.uk.
[2] Tomsk State University, Russia.

Research suggests that within any country, almost the whole spectrum of individual variation in academic achievement is observed in any school or classroom, with only a small portion of within-population variance attributable to differences across teachers, classes and school (e.g. Asbury et al., 2008). It may be that shared effects of class/teacher are weaker or stronger as a function of such factors as teacher training, curricula, educational norms, and cultural stereotypes (e.g. Kovas et al., 2013). As longitudinal research into teacher/classroom effects are limited to date and neglect the contribution of non-cognitive factors, this study investigates teacher/classroom effects on academic achievement, across several points of the academic year in two countries.

This longitudinal study follows 622 11-12 year old Russian and UK secondary school students at several waves across one academic year. As students have subject-specific teachers for the first time in their education, comparisons can be made between their classrooms for two subjects, maths and geography. The students from 3 urban schools completed a range of tests and self-report questionnaires during their maths lesson. Data were collected to assess cognitive and non-cognitive factors in relation to academic progress. The students' school achievement data were also obtained. We explore differences: across the two countries; within and between classes; across the two school subjects; and motivational factors.

Preliminary results (from the first 3 waves) suggest stability of the measures, maths ability and maths self-efficacy, over time. A reciprocal relationship was shown between maths ability and maths self-efficacy across time 1 and time 2. This suggests that higher performance increases self-efficacy and higher self-efficacy increases performance. This reciprocal relationship remains when controlling for IQ and the relationship strengthens between ability at time 1 and self-efficacy at time 2. A negative relationship, which appears between ability at time 2 and self-efficacy at time 3, is likely to be the result of performance feedback.

This research investigates potential differences between Russian and UK education systems comparing classroom environments of mathematics in contrast to geography. Although taught and utilised differently, both academic subjects contain similar attributes. Both Russian and UK secondary school students have specific subject teachers for the first time in their education. UK students have the same teacher for all subjects during primary school and changes yearly, whereas Russian students have the same teacher throughout the four years of their primary education. The study therefore provides an ideal comparison of cognitive and non-cognitive factors across subject and classroom environments. Identifying factors moderating classroom effects is important for educational policy and provision.

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MORE PSYCHOMETRIC PROBLEMS WITH THE METHOD OF CORRELATED VECTORS

Jelte M Wicherts[1]

[1] Tilburg University, j.m.wicherts@uvt.nl.

The method of correlated vectors (MCV) was developed by Jensen (1980, 1998) to study the hypothesis that the relation between cognitive measures and an extraneous variable (e.g., ethnicity) is fully explained by g. Despite criticism, MCV continuous to be widely used in the study of group differences in intelligence test performance, most often to study Spearman's hypothesis stating that ethnic group differences in cognitive performance are most pronounced on the most highly *g* loaded tests or items. In addition, recent studies have submitted MCV results to psychometric meta-analytic techniques in which MCV results are corrected for particular psychometric artifacts.

In this talk, I critically evaluate the psychometric assumptions underlying MCV. I focus on meta-analytic corrections applied to vectors of *g* loadings and on the application of MCV to item-level data. I use both formal arguments and empirical data to illustrate the drawbacks of MCV. I particularly address studies that have applied MCV to study group differences on items of Raven's Standard Progressive Matrices (SPM). SPM data have yielded strong MCV correlations (i.e., Jensen effects) that have been interpreted as showing that the SPM measures g similarly across ethnic groups and is not subject to item bias.

Using formal arguments, I show that failures of metric measurement invariance (group differences in *g* loadings) actually lead to higher MCV estimates in meta-analyses despite the fact that such violations clearly contradict Spearman's hypothesis that group differences are due to g. Moreover, I show that MCV applied to item-level data does not provide accurate information about the comparative psychometric properties of a cognitive test and the role of g. The empirical results show that MCV applied to SPM items in one group yields substantial Jensen Effects even when the items in the second group (N=252) are not from the SPM but rather from a test composed of items from the State-Trait Anxiety Inventory and the State-Trait Anger Scale.

Combined, these results highlight problems with meta-analytic corrections to MCV results and show that MCV applied to item level data does not accurately reflect the degree to which item bias or *g* plays a role in the ethnic group differences. Although MCV may be useful in some circumstances, it is better to use model-based approaches like multi-group confirmatory factor analysis or Different Item Functioning (DIF) analyses whenever these are feasible.

DISSECTING HUMAN ABILITY INTO CORE MECHANISMS: MULTIPLE OBJECT TRACKING (MOT) IN A SAMPLE OF 19,000

Jeremy B Wilmer[1], Ken Nakayama[2], Laura Germine[3]

[1] Wellesley College, jwilmer@wellesley.edu.
[2] Harvard University.
[3] Massachusetts General Hospital.

Though recent decades have seen massive improvements in our understanding of cognitive and neural mechanisms of behavior, the task of dissecting human ability into its basic cognitive and neural components has remained elusive (Deary, 2000, 2010). Here, we examine a potential new tool for such dissection: multiple object tracking (MOT), the elementary cognitive task (ECT) of keeping track of several moving objects amongst moving distractor objects. MOT's neural substrates have been well-characterized (Jovicich et al., 2001) and the bulk of reliable individual differences in MOT can be explained by a single posterior event-related potential (ERP) component (Drew & Vogel, 2008). Yet of the 145 papers on MOT to date, only one other has examined individual differences (Oksama & Hyona, 2004).

Our aim was to characterize the cognitive correlates of MOT. To this end, we developed a brief (8-10 min), reliable (Cronbach's alpha = .88), web-based measure of MOT performance. We posted this test and several others on our website TestMyBrain.org, which has succeeded in sustainedly attracting a large number of motivated volunteer participants (~1.5 million since 2008) by providing engaging tests that give performance feedback. We tested a total of 19,724 participants (10,014 male) of varying ages (5th, 50th, and 95th percentiles 14, 25, and 58 years, respectively), educations (e.g. 34% of 25+ year olds had no more than a high school diploma), and ethnicities (46% non-European).

MOT dissociated strongly from reliable (Cronbach's alpha > .80), well-validated tests of sustained visual attention ($r(1930)=-.03$) and vocabulary ($r(2810)=-.09$), evidence that individual differences in MOT performance are driven by a relatively specific cognitive mechanism that is not reducible to a single general ability. MOT associated strongly with reliable (Cronbach's alpha > 0.80), well-validated tests of spatial working memory ($r(10841)=.44$) and rapid spatial attentional switching ($r(533)=.41$), evidence that MOT captures a mechanism important for visuospatial performance. Finally, MOT robustly predicted SAT-math performance ($r(2467)=.29$), but less so SAT-verbal performance ($r(2467)=.09$), evidence for a relatively specific link of MOT performance to math potential.

Here, we report a study of MOT that is nearly two orders of magnitude larger than the entire prior literature on MOT. Our results demonstrate that individual differences in MOT can be reliability and validly measured. We develop, norm, and validate a brief, reliable, new web-based test of MOT. By characterizing several key cognitive correlates of (and dissociations from) MOT, we place MOT firmly in a broader framework of human abilities. Given advances in our understanding of the neural correlates of MOT, we suggest that MOT could aid future efforts to dissect human ability into its core neuro-cognitive components.

THE ESTIMATION OF GENOMIC-LEVEL HERITABILITIES OR GENETIC "TRANSMISSIBILITIES" OF COGNITIVE MENTAL (IQ) ABILITIES AND CONATIVE LIFE HISTORY TRAITS

Michael A. Woodley of Menie[1], Aurelio José Figueredo[2],
Thomás Cabeza de Baca[3], Heitor B. F. Fernandes[4],
Pedro S. A. Wolf[5], Candace J. Black[6]

[1] TU Chemnitz, Department of Psychology; Vrije Universiteit Brussel, CLEA, Michael.Woodley@vub.ac.be.
[2] University of Arizona, Department of Psychology.
[3] University of California, San Francisco, Center for Health and Community.
[4] Federal University of Rio Grande do Sul, Department of Psychology.
[5] Prevention Research Center and Methodology Center, Pennsylvania State University, Pennsylvania USA.
[6] Department of Psychology, University of Arizona, Tucson, Arizona USA.

The Continuous Parameter Estimation Model (CPEM; Gorsuch, 2005) is applied to develop a method for the estimation of individual genomic-level heritabilities for the latent hierarchical structure of heritable traits, including cognitive mental (IQ) abilities and conative life history (LH) traits.

This novel heritability algorithm measures individual genetic transmissibility, therefore opening new avenues for analyzing complex interactions among heritable traits inaccessible to standard structural equations methods. CPEM permits the change in the covariance between any two variables to be determined throughout the full range of another variable.

For all IQ and LH domains sampled, correlation coefficients were estimated at the individual level by taking the cross-product of the standardized (z) scores of each individual's performance on the relevant subscales. It is thus mathematically inevitable, by definition, that the group mean of these individual-level cross-products automatically becomes the correlation coefficient for each group under consideration. Therefore, the cross-product itself (Zx*Zy) can be used as the individual-level "raw score" in CPEM to estimate the varying amount of strategic integration or differentiation "effort" in each group. Computing and comparing the group means of these cross-products using ANOVA also automatically calculates and compares group-level Pearson Correlation Coefficients.

The CPEs of SD-IE parameters for each individual co-twin were calculated, regardless of zygosity. After matching of co-twins and then random pairing of MZ-DZ twin dyads, heritability coefficients for each randomly-assigned MZ-DZ dyad pairing were estimated and then aggregated across 50 random pairings to obtain "individual-genome-level" MZ dyadic means. Individual-genome level heritabilities were estimated by CPEM by applying the Falconer Formula (Figueredo et al., 2004) separately to each random MZ-DZ dyad pairing. The mean values of these individual-genome-level CPEs of heritability coefficients automatically yield values approximating the group-level aggregates obtained using conventional methods (Figueredo et al., 2004; Figueredo and Rushton, 2009).

COGNITIVE SPECIALIZATION FOR VERBAL VS. SPATIAL ABILITY: NEURAL AND BEHAVIORAL CORRELATES

Ronald A. Yeo[1], Sephira Ryman[1], Martijn van den Heuvel[2],
Marcel A. de Reus[2], Jessica Pommy[1], Brandi Seaman[1], Rex E. Jung[1]

[1]University of New Mexico, [2]University Medical Center Utrecht, ryeo@unm.edu.

A great deal has been learned about the neurobiological underpinnings of general intelligence, from neurophysiology to neuroanatomy and network science, but much less is known about the neurobiology of cognitive specialization. Independent of general cognitive ability (GCA), what brain features confer relatively better verbal or spatial ability? The goal of the present study was to investigate verbal vs. spatial cognitive specialization with many of the analytic tools that have proven useful in establishing the nomological net of GCA: assessment of gross morphological correlates, graph theory analysis of brain networks, examination of possible sex differences in neurobehavioral relationships, and exploration of non-cognitive correlates.

Participants (N = 244, 119 women) had an interest in or were pursuing higher education or work within the STEM fields. All were recruited by postings around the University of New Mexico. From cognitive tests (WAIS IV: Similarities, Block Design and Matrix Reasoning, Johnson - O'Conner: Paper Folding, Mental Rotation, and Vocabulary) we derived "pure" scores for spatial ability (covarying verbal ability) and verbal ability (controlling for spatial ability). Personality assessment yielded Big 5 variables and a measure of "quirkiness". From structural MRI scans (3-Tesla Siemens Triotim) we computed surface area and cortical thickness (Freesurfer) and from DWI images we derived normalized graph metrics of clustering, efficiency, path length, and overall connectivity.

Sex differences were found for cognitive, personality, anatomic, and network measures, as in prior studies. A series of repeated measures (RM) analyses (within sex) evaluated hypotheses that spatial and verbal processing were differentially related to predictors (an interaction with the RM factor). A similar pattern of results was observed across analyses. In men only, a set of personality variables (esp., neuroticism and quirkiness) were significantly, differentially related to the two cognitive variables. Similarly, in men only, cortical surface was significantly, differentially related to the cognitive variables, predicting spatial but not verbal ability. Different graph metrics predicted spatial ability in men (overall connectivity) and women (clustering).

Verbal vs. spatial cognitive specialization is a dimension of individual differences with broad impact on behavior and anatomy. In this study verbal-spatial specialization was related to sex, cortical surface area, network organization, personality, and vocational interests. However, most of the identified correlates of this cognitive specialization were found only in men, and mostly for spatial ability. A principal components analysis of variables differentially linked with these cognitive abilities demonstrated a larger first factor in men. Thus, we have identified a suite of neurobehavioral features whose expression and covariance is sex-specific. These observations suggest that there may be a sex-specific developmental trade-off regarding specialization in verbal vs. spatial ability.

INTELLIGENCE AND TIME PERSPECTIVE: HOW THE VIEW OF THE PAST, PRESENT AND FUTURE INFLUENCES OUR ABILITY?

Marcin Zajenkowski and Maciej Stolarski[1]

[1] Faculty of Psychology, University of Warsaw, zajenkowski@psych.uw.edu.pl.

Intelligence and time perspective (TP) have been shown to correlate with a variety of psychological variables, such as health, risk taking and psychoactive substance use, and gratification delay. In general, both intelligence and TP predict behavior that might be described as adaptive. These similarities prompt the question of whether and how these seemingly distinct constructs are related. In the present study we examine the complex relationships between TP and cognitive ability. Additionally, we consider other variables, cognitive, emotional and motivational, that might mediate this relation.

In the first study (n=230) we used Zimbardo Time Perspective Inventory, Raven's test, verbal intelligence and subjective assessment of intelligence. In study 2 (n=300) we used Zimbardo Time Perspective Inventory, Raven's test, and stress states related to solving Raven's test.

Past Negative and Present Fatalistic time perspectives correlated negatively with both fluid and crystallized intelligence. Present Hedonism was negatively and Future orientation positively associated with verbal intelligence. Moreover, subjectively assessed intelligence mediated the relationship between Fatalism and intelligence. Finally, Balanced TP positively correlated with fluid intelligence.

The second study revealed that Present Fatalism and Past Negative were associated with higher stress related to intelligence test, while Balanced TP reduced this stress.

The obtained results suggest that TP plays significant role in acquiring abilities (crystallized intelligence), but also that it influences test performance. Finally, Balanced Time Perspective helps in taking intelligence tests due to efficient emotion regulation.

EEG CORRELATES OF MATH ANXIETY: TWIN STUDY*

Ilya Zakharov[1], Mikhail Zaleshin[2], Elena Esipenko[2],
Tatiana Dolgorukova[2], Tomasz Bloniewski[3]

[1] Laboratory of Developmental Behavioural Genetics at Psychological Institute, Russian Academy of Education, iliazaharov@gmail.com.
[2] International Laboratory for Cognitive Investigations and Behavioural Genetics, Department of Psychology of Tomsk State University.
[3] Department of Psychology, Goldsmiths University of London.

Mathematics anxiety (MA) refers to the negative feelings and emotional reactions elicited by mathematics or by the task related to it. There is a combination of environmental and genetic factors that contribute to individual differences in MA. Some of these factors are shared with generalized anxiety and others with mathematics problem solving ability. The study of the brain correlates of MA can be important to understand the role of various factors.

We performed an EEG experiment in the ongoing twin study to address the brain mechanisms and genetic/environmental contributions to individual differences in MA. The participants were presented with 3 types of stimuli: 1) Algebraic equations with and without error 2) Arithmetic equations with and without error 3) Sentences in native language with and without error. Every trial was preceded with a cue that signals what type of stimuli will be presented. After every response the subject was given feedback on whether their response was correct or incorrect. The subject was also presented with the startle sound in small percentage of the trials. All the subjects have also completed the cognitive battery and MA questionnaire.

We analyzed ERP for cues and tasks presented with and without errors. The task presentation evoked N100 and P200 ERP components with maximum in fronto-central areas with the lowest N100 amplitude for lexical task presentation. The cues evoked P300 component with different amplitude for task type. There was differences for low and high math anxious participants.

Preliminary results of the ongoing study have shown different EEG activity patterns in lexical, arithmetic and algebraic tasks for cues and task presentation. There were differences between low and high math anxious participants. Brain mechanisms related to processing of math and non-math related stimuli in low and high math anxious groups are discussed.

* Presentation is eligible for a Student Award.

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NOTES