International Society for Intelligence Research (ISIR)

17th Annual Conference

July 15–17, 2016
Saint Petersburg, Russia

Solo Sokos Hotel Palace Bridge

www.isironline.org

Pre-conference Workshop:
International Summer School
«Interdisciplinary Approaches to the Study of Intelligence»
July 12–14, 2016, St Petersburg, Russia

The school is organized by the Psychological Institute of Russian Academy of Education and supported by the Russian Science Foundation (project №15-18-30055) and is open free of charge for students and early career researchers attending the ISIR conference.

The Venue for the International Summer School is Solo Sokos Hotel Palace Bridge, Birzhevoi pereulok 2–4 (Vasily Island), 199004 St Petersburg, Russia: *https://www.sokoshotels.fi/en/st-petersburg/sokos-hotel-palace-bridge*

Lev Vygotsky
(1896–1934)

This year is the celebration of 120 years since the birth of Lev Vygotsky – Russian psychologist, the founder of a theory of human cultural and bio-social development. The work of Lev Vygotsky has become the foundation of much research and theory in cognitive development and education.

ISIR PRESIDENT AND BOARD 2016

LOCAL HOST

Professor Yulia Kovas
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ACKNOWLEDGMENTS

CONFERENCE VENUE

Solo Sokos Hotel Palace Bridge
Birzhevoi pereulok 2–4 (Vasily Island),
199004 St Petersburg, Russia

IN MEMORIAM

Earl «Buz» Hunt, 1933–2016

May we all live so well, accomplish so much, laugh so often.

Earl «Buz» Hunt was a giant in our field, not just for his empirical contributions, but also for his efforts to substantiate the idea that individual differences are central not only to understanding measures of broad cognitive performance (such as IQ scores, educational achievements, and job competence) but also for understanding the specific cognitive components involved in carrying out any particular cognitive task. Buz was an original member of Intelligence's Editorial Board and the ISIR Executive Board. He worked tirelessly to bring in more members and conference attendees, and to expand the breadth of topics featured at the conference. With Wendy Johnson, he drafted the Society's Constitution and he was the first President elected by the Society in 2011. He received its Lifetime Achievement Award in 2009 and was the conference Distinguished Interviewee in 2005. The Association for Psychological Science honoured him in 2011 with the James McKeen Cattell Award for outstanding contributions to applied psychology. He was a frequent contributor to Intelligence and a tireless and constructively critical reviewer for many submissions by junior and senior researchers.

Schedule-at-a-Glance

DAY 1: Friday 15th July

Time	Event
8:45–9:20	Registration
9:20–9:30	Opening remarks: M.A. McDaniel
9:30–9:40	Lifetime Achievement Announcement: K. Warner Schaie / Announcement: 2017 Conference
9:40–10:40	Keynote Address: Yulia Kovas
10:40–11:40	Talks: Session 1 (Plomin, Sellers, Karama)
11:40–12:00	Break
12:00–13:00	Talks: Session 2 – Education (Schneider, Neubauer, von Stumm)
13:00–14:30	Lunch (*Provided)
14:30–15:30	Talks: Session 3 – Genes & Environment (Rodic, Rimfeld, Hill)
15:30–16:15	Lightning Talks Session 1 (Wraw, White, Loesche, Kirkegaard, Bloniewski, Gignac)
16:15–16:45	Coffee Break (*Provided)
17:00–18:00	ISIR Business Meeting / How to get your paper published (Fraser)
18:00–19:00	David Lubinski interview with Linda Gottfredson
19:00–21:00	Poster Session & Elsevier Reception

DAY 2: Saturday 16th July

Time	Event
8:00–9:00	Student Breakfast with Douglas Detterman (signup on Day 1)
9:00–10:00	President's Invited Research Presentation: Lars Penke
10:00–11:40	Talks: Session 4 – Neuroscience (Basten, Tatti, Zhou, Davis, Chuderski)
11:40–12:00	Break
12:00–13:00	Talks: Session 5 – Flynn Effect (Rodgers, Pietschnig, Must)
13:00–14:30	Lunch (*Provided)
14:30–15:05	Lightning Talks Session 2 (Rymareva, Scott, Morosanova, Baudson)
15.05–16:05	Talks: Session 6 – Methodology (Wicherts, Lawrence, Loe)
16:05–16:30	Coffee Break (*Provided)
16:30–17:30	Talks: Session 7 – Culture (Gottfredson, te Nijenhuis, Zajenkowski)
17:30–18:30	President's Invited Address: Douglas Detterman
19:30	Conference Banquet (included in registration)

DAY 3: Sunday 17th July

Time	Event
10:00–11:00	Holden Memorial Address: David Epstein
11:00–11:30	Break
11:30–12:30	Talks: Session 8 (Papageorgiou, Shcherbakova, d'Apice)
12:30–14:00	Lunch (*Provided)
14:00–16:00	Talks: Session 9 (Kovacs, Stankov, Lee, Kazali, Malanchini, Lotz)
16:00–16:20	Coffee Break (*Provided)
16:20–16:30	Student Awards

Note: The order of names reflects the order of presentations; *Provided = each day one coffee break with snacks and lunch are included in the registration fee.

ADDITIONAL INFORMATION:

Please arrive at conference registration desk from 8.30 am on July 15. The registration desk is located in the hotel lobby.

Poster presentation advice:

Poster boards accept a maximum size poster of 841×1189 mm (34-inches × 47-inches) wide. Portrait (Vertical) orientation is preferred. Poster session will take place on the 1st day of the conference, 19.00–21.00.

Talk length:

- Full Talk (15 minutes + 5 minutes of discussion)
- Lightning Talk (4 minutes + 2 minutes of discussion)

Day 1: Friday 15ᵗʰ July 2016

8:45–9:20	Registration
9:20–9:30	Opening remarks *Michael A. McDaniel*
9:30–9:40	Lifetime Achievement Announcement: K Warner Schaie *Presented by Michael A. McDaniel* Announcement: 2017 Conference *Presented by Sherif Karama*
9:40–10:40	Keynote Address: *Yulia Kovas* *Introduced by Michael A. McDaniel*
10:40–11.00	Polygenic scores for intelligence and academic achievement *Robert Plomin*
11:00–11.20	Early risk mechanisms for the development of reading and math ability: examining the role of genetically informed attributes of child ADHD, and parental hostility *Ruth Sellers et al.*
11:20–11.40	Revisiting the association between intelligence and trajectory of cortical development *Sherif Karama*
11:40–12:00	Break
12:00–12:20	Intelligence and self-concepts as predictors of elementary school achievements *Rebecca Schneider et al.*
12:20–12:40	Intelligence, personality and interests predict apprenticeship success *Aljoscha C. Neubauer et al.*
12:40–13:00	Are changes in mood coupled with changes in cognitive function? *Sophie von Stumm*
13:00–14:30	Lunch (*Provided)

14:30–14.50	Early risk mechanisms for the development of reading and math ability: examining the role of genetically informed attributes of both child and parent executive functioning *Maja Rodic Bjedov*
14:50–15:10	Genetic influence on educational attainment and occupational status during and after the Soviet era in Estonia *Kaili Rimfeld et al.*
15:10–15:30	Molecular genetic aetiology of general cognitive function is enriched in evolutionarily conserved regions *W. David Hill et al.*
15:30–15:37	Intelligence in youth and mental health at age 50 *Christina S. Wraw et al.*
15:37–15:44	Twin classroom separation dilemma: evidence from 2 twin studies *Elaine White et al.*
15:44–15:51	Eye movements help the interpretation of response times in matrix reasoning *Patrick Loesche et al.*
15:51–15:58	The OKCupid dataset: a very large public dataset of dating site users *Emil OW Kirkegaard et al.*
15:58–16:05	Neural manifestations of mathematical anxiety in a sample of Russian twins *Tomasz Bloniewski et al.*
16:05–16:12	Short-term memory and working memory may differentiate themselves to the degree that they draw upon the phonological loop or the visual sketch pad *Gilles E. Gignac*
16:15–16:45	Coffee Break (*Provided)
17:00–18:00	ISIR Business Meeting / How to get your paper published *Adam Fraser*
18:00–19:00	Distinguished Interview: Linda Gottfredson Interviewer: David Lubinski *Introduction Michael A. McDaniel*
19:00–21:00	Poster Session & Elsevier Reception

Day 2: Saturday 16ᵗʰ July 2016

8:00–9:00	Student Breakfast with Douglas Detterman (signup on Day 1)
9:00–10:00	President's Invited Research Presentation: *Lars Penke* *Introduced by Michael A. McDaniel*
10:00–10:20	Intelligence and brain connectivity: the role of intrinsic brain network organization for individual differences in intelligence *Ulrike Basten et al.*
10:20–10:40	Electrophysiological correlates of distinct abstract-reasoning processing stages in humans *Elisa Tatti et al.*
10:40–11:00	Neural correlates of numerical processing for adults with mathematical overachievement and underachievement *Xinlin Zhou*
11:00–11:20	Cognitive task performance and spatial abilities among adolescence in a traditional and transitioning population, the Tsimane of Bolivia *Helen Elizabeth Davis et al.*
11:20–11:40	Fluid intelligence can be predicted by the cross-frequency coupling of neuronal oscillations *Adam Chuderski et al.*
11:40–12:00	Break
12:00–12:20	A variance decomposition approach to identifying the source of the Flynn effect in the NLSY family data *Joseph Lee Rodgers et al.*
12:20–12:40	Stagnation, reversal, and a new domain: meta-analyzing the Flynn effect *Jakob Pietschnig et al.*
12:40–13:00	Results of the national intelligence tests support the explanation of the FE: the abstract thinking abilities of Estonian students has risen over the last 70 years *Olev Must et al.*
13:00–14:30	Lunch (*Provided)
14:30–14:37	Comparison EEG correlates of emotional intelligence among different ethnic groups during face recognition task *Yulia M. Rymareva et al.*

14:37–14:44	Intelligence or personality trait? Measuring individual differences in imagination *Hannah R. Scott et al.*
14:44–14:51	Self-regulation as a mediator of the relationship between intelligence, cognitive characteristics, mathematical abilities and mathematical success *Varvara I. Morosanova et al.*
14:51–14:58	Mini-q: a three-minute screening of speeded reasoning *Tanja G. Baudson*
15:05–15.25	Problems with sampling in IQ research: a meta-meta analysis *Jelte M. Wicherts et al.*
15.25–15.45	Applying MLM to hierarchically partition longitudinal variance in cognitive function into CHC strata I, II, and III *Ashley V Lawrence et al.*
15.45–16.05	A cognitive model of automatic alpha-numeric item generator *Bao Sheng Loe et al.*
16:05–16:30	Coffee Break (*Provided)
16:30–16:50	Differences in the distribution of g and its effect on culture: the USA as a case *Linda S. Gottfredson*
16:50–17:10	Spearman's hypothesis not confirmed? Three meta-analyses of Black and White prisoners, northeast Asians, and Arabs and Jews *Jan te Nijenhuis et al.*
17:10–17:30	Why does intelligence reduce anger? An experimental approach *Marcin Zajenkowski et al.*
17:30–18:30	President's Invited Address: *Douglas Detterman* *Introduced by Michael A. McDaniel*
19:30	Conference Banquet (included in registration)

10:00–11:00	Holden Memorial Address: *David Epstein* *Introduced by Michael A. McDaniel*
11:00–11:30	Break
11:30–11:50	Siblings' sex is linked to mental rotation performance in males but not females *Kostas A. Papageorgiou et al.*
11:50–12:10	IQ does not fit into the plomin – daniels generalization? *Olga V. Shcherbakova et al.*
12:10–12:30	Assessing toddlers' intelligence and homes: the practicability of digital language recorders *Katrina H. d'Apice et al.*
12:30–14:00	Lunch (*Provided)
14:00–14:20	Cognitive abilities, educational achievement, and physical fitness – latent variable analysis *Kristof Kovacs et al.*
14:20–14:40	Conservatism and cognitive ability revisited *Lazar Stankov*
14:40–15:00	Non-cognitive factors in mathematics achievement: evidence from PISA and TIMSS *Jihyun Lee et al.*
15:00–15:20	Structure and development of deductive reasoning during childhood: interrelation with cognizance, cognitive processes and general intelligence (g) *Elena Kazali*
15:20–15:40	Preschool drawing and school mathematics: the nature of the association *Margherita Malanchini et al.*
15:40–16.00	Complex problem solving in educational contexts – still something beyond a «good g»? *Christin Lotz et al.*
16:00–16:20	Coffee Break (*Provided)
16:20–16:30	Student Awards

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

Behavioural Genetics for Education:
New Insights into the Origins of Academic Ability,
Motivation and Achievement

Yulia Kovas[1,2]

[1] Goldsmiths, University of London;
[2] Tomsk State University

Many important for education findings have recently emerged from genetic research, suggesting that genetic effects are not static or deterministic, but change throughout life and in different educational and cultural contexts. For example, academic achievement – such as performance in reading, language and mathematics – has been found to be highly heritable throughout school education in the UK. On the contrary, heritability of general cognitive ability is only moderate in the early school years and increases gradually, reaching substantial levels in adulthood. It is possible that high heritability of reading and mathematics can be explained by the high homogeneity of educational environments. For example, the UK National Curriculum is highly uniform and therefore may decrease the environmental contribution to the variance in these traits. On the contrary, general cognitive ability is not explicitly taught at schools, and therefore may be under highly variable environmental influences across children, especially early in development. Gene-environment correlations, whereby children experience, modify, and select their environments – partly because of their genetic propensities – may contribute to the observed increase in heritability of IQ. Recent large-scale twins studies also provided insights into the origins of individual differences in such educationally-relevant characteristics as motivation, grit, academic anxiety, and choice of specific academic subjects. Incredible recent advances in molecular genetic research have led to identification of specific DNA polymorphisms responsible for ubiquitous genetic influence. Moreover, new methods allow us to make predictions about development directly from DNA, which opens up unprecedented opportunities for further research and educational practice.

Biological Foundations of Intelligence

Lars Penke[1]

[1] *Georg August University Göttingen, Germany*

The heritability of intelligence is well-established, clearly indicating that it has a biological foundation. A rapid development in both neuroscience and molecular genetics has provided fascinating insights into these foundations in recent years.

While the total brain volume is at the same time the historically oldest, roughest, and most robust neuroanatomical correlate of intelligence, we now know a lot more: Cortical volume is more important than subcortical volume, cortical area more so than thickness, and morphometric, functional, network and lesion-mapping approaches all point to a broad parieto-frontal cortical network underlying differences in general intelligence. While localization efforts will likely continue to narrow down more precisely where in the brain intelligence resides, a common theme in several current studies is that global measures of brain integrity (e.g., of white matter or cerebral blood vessels) predict a large amount of variance in intelligence already, and appear to do so over the whole lifespan. This pattern of results suggest that overall neurodevelopmental stability or system integrity may be an important part of the biological foundation of intelligence.

In line with this interpretation, genomic research has conclusively shown that there are not a few common genetic variants underlying differences in intelligence, as well as genetically highly correlated traits like educational attainment, but thousands of variants with individually miniscule effects that are widely shared with indicators of brain, physical and mental health. These common variants mostly occur in evolutionary conserved regions of the genome, suggesting that they tag genetic variation in areas that purifying natural selection tries to keep as is. Furthermore, the majority of cases of severe mental disability, the very low end of the intelligence distribution, can now be conclusively explained by a limited number of rare genetic mutations. While gross indices of overall mutational burden fail to show associations with intelligence so far, a recent sequencing study suggests that rare variants in conserved regions do.

Overall, a major component of the biology of intelligence seems to be a large, efficient and integer brain (and particularly the parieto-frontal network therein), based on a genome that lacks variation in areas where natural selection does not tolerate them well, supporting the mutation-selection balance account of intelligence differences.

PRESIDENT'S INVITED ADDRESS

Intelligence Research: 50 Years of Satisfaction

Douglas K. Detterman[1]

[1] Case Western Reserve University, detterman@case.edu

Intelligence research, the most important topic in science that can be studied, has made amazing gains in the last 50 years. I will review my perspective on where we were 50 years ago, where we are today, and what we need to do going forward. The areas of psychometrics, cognition, genetics, neuropsychology, and what intelligence predicts will be covered. History (and data) clearly indicate the substantial progress that has been made in the last 50 years. A few issues will be covered in some detail. These issues suggest a different perspective than is currently held by most researchers. Finally, I will attempt to predict what intelligence research will have accomplished by 2066 so someday everyone can laugh at how short-sighted I was in 2016 and how much I failed to anticipate.

ISIR 2016 PRESENTATIONS

Abstracts for the remaining papers follow in alphabetical order
by first author's last name.

Intelligence and Brain Connectivity: The Role of Intrinsic Brain Network Organization for Individual Differences in Intelligence

Ulrike Basten[1], Kirsten Hilger[1], Matthias Ekman[2], Christian J. Fiebach[1]

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Radboud University Nijmegen, The Netherlands

The Parieto-Frontal Integration Theory (P-FIT) of intelligence (Jung & Haier, 2007; Basten et al., 2015) postulates that intelligence depends on neural processing in distributed, yet integrated brain regions including frontal and parietal cortex. Previous neuroimaging studies mostly focused on identifying localized correlates of intelligence in brain structure and function (for review, see Basten et al., 2015). However, more recent work highlights the 'integration' aspect of P-FIT, suggesting that differences in the efficiency of information flow between brain systems may critically contribute to variation in intelligence between persons. This talk will introduce the investigation of intrinsic brain connectivity and highlight its importance for intelligence research.

We will review published work on the relationship between functional brain network connectivity and intelligence and present recent work from our own group, including a graph theoretical study investigating the relationship between intrinsic topological brain network properties and intelligence: Functional magnetic resonance imaging (fMRI) data acquired from 54 healthy adult participants during wakeful rest were modelled as graphs representing individual functional brain networks. Local and global measures of efficient network organization (i.e., individual values of nodal efficiency and global efficiency) were correlated with intelligence scores (Wechsler Abbreviate Scale of Intelligence, WASI).

While global network efficiency showed no significant association with intelligence, the local measure of nodal efficiency was significantly associated with intelligence in three brain regions. More intelligent subjects showed higher nodal efficiency in right anterior insula (AI) and dorsal anterior cingulate cortex (dACC), two hub regions of a functional brain network previously described as salience network. Furthermore, intelligent persons showed lower nodal efficiency in the left temporo-parietal junction area (TPJ). Distinct connectivity profiles were observed for brain regions showing positive versus negative correlations between intelligence and nodal efficiency.

Our results suggest that brain regions related to salience processing (AI, dACC) and the filtering of incoming information (TPJ) play a role in explaining individual differences in intelligence. The specific network integration of these regions may enable intelligent people to more effectively detect and evaluate salient information and to protect ongoing processing from interference of irrelevant information. The results are in line with behavioral studies suggesting intelligence-related differences in the ability to distinguish between relevant and irrelevant information in cognitive processing. More generally, our results contribute to a growing understanding that fundamental properties of brain network organization are critical determinants of individual differences in intelligence.

Mini-q: A Three-Minute Screening of Speeded Reasoning

Tanja G. Baudson[1]

[1] *University of Duisburg-Essen, Germany, tanja.baudson@uni-due.de*

Assessing intelligence is of interest in numerous research questions, be it as a variable of its own or as a control variable. However, assessing intelligence takes time. I therefore present a brief screening of speeded reasoning, based on Baddeley's Test of Verbal Reasoning, with potential for application in other languages as well.

The mini-q (Baudson & Prickle, 2015) consists of 64 statements along with a combination of three figures (a circle, a triangle, and a square), which either represents the statement or not. Testees have to decide whether this is the case or not. The mini-q has been administered both in paper-and-pencil format and online, with N>500 in either case. It has been tested with adults (mostly university students) and with pupils from a broad range of school types, starting at grade 3 (9 years of age). mini-q results were validated against several criteria.

The mini-q proved valid with regard to other IQ tests (the CFT, the IST Screening, a test of crystallized intelligence, a newly developed measure of clerical speed, teacher, parent, and self ratings of cognitive ability, grades, and academic self-concept. The test is fair with regard to gender and socioeconomic status; it depends on testees' language abilities. In sum, the mini-q seems to be a valid and useful screening of speeded reasoning for research purposes.

Besides its obvious practical use in applied research, the mini-q provides potential for research at the processual level. Currently, we are examining in how far strategies to solve the mini-q items correspond to Spearman's Neogenetic Laws; an improved online version, which will allow to assess time-on-task for individual items is being programmed. The test has potential for translation into other languages where a direct translation from Baddeley's original is not possible.

Neural Manifestations of Mathematical Anxiety
in a Sample of Russian Twins[*]

Tomasz Bloniewski[1], Ilya M. Zakharov[3], Mikhail S. Zaleshin[2]

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[2] *Tomsk State University;*
[3] *Psychological Institute of Russian Academy of Education*

Research on Mathematical Anxiety (MA) has historically used questionnaire assessment of this construct. This poses a number of limitations in that it considers cognitive deficits in MA in a retrospective manner when MA has taken its toll. Only few studies to date have addressed the temporal course of MA and the way MA erodes cognitive deficits in real time. It is important to stress that MA may influence performance on cognitive tasks differently, depending on whether the tasks involve mathematical operations or not. It remains largely unanswered whether cueing individuals to an upcoming task (e.g., algebraic operations) elicits different neural responses in low- and high-math anxious individuals.

The methods used include electroencephalography (EEG) data with a particular emphasis on event-related potentials (ERPs) with the P300 component measured in low- and high-math anxious individuals. The data come from an on-going study on twins from the Russian School Twin Registry who performed on three cognitive tasks: lexical, arithmetic, and algebraic. The proposed talk aims to offer an insight into the effects a particular cue has on the anticipation of the upcoming task and the potential carry-over effects this may have on the performance on the task itself.

Results have indicated a trend in the P300 component with high-math anxious individuals showing a larger mean amplitude as compared to their low-math anxious peers. This holds under the effects that all cues have on the anticipation, irrespective of the task type (lexical, arithmetic, or algebraic). This may indicate that MA may influence the amount of cognitive resources being invested to compensate for the detrimental effects anxiety has on cognitive performance.

The study has several important implications. Firstly, it is a first study to date to address the role anticipation plays in MA. The different anticipation profiles in low- and high-math anxious individuals may indicate that the way individuals appraise the upcoming task could be targeted in order to ameliorate the decrements in later performance. Secondly, the lack of the difference between anticipating different types of tasks may suggest that MA is more domain general rather than domain specific. Finally, the study allows to examine the exact temporal resolution of the effects of MA on cueing.

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[*] Presentation is eligible for a Student Award.

Fluid Intelligence Can Be Predicted by the Cross-Frequency Coupling of Neuronal Oscillations

Adam Chuderski[1], Adam Gagol[1], Mikolaj Magnuski[1], Patrycja Kalamala[1],
Bartlomiej Kroczek[1], Michal Ociepka[1]

[1] *Jagiellonian University in Krakow, Poland, adam.chuderski@gmail.com*

Some existing computational models predict that fluid intelligence strongly depends on the cross-frequency coupling of neuronal oscillations (the modulation of a fast oscillatory band by a slow band). Specifically, our own model of figural analogical reasoning (a benchmark intelligence test) assumes that how many gamma oscillations (each representing one attribute of a relation) can be coupled within one theta oscillation (representing the complete relation that need to be processed), that is, the theta/gamma cycle length ratio, determines scores on figural analogy tests (Chuderski & Andrelczyk, 2015, Cognitive Psychology). However, empirical evidence supporting these predictions is still scarce.

Using EEG, we gathered data from 21 participants solving a computerized variant of the Raven test, which requires inductive reasoning on matrix problems. By means of the novel cluster-based method of cross-frequency coupling analysis, we identified the characteristic, most strongly coupled theta (3–9 Hz) and gamma frequency (30–80 Hz) for each individual, at which the long-range coordination of neuronal processing most likely took place.

We found that the modulation of the gamma wave amplitude by the theta wave amplitude predicted the analogy test scores. The theta/gamma cycle length ratio correlated substantially and positively ($r = .53$) with reasoning performance. This finding suggests that better reasoners can bind more items/attributes together, and thus can process more complex problems/relations. Surprisingly, the very strength of coupling was negatively correlated with reasoning ($r = -.56$), meaning that the (more complex) bindings in better reasoners were less stable than the (simpler) bindings in less intelligent people. The clusters of coupled oscillations were primarily located in the parietal cortex. These data were in line with the predictions of the computational model.

Our results suggest that the coupling of gamma and theta oscillations serves as a cognitive mechanisms for representing structured information (lists, relations), necessary to cope with intelligence tests. Individual ability to process more complex structures is underpinned by the ability to couple more gamma cycles within one theta cycle, but also with the ability to hold reliably such an unstable coupling. In general, these data indicate that brain oscillations and their interaction may be a promising line of research uncovering neuronal mechanisms of human intelligence.

Assessing Toddlers' Intelligence and Homes:
The Practicability of Digital Language Recorders[*]

Katrina H. d'Apice[1], Sophie von Stumm[1]

[1] *Goldsmiths, University of London, k.dapice@gold.ac.uk*

The assessment of children's early life ability and experiences has been a long-standing challenge in intelligence research. Assessing toddlers and their environments reliably is very costly (e.g. researchers must complete home visits) and as a result, most studies on individual differences in early life intelligence use sub-optimal, yet cost-effective measures, such as parent ratings of ability. Here, we report on the practicability of digital language recorders for assessing children's ability and their environment over the course of several days in their homes.

Overall 120 monolingual British families with a toddler aged 2 to 3 years (mean 2.8 years; SD = 0.6; 47.5% females) were recruited for this study. First, mothers and fathers completed online surveys that assessed their socioeconomic status (SES) and their child's cognitive ability (i.e. parent report). Families then received 3 digital language recorders and t-shirts with pockets to insert them into. Study children «wore» the recorders for 3 full days. From the recordings, child word count (CWC), adult word count (AWC), and conversational turn count (CTC) were extracted. Also, two 5-minute excerpts from each recording day were transcribed to obtain detailed functional and structural language markers. Finally, parents completed an IQ testing booklet with the study child.

Over 85% of families that received the audio recorders completed 3 days of recordings with an average of 44.6 hours per family (SD 5.4), suggesting that LENA is effective and practical for assessing children's language ability. The 3 day long recording data showed substantial individual differences in CWC (range 742 to 4633, mean = 3294, SD = 740), AWC (range 7505 to 27171, mean = 17456 and SD = 3907) and CTC (range 235 to 1407, mean = 800, SD = 208).

Preliminary analyses suggested that children's language markers were closely associated with the parent-rated and booklet-based IQ scores, substantiating the markers' concurrent validity. Also, children's language correlated with their parents' language ability and the characteristics of their family's home (e.g. family composition, SES).

The findings of this study have 3 implications. First, digital language recorders were found to practicable and unobtrusive for collecting rich, naturalistic data on children and their home environments. Second, the close relationship between CWC and IQ scores suggests that verbal skills are a core element of early life intelligence, which may guide future studies that seek to assess toddlers cognitive ability. Third, children's language resembled their linguistic home environment, highlighting that language in the family home may be a good target for interventions that seek to improve children's cognitive ability to better their life-chances.

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[*] Presentation is eligible for a Student Award.

Molecular Genetic Aetiology of General Cognitive Function is Enriched in Evolutionarily Conserved Regions

W. David Hill[1], Gail Davies[1], Riccardo E. Marioni[1], Sarah E. Harris[1], Saskia P. Hagenaars[1], David C. Liewald[1,2], Catharine R. Gale[1,2], Ian J. Deary[1,2]

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As with many polygenic traits, the difference between the variance explained by single nucleotide polymorphisms (SNPs) that do reach genome-wide significance and heritability estimates derived using all SNPs indicates that much of the variance of general cognitive function can be explained by SNPs that have not yet attained genome-wide significance. Whilst an increase in sample size will result in an increase in the power to detect significant effects of single nucleotide polymorphisms (SNP) in a Genome-Wide Association Study (GWAS), the problem remains of organising these individual hits into a coherent description of the genetic architecture of cognitive function.

We examine two large GWAS data sets. General fluid cognitive function was measured in the CHARGE consortium (n= 53,949) and Verbal-numerical reasoning (n=30,801) was assessed in UK Biobank. We use stratified linkage disequilibrium score regression to partition the total heritability found in large GWAS data sets on general cognitive function, and on the Verbal-numerical reasoning test in UK Biobank, into 24 broad functional annotations and 10 cell type specific tissue annotations. Our analysis modelled linkage disequilibrium between regions, took into account overlapping categories, as well as considering the proportion of SNPs in each category.

In general cognitive function (CHARGE), significant enrichment was found for 10 of the functional annotations tested and 1 of the cell type specific annotations. SNPs found in evolutionarily conserved regions accounted for 2.5% of the SNPs found in the general cognitive function data set, but collectively explained 49.2% of the heritability estimate, representing a significant enrichment (P = 4.88×10^{-6}). These evolutionarily conserved regions also displayed significant enrichment in the Verbal-numerical reasoning data set from UK Biobank (P = 2.40×10^{-5}). Significant levels of enrichment were also found for histone marks expressed in the central nervous system for both of these cognitive phenotypes.

The enrichment found in evolutionarily conserved regions indicates that the variants that are associated with cognitive function are under selective pressure. The conserved regions used in the current paper have also been examined for enrichment with several disease and health related phenotypes. Significant enrichment has been found for BMI, schizophrenia, and HDL cholesterol, but not for coronary artery disease, type 2 diabetes, or bipolar disorder. The diseases and traits that were enriched in these conserved regions each show a genetic correlation with cognitive function, whereas those that showed no enrichment at conserved regions did not. This suggests that conserved regions play a greater role in cognitive functions, and may also harbour variants with pleiotropic effects.

Cognitive Task Performance and Spatial Abilities Among Adolescence in a Traditional and Transitioning Population, the Tsimane of Bolivia

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This project seeks to determine the developmental processes that underlie spatial ability and IQ performance in a non-Western forager farmer society, the Tsimane of Bolivia. Drawing from an 8 year longitudinal study, two specific predictions are tested: 1) Because of broader environmental experience, Tsimane children will be precocious in mobility and ability to perform spatial tasks when compared to Western populations; and 2) more acculturated Tsimane children, due to the recent establishment of schools and changes in patterns of mobility in some communities, will show greater sex differences in mobility and spatial ability that more closely resemble patterns observed in Western industrialized societies, but also exhibit greater performance on western IQ tests.

Tsimane males and females between the ages of 10 and 18 (N=83) from three villages with varying degrees of market access were included in the study. Data on daily mobility were collected with GPS. Navigational ability and mental rotation were evaluated with computer and compass based tasks. Raven's Coloured Progressive Matrices was administered to test IQ performance.

Previously collected data on socioeconomic, demographic, and community level differences were also included and combined with pilot data, to be analyzed using multilevel modeling. Individual level effects include age, sex, formal-school exposure, and family size; household level effects include means of income, SES assessment and parent education; village level effects include community.

Our prior work among adults in the more acculturated communities found males to be more proficient at mental rotation spatial ability tasks (t= 3.60, df=139, p =.01) when compared with unacculturated villages. Preliminary data on children show similar patterns on mental rotation tasks and navigational ability. Early assessments of Tsimane GPS activity suggest that unlike acculturated villages, Tsimane girls and boys in the unacculturated regions are highly independent and explore a broad physical environment at younger ages.

Gender differences in range size and spatial ability are widely reported, but there is disagreement about the age at which these differences arise. Further, little is known about the emergence of spatial ability and mobility, or what factors affect IQ performance within traditional societies. Variation in ecology, patterns of food acquisition, and education may be critical components to the development of spatial skills and abstract problem solving abilities.

Our initial findings suggest that among the Tsimane, environmental and social variation play a significant role in the degree of difference found within the population, and that generalizations based on Western populations should be made with caution.

Short-Term Memory and Working Memory May Differentiate Themselves to the Degree That They Draw Upon the Phonological Loop or the Visual Sketch Pad

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A substantial amount of empirical research has addressed the question of whether short-term memory capacity and working memory capacity are the same or, to some degree, distinct constructs. Arguably, previous research may be considered limited, as the tasks used to measure short-term memory and working memory tend to be different in ways more than just the possibility that some tasks draw upon the key defining characteristic of working memory: the simultaneous maintenance and manipulation of information in memory. Consequently, the purpose of this investigation was estimate the true score association between corresponding short-term memory and working memory tasks for which the only distinguishing feature was that one task required the simultaneous manipulation of information in memory.

Corresponding digit span, word span, and visual span tasks were administered in both forward and backward formats to a sample of 211 young adults.

The correlations between the STMC and WMC span latent variables for the digit span, word span, and visual span tasks were estimated at r = .47 (95%CI: .29/.63), r = .67 (95%CI: .42/.90), and r = .87 (95%CI: .69/1.03), respectively. The results were interpreted to suggest that isomorphic relations between STMC and WMC scores may be expected to be observed when both the STMC and the WMC necessarily draw upon the visual sketch pad. By contrast, when STMC tasks afford the opportunity to be executed by the phonological loop, the correlation between corresponding STMC and WMC task scores will be diminished, as the corresponding WMC task will likely draw, to some degree, upon the visual sketch pad, even if the STMC task is ostensibly completely verbal in nature.

The debate about the possible distinction between STMC and WMC has been the source of a substantial amount of research, none of which appears to have a facilitated a consensus on the issue. The results of this investigation may offer a novel and credible solution to the problem: the association between STMC and WMC may be moderated by the degree to which the tasks draw upon the visual sketch pad. At their most ambitious, the results of this investigation suggest that the commonly observed emphasis placed upon the manipulation of information as the key defining feature of WMC may be misplaced. Instead, the emphasis may be best placed upon the activation or de-activation of the visual sketch pad to execute a particular memory span task.

Differences in the Distribution of G and Its Effect on Culture: The USA as a Case

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Galton introduced a biometric approach to studying human populations. It was the foundation on which Spearman, Eysenck, and other staunch empiricists would erect the London School of Psychology's biological approach to psychology. All were keenly interested in, not just the structure of intelligence, but also how its distribution within populations affects national well-being (e.g., Eysenck, 1973), including the mental distance between individuals, social cohesion, cultural level and social habits, diffusion of information («percolation range»), rate of innovation, proneness to extreme (simplistic) political positions, and economic divergence (Cattell, 1938). Drawing on these mechanisms, I look at how policies to achieve occupational parity, in spite of persistently large racial differences

Data are publicly available in the United States for (a) number of black and white males employed in detailed occupations, (b) the ranges of IQ from which various occupations recruit their workers (recruitment ranges), and (c) the IQ distributions of blacks and whites. Thirty years ago (Gottfredson, 1986), I used these data to estimate whether black males were employed at the same rate as white males in 1970 and 1980 when they fall within the recruitment ranges. I examined 9 large occupations (physician, engineer, secondary teacher, real estate sales, fire fighter, police officer, electrician, truck driver, and butcher/meat cutter) falling in four IQ recruitment ranges (86–112, 91–117, 109–134, and 114+). Here I update those analyses with employment data for 1990 and 2005–2009.

Employment trends:

• If black and white males were recruited from the same IQ ranges, we would expect the B/W ratio of %-of-blacks to %-of-whites in an occupation to rise from .05 (physicians, engineers) to .72 (truck drivers, meat cutters).

• In 1970 and 1980, the B/W ratios for actual employment were more consistent with black males being recruited from .5 SD below that for white males (.22 to 1.07).

• The B/W ratios for actual employment rose in 1990 and 2005–2009; half were commensurate with black males being recruited from 1 SD below white males.

Cultural trends:

• More blacks in good jobs and elite schools; working class white males have worse health and job prospects; institutions restructured; race relations worse; political discontent.

Human variation in intelligence is a biological fact that poses social challenges, especially when identifiable groups differ noticeably in mental ability. How a culture reacts to that variation also shapes its future. A nation that ignores or denies the practical and social significance of substantial intelligence differences risks its well-being. Constructive alternatives are available.

Cattell, R. B. (1938). Some changes in social life in a community with a falling intelligence quotient. The British Journal of Psychology, 28, part 4, 430–450.

Eysenck, H. J. (1973). The inequality of man. London: Temple Smith.Gottfredson, L.S. (1986). Societal consequences of the g factor in employment. Journal of Vocational Behavior, 29, 379-410.

Stagnation, Reversal, and a New Domain: Meta-Analyzing the Flynn Effect

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Generational IQ test score changes (i.e., the Flynn effect) have attracted considerable attention in the scientific community over the past forty years. Although changes have been shown to be predominantly positive over most of the 20th century, more recent findings suggest a decrease in these gains, that may indicate a potential stagnation and even a reversal of the Flynn effect in some countries. Here, we demonstrate, based on three independent meta-analyses, evidence for globally decreasing gains, inverse U-shaped trajectories of the Flynn effect for spatial IQ in German-speaking countries, and novel evidence for test score changes in ability-based emotional intelligence.

First, data of 271 general population samples (N = 3,900,000+) from 31 different countries over 100 years (1909–2013) were analyzed in three multiple weighted meta-regressions. This approach allowed us to investigate influences of average national fertility, economic prosperity, sample age, sample type, test g-ness, and time span on full scale, fluid, and crystallized IQ. Moreover, we investigated non-linearity of changes using segmented line regressions. Second, we analyzed cross-temporal changes of spatial IQ task performance in 96 German-speaking samples (N = 13,000+) using both IRT-based approaches and methods of classical test theory. Third, in an additional cross-temporal meta-analysis we examined changes in ability-based emotional IQ in 144 English-speaking samples (N = 17,000+).

Our results showed substantial global gains in three investigated IQ domains. However, analyses showed gains were non-linear and significantly decreased over recent decades. The Flynn effect was more pronounced among adults and positively associated with economic prosperity, but negatively related to tests' g-ness. Of note, in two domains fertility was positively related to the Flynn effect. Consistent with the apparent deceleration of gains, data from our second meta-analysis indicated curvilinear associations between year of data collection and spatial task performance in German-speaking samples, thus indicating a stagnation of IQ gains during the 1990s and a subsequent reversal. Finally, we did not find evidence for a Flynn effect for ability-based emotional IQ.

Our results suggest influences of factors associated with life-history speed (i.e., better education and nutrition, less pathogen stress) and changes in test-taking behavior as prime candidates for IQ gains, whilst domain differences may be attributed to social multiplier effects. However, these theories lack explanatory value for decreases in the strength or a reversal of the gains. Further, some proposed explanations, such as the notion of dysgenic fertility, seem unlikely, when considering the positive associations between fertility rates and IQ gains. We therefore argue that decreasing IQ test performance may well be due to ceiling effects and diminishing returns of IQ-boosting factors, whilst decreasing scores are attributable to negative associations with psychometric g.

Revisiting the Association Between Intelligence and Trajectory of Cortical Development

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Many studies have examined associations between intelligence and cortical thickness but, to date, only two have looked at associations between intelligence and cortical thickness development. In both of these, brighter subjects were observed to have a relatively thinner cortex until a certain age and a thicker cortex afterwards [in Shaw et al (2006), reversal occurred at 8 years, whereas in Schnack et al (2015), reversal occurred at 42 years]. Both studies used automated cortical thickness pipelines but neither reported having applied quality control procedures to the pipeline outputs. Yet, it has been shown (Ducharme et al., 2016) that quality control of cortical thickness pipeline outputs was necessary to avoid spurious curvilinear trajectories of cortical thickness development.

Here, we examined associations between intelligence and trajectory of cortical development using subjects from the NIMH Study of Normal Brain Development; a longitudinal study (up to three visits, two years apart) that includes MRIs and WASI IQ data in healthy children and adolescents (N=265; 626 scans) between 6 and 18 years of age at the first visit. Analyses were conducted with mixed effects linear models (as used by Shaw et al. and Schnack et al.) after implementing the same quality control procedure described by Ducharme et al.

Results show that the association between IQ and cortical thickness remains positive from childhood to early adulthood and, more formally, that there is no 'age by IQ' interaction on cortical thickness. Issues of quality control may explain some of the apparent contradiction between the above-mentioned studies and the majority of studies on the topic where mostly positive associations have been reported between intelligence and cortical volume or thickness for subjects of various ages.

Given that the cortex is now known to thin from age 5 onward, findings suggest that those with a higher IQ tend to have started with greater cortical thickness and retain their cortical thickness rank-order as they age. Individuals with higher IQs may have more synaptic connections to choose from during the neural development pruning process, hence possibly having a greater probability of retaining more efficient connections.

Structure and Development of Deductive Reasoning During Childhood: Interrelation With Cognizance, Cognitive Processes and General Intelligence (G)*

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This study investigated the structure and development of deductive reasoning from 5 to 11 years of age and its interrelation with a variety of other cognitive processes.

A total of 159 children about equally drawn among preschool, first, third, and fifth primary school grade were individually examined by tasks addressing (i) deductive reasoning, (ii) general Intelligence (g), (iii) basic processing efficiency (i.e., processing speed, inhibition control, cognitive flexibility and working memory), (iv) cognizance of cognitive processes (i.e., perception and inferential awareness), and (v) Theory of Mind.

Analyses of Variance showed that all processes developed systematically throughout this age period. In line with Demetriou's theory, structural equation modeling showed that (a) perception, awareness and Theory of Mind capitalize on cognitive flexibility, making them the best predictors of working memory development, (b) working memory played a significant role in the development of inferential awareness and fluid intelligence and, (b) finally, inferential awareness proved to be the cornerstone for the emergence of deductive reasoning.

The relations between deductive reasoning and the rest of the constructs examined here are equally important in highlighting its role in intellectual development.

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* Presentation is eligible for a Student Award.

The Okcupid Dataset: A Very Large Public Dataset of Dating Site Users[*]

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Psychology is currently undergoing a replication crisis. This is due to publication bias and small samples among others things. To counteract this, psychologists must gather larger samples.

History shows that large, public datasets have high and lasting value (e.g. Project TALENT, NLSY79/97).

To gather a large public dataset, we scraped user information from OkCupid a large, population dating site. The initial release has N = 68000 with 2600 variables.

The dataset is not representative, consists mostly of young adults from the US, Canada and the UK.

To make sure that the data are suitable for analyses, we replicated three known results. 1) Intelligence, as measured by a 14-item ad hoc test, is related to political interest and participation (latent r's .19 to .32). 2) Intelligence is negatively related to measures of religious belief; latent r's -.26 to -.35. 3) Zodiac sign was compared to every question in the dataset (N = 2500). As expected, there was little sign of any signal (flat p-curve).

This is a new, very large, public dataset with a rich variety of variables. It can be used in many ways for research questions about intelligence and other matters.

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Cognitive Abilities, Educational Achievement, and Physical Fitness – Latent Variable Analysis

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The relationship between cognitive abilities, educational aptitudes, and school achievement is well established. In particular, there are several studies, which demonstrate the relationship between working memory and school achievement. Also, there are individual studies demonstrating a link between cognitive ability and physical activity, highlighting the beneficial impact of physical exercise on cognitive performance in general, and on memory functions in particular. Yet the studies are inconsistent in terms of both the results and their interpretation. Our goal was to investigate the relationship between these constructs.

We measured a large sample (N = 428) of high school students (14–18 year olds). Participants completed cognitive tests online, including the Corsi span task, the Digit Span Test and the N-back Test. We obtained students' academic grades in maths, grammar, literature, and in English as a foreign language; their PISA competency scores for mathematics and reading comprehension; and the result of the National Unified Student Fitness Test (NETFIT), which included indicators of physical fitness such as the maximum number of pushups and curl-ups. We used structural equation modelling to investigate the correlations between the latent variables Working Memory, School Achievement, Competencies, and Physical Fitness.

We have found that physical fitness correlates moderately with working memory, competencies, and school achievement. The correlation was strongest with working memory and the lowest with school grades. We have also found strong correlations between working memory and indicators of school achievement. Remarkably, competencies are more strongly related to working memory than to actual school performance. Independently of the SEM analysis, we examined correlations between school achievements on the one hand and body mass index (BMI) and body fat (BF) on the other. BMI did not correlate significantly with most indices of educational performance or memory, whereas correlations with body fat were mostly significant and varied from small to moderate.

Our results replicate previous findings about the relationship between working memory capacity and educational achievement with an additional and theoretically interesting link to physical activity. These results have relevance for a number of topics in intelligence, from interpreting physical fitness as an ability to evolutionary accounts of individual differences. Moreover, taking into account the recent proliferation of research on working memory training and its possible transfer to a number of cognitive abilities, our results point to the importance of physical condition in the development of core abilities as well as in influencing educational outcomes.

Applying MLM to Hierarchically Partition Longitudinal Variance in Cognitive Function into Chc Strata I, II, and III

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Hierarchically nested comparisons of Multilevel Models (MLM) were used to partition the proportions of variance in longitudinal data on cognitive function due to: (CHC Stratum III) general cognitive function; (CHC Stratum II) factor-specific variance; and (CHC Stratum I) indicator-specific variance. Nine manifest indicators of cognitive function were each individually standardized then entered as parallel measures into MLMs, with unstructured residual covariances, random intercepts, and restricted maximum likelihood estimation; these convergent indicators were sorted into three specific factors of cognitive function as grouping factors in the variance components model. Nested model comparisons then estimated the additional variances explained by each successive level of disaggregation.

We used MLM to analyze longitudinal data on cognitive function from 2802 usable cases (out of 2,832) from the Advanced Cognitive Training for Independent and Vital Elderly (ACTIVE) study, funded by the NIA and NINR components of the NIH. The cognitive function data were organized into three latent common factors (Activities of Daily Living, Memory, and Reasoning), each of which was measured by three convergent tests as manifest indicators. The natural logarithm of the increasing ages of respondents was the primary predictor of cognitive function. Hierarchically nested MLM comparisons partitioned the proportions of variance in declining cognitive function attributable to: (1) general cognitive function; (2) factor-specific variance; and (3) indicator-specific variance.

Excluding effects of training programs to improve specific cognitive abilities, 42.0% of the variance in cognitive decline with age were Level 1 (L1) individual differences, of which 2.1% were Level 2 (L2) shared effects; .81% L1 (39.2% L2) variance in cognitive decline with age was due to the higher-order factor of general cognitive function, with .44% added L1 (21.4% L2) variance was due to the three specific factors, and .81% L1 (39.2% L2) variance due to the three manifest indicators of each specific factor. Training programs effects explained .01% added L1 (.75% L2) variance in general cognitive function, .62% added L1 (46.6% L2) variance in the three specific factors,.70% added L1 (52.6% L2) variance in the three manifest indicators of each specific factor.

Partitioning CHC Strata I, II, and III via hierarchically nested MLM comparisons revealed that the same proportions of L2 longitudinal variance in cognitive function were due to the general higher-order factor (CHC Stratum III) and to the manifest indicators of each specific factor (CHC Stratum I), with about half that proportion of the longitudinal variance attributable to specific factors (CHC Stratum II) themselves. When considering training effects, this situation was different, with a negligible proportion of the training effects due to longitudinal changes in the general higher-order factor (CHC Stratum III), and roughly equal proportions of the training effects due to longitudinal changes in the specific factors (CHC Stratum II) and in their component indicators (CHC Stratum I).

Non-Cognitive Factors in Mathematics Achievement: Evidence From Pisa and Timss

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Over the past several years a dominant sentiment among educationists has been broadened and shifted away from a strong focus on cognitive abilities. Serious efforts have been made to identify important non-cognitive constructs that are most relevant to and have direct effects on students' academic performance. The trend was partly driven by concerns put forward by policy makers and economists. A general consensus has evolved that with a possibility of traditional skills becoming obsolete, different types of competencies that are partly non-cognitive in nature would emerge and be valued in the new century. What is the correlation between non-cognitive measures such as personality, self-beliefs, motivation and interests and performance on standardized tests of mathematics achievement?

Based on the international datasets of the Programme of International Student Achievement (PISA) by the Organization for Economic Co-operation and Development's (OECD) and the Trends in International Mathematics and Science Study (TIMSS) of the International Association for the Evaluation of Educational Achievement's (IEA), we summarize empirical findings about the relationship between over 200 non-cognitive constructs and students' academic performance in mathematics. The measures included SES, student's self-expectation of educational level; confidence in mathematics; weekly time spent on mathematics homework; time spent on extra lessons on mathematics, etc. The PISA 2003, and 2012 and the TIMSS 2003, 2007 and 2011 data were analysed. The total number of participants is N = 1,532,995.

A series of correlational analyses, including hierarchical linear modelling, indicate that students' self-beliefs (i.e., self-efficacy, self-concept, and anxiety) show the strongest relationship to academic performance at both individual- and country-levels. The strength of this relationship is about the same or greater than the relationship between socio-economic measures of students' family background and academic performance. Our findings are that only a small number of non-cognitive constructs (less than 8) have correlations higher than .20 with mathematics achievement. Measures of interest, strategies of problem solving, time spent studying mathematics, doing homework in mathematics and the like have low correlation with achievement.

Our finding is important since it shows that psychological measures of self-beliefs are stronger predictors of achievement and ability than sociological measures of socio-economic status. Given that most background questionnaires in PISA and TIMSS are carefully chosen by experts to measure what are believed to be important influences in education, low predictive validity of so many constructs in large-scale studies should affect both educational theories and empirical studies. Future background questionnaires in large-scale surveys should remove much of what is currently being covered and new measures of self-beliefs and related mental toughness measures should be included.

A Cognitive Model of Automatic Alpha-Numeric Item Generator

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This study investigates the item properties of a newly created Automatic Alpha-Numeric Intelligence Generator (A-ANIG). In total, there are 7 item families, which tap into 7 hypothesised cognitive domains. The item families are further categorized into 4 main stages proposed by the model of hierarchical complexity theory, with an integrated view of Piaget's cognitive developmental model. We built the A-ANIG item models based on the later two stages of Piaget's model, which emphasise on logical understanding and pattern recognition about concrete objects and abstract propositions.

The study was conducted using MTurk. The analysis was in R. We collected 127 participants in total (46 males, 80 females and 1 missing). Majority of the participants were Americans (n=101). The researchers randomly selected 40 alpha-numeric items for this study. Participants had to complete the alpha-numeric items and the ICAR-16 cognitive ability test. The 2PL and Rasch model were employed to examine uni-dimensionality and calibrate items. The researchers then employed the Linear Logistic Test model to investigate the cognitive parameters which predict item difficulties. The item difficulty parameters between both models were compared. Construct validation was conducted using the ICAR cognitive ability test.

The 2PL model supported unidimensionality for 24 out of the 40 items. The overall followed-up Rasch model was assessed using the Anderson's Likelihood Ratio (LR) test, which showed a p value of 0.8, suggesting an adequate model fit. The results of CFA also revealed a good model fit, with RMSEA of 0.036, CFI of 0.95. Cronbach's alpha was 0.82, indicating acceptable reliability.

The item difficulties found in Rasch and those using the LLTM had a high correlation of 0.912, suggesting that 83% of the variance in the Rasch model was accounted for by the 7 cognitive parameters defined in this study. A construct validation between ICAR items and the alpha numeric items found a r=0.63, providing initial evidence that the alpha numeric items form a reliable and valid cognitive ability measure.

AIG is a rapidly evolving research area where cognitive and psychometric theories are integrated to produce good item estimates. The A-ANIG has the ability to create more than 1000 items for each item family. Our study found that majority of the good items were from four item families, enabling us to predict item properties for new items without the need to continuously collect data from new participants. Furthermore, the approach gives us insight into the cognitive strategies that participants employ to complete cognitive tests, hence, improving how cognitive items can be developed in the future.

Eye Movements Help the Interpretation of Response Times in Matrix Reasoning[*]

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The correlation between test performance and overall test-taking time is usually positive on complex reasoning or problem solving tasks. That is, persons with higher ability are slower than the rest. On the other hand, there is a long research tradition showing that item characteristics that increase the complexity and difficulty go hand in hand with increased response times. That is, on any given item, difficulty increases response time and easiness reduces response time. That should mean that a person with high ability, for whom the item is easy, would be faster than a person for whom the item is hard. But why is that not the case?

We analyzed test performance, response times, and eye movement behavior from a sample of 109 college students in a series of multi-level models. Participants completed selected items from Raven's matrices test and three additional measures of fluid intelligence: letter sets, number series, and figural analogies.

A multi-level analysis revealed a significant cross-level interaction effect, suggesting a varying effect of ability on response time, depending on item difficulty. That is, subjects with high ability were as fast as the rest on easy items (or slightly faster even) but seemed to adapt to increasing item difficulty with longer response times. Subjects with low ability were also adapting and increasing their response times to difficulty but at a significantly lower rate. Furthermore, the effect of difficulty was four times as strong as the effect of ability on response times. Finally, the analyses of eye-movements suggest that high ability subjects use their increased response time for the analysis of the matrix area, which is consistent with the idea of a constructive matching strategy.

Our analyses of response times suggest that subjects of high ability do generally employ more effort in their reasoning and even more so on challenging problems. Eye movements indicate that increased response time is being spent with efficient and mentally demanding strategies. This hints towards a motivational aspect in reasoning that is, at the same time, closely linked to ability and difficulty. Recent discussions about the application of speeded versus power tests (Ackerman & Ellingsen, 2016) could be informed by this finding, suggesting that high ability individuals can only play their cards right when they have the proper time for it.

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[*] Presentation is eligible for a Student Award.

Complex Problem Solving in Educational Contexts – Still Something Beyond a «Good g»?[*]

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Complex Problem Solving (CPS) became increasingly important in research on educational success (e.g., CPS assessments in large scale studies as PISA 2012/2015). Although intelligence (as the most important predictor of educational success) and CPS correlate substantially, recent studies showed incremental validity of CPS for school grades. However, those studies used mostly narrow operationalizations of intelligence (as figural reasoning), not fulfilling the criteria of a good g (Jensen & Weng, 1994). The objective of this study was threefold: we expected (1) higher correlations of CPS and a good g, compared to former studies using a «weaker g»; (2) substantial correlations for g and CPS with educational success; (3) CPS to predict incremental variance beyond g in educational success.

A sample of N = 496 German high school students completed an intelligence test battery, the CPS microworld MicroDYN, and scholastic competence tests in mathematics or reading comprehension; additionally they marked their grades in mathematics and German from their last midterm report cards. Latent structural equation models were computed separately for the two subsamples (Mathematics subsample n = 245; German subsample n = 251) considering the hierarchical ordering of the data (students in classes).

Results showed (1) higher correlations between CPS and the good g (r ≈ .70) compared to most former studies; (2) mostly moderate to high CPS-achievement-correlations that were comparable to the g-achievement-correlations in both school subjects; (3) when controlling for the common variance of g and CPS, the regression coefficients of CPS dropped considerably and intelligence always was the significantly better predictor of the competence tests and grades in both subjects. Additionally, residual models revealed that the (CPS-independent) intelligence-residual incrementally predicted these criteria beyond CPS, but the (intelligence-independent) CPS-residual only predicted the mathematics competence test beyond intelligence.

This study examined the incremental validity of CPS beyond g using (a) a broader operationalization of intelligence and (b) as criteria not only grades but, for the first time ever, also scholastic competence tests in two important school subjects (mathematics and German). Results indicated that g is still the strongest predictor of educational outcomes. The assessment of competence tests and grades in two different school subjects allows the conclusion that CPS and solving mathematical problems were connected to some extent. However, the non-substantial relations of CPS in the language domain urges for further research.

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[*] Presentation is eligible for a Student Award.

Preschool Drawing and School Mathematics: The Nature of the Association[*]

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The notion that children's drawing ability is linked to their cognitive development has been around for more than a century. It is possible that early human figure drawing ability may be particularly related to specific aspects of cognitive development, such as mathematics. Mathematical ability may be strongly related to drawing, both because it is linked to general cognitive ability and because of several specific features that mathematics may share with human figure drawing. For example proportionality, appropriate use of space and symmetry may all be specifically related to mathematical development. The present study investigated the aetiology of the association between early drawing of the human figure and later mathematical abilities accounting for general intelligence.

Participants (N = 14,760), members of the Twins Early Development Study, were assessed on their ability to draw a human figure, including number of features, symmetry and proportionality. Mathematics ability was assessed 8 years later, when the twins were 12, by means of teachers' ratings as well as via an online battery of tests. Measures of general cognitive ability (g) were available at 4 and 12 years of age. We used the twin method to explore the aetiology of drawing ability at age 4½ and of its association with mathematics and general cognitive ability later in development.

Human figure drawing was moderately stable across six-month (average r = .40). Individual differences in drawing at age 4½ were influenced by genetic (.21), shared environmental (.30) and non-shared environmental (.49) factors. Drawing was related to later (age 12) mathematical ability (average r = .24). This association was explained by genetic and shared environmental factors that also influenced general intelligence. Some genetic factors, unrelated to intelligence, also contributed to individual differences in drawing.

The present investigation of individual differences in preschool human figure drawing ability represents a step forward in our understanding of the mechanisms through which early drawing ability relates to the overall cognitive development. Preschool drawing ability is not only an indicator of artistic talent, but it also reflects young children's cognitive competence.

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[*] Presentation is eligible for a Student Award.

Self-Regulation as a Mediator of the Relationship Between Intelligence, Cognitive Characteristics, Mathematical Abilities and Mathematical Success

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Psychological factors of academic success are a hot point in modern psychology. For a long time the issue had been solved within the framework of intelligence and cognitive factors researches. Yet nowadays the non-cognitive factors of academic success are paid much more attention. Self-regulation researches take a special place among them proving this factor to be a significant predictor of academic achievements (Morosanova et. al., 2016; Steinmayr et al., 2011; Zimmerman, Schunk, 2001). In this study we sought to answer the question whether the conscious self-regulation plays its mediating role in the intelligence, cognitive features, and ability to mathematics influencing the students' success in Math.

The sample included 318 (158 males) 14–16 year old students (mean age = 15.1) educated in State secondary schools in Russia. We assessed cognitive abilities: Spatial memory (Corsi Block test), Number sense (Number Line), Non-verbal Intelligence (Ravens progressive matrices); mathematical abilities (Mathematical fluency and Understanding Number).To study the regulatory features, we used Morosanova's «Self-Regulation Profile of Learning Activity Questionnaire – SRPLAQ-M», measuring the level of Self-regulation of students' learning activity and different aspects of self-regulation related to achieving learning goals: Planning of goals, Modeling of conditions, Programming and Results Evaluation. Year Math Grade was used as an indicator of the mathematical success.

The results analysis revealed a partial mediator effect of the regulatory process of Modeling. Mediator hypothesis checking was carried out by analysis of several series of multiple regression analysis and using the Sobel test. Its mediator effect has been verified in the analysis with Non-verbal Intelligence and «Number Line» test results as independent variables proved to be significant predictors of the academic success. In addition, we found that Modelling played the mediating role in relationship between mathematical abilities and academic success. We observed mediating effect for independent variables Mathematical fluency and Understanding Number.

The nature of interconnection between intelligence and self-regulation remains to be a matter of discussion. In our study, the mediator role of Self-regulation in relation to cognitive determinants of academic achievement is empirically substantiated. The results showed that regulatory process (Modeling) contributed to the optimal use of intellectual resources of student's learning activity. The mediator effect of self-regulation had been also revealed as regards to the Number Sense. Modelling allows assessing students' ability to discover and effectively use learning conditions that are necessary for learning goals achievement. Apart from being an important feature for learning in general, it is possible that Modelling is particularly important specifically for mathematical learning.

Results of the National Intelligence Tests Support the Explanation of the FE: The Abstract Thinking Abilities of Estonian Students Has Risen Over the Last 70 Years

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The aim of our study was to investigate the Flynn Effect (FE) and its relation to abstract thinking ability.

We compared two cohorts of Estonian students (1933/36, n= 888 and 2006, n= 912). We measured the abstract thinking ability via the Concepts (Logical Selection) subtest of the National Intelligence Tests (NIT). This subtest is analogous to the historical Similarities subtests of the Binet scales. The subtest consists of 24 items and requires the test taker to select two characteristic features from among those that are given. For example «Shoe: button, foot, sole, toe, tongue. Cat: sphere, claws, eating, eyes, mouse». The abstractness of the items was measured by determining the abstractness of the words that comprise the content of the items. The familiarity of the words was estimated by calculating the frequency with which the words appear in school textbooks.

We found that the item presentation order of the subtest correlates with the abstractness of the words used in the items (r = .609). The different test results (right, wrong and missing answers) were analysed in order to estimate the FE magnitude. The FE for abstract thinking ability of those samples was 1.06 Hedges' g (adjusted for guessing). The magnitude of the FE is dependent upon the degree of difficulty of the items (an item's difficulty is estimated by determining its abstractness and its familiarity to students). The more difficult part of the subtest (the second half) showed a FE = 1.80, whereas the easier part (the first half) showed a FE= .72. Word abstractness was a strong predictor of all the testing results in both cohorts (Beta = .700).

Our findings support Flynn's explanation that the FE is primarily an indicator of the rise in abstract thinking ability. Our findings and conclusions also cohere with those of Fox, Mitchum, and Flynn. Further confirmation is evidenced by the ability to function via natural language, and the ability to successfully solve the abstract items of the Raven's matrices, which all illustrate the same phenomenon – abstract thinking abilities are rising over time.

Intelligence, Personality and Interests Predict Apprenticeship Success

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The question which psychological measures should be assessed when aiming at the prediction of professional success is a rather old one, hitherto it mostly focussed on the relationships between abilities, interests and personality as well as their incremental contributions to the prediction of job success. The vast majority of these studies, however, has analysed this research question in adults; adolescents learning in professional schools and at the same time learning on the job in firms, i.e. so-called apprentices, have rarely been studied. To our knowledge this is the first study to analyse the respective contributions of not only cognitive but also alternative aptitudes, relevant personality traits and interests to the prediction of job success in apprenticeship.

We aimed at analyzing relationships between aptitudes, personality traits and interests, as well as their predictive power and respective incremental validities with respect to professional success in a sample of young apprentices from 14 different professions. For this, we employed a comprehensive test battery for the assessment of 6 aptitudes (verbal, numerical, spatial, social, practical, creative), of conscientiousness at the facet level and the other big four at scale level as well as of 14 interest domains in a sample of 574 3rd year apprentices and high school students (42.4% female; mean age = 17.71, SD=3.39). Additionally, measures of professional success (job-relevant grades earned in vocational school) were collected.

In ANOVAs of aptitude verbal, numerical, and figural intelligence significantly differentiated between apprentices with high vs. low grades in vocational school. Regarding personality, the same applied for conscientiousness and perceived self-efficacy. Furthermore, we tested the specific contributions of abilities versus interests versus personality traits and their respective incremental contributions in the prediction of an adolescent's suitability for specific professions. Using R's neuralnet package we trained a neural network in categorizing students to their respective vocations. Amongst abilities most variance was explained by verbal intelligence; amongst personality variables the eagerness facet of conscientiousness; and amongst interests scales interest in assembling.

Apprentices have rarely been studied in psychology. This is the first attempt to assess the predictive validities of not only cognitive abilities but also «alternative aptitudes» like social-emotional competence, divergent thinking ability as a proxy of creative potential and practical abilities. Interests were assessed using a new and more differentiated model of interests (as compared to RIASEC model), which was moreover especially developed for counseling in the apprenticeship context. It was shown that abilities explained most variance in job suitability but personality and interest scales hold incremental validity over and above the abilities. Furthermore, with the trained neural networks we could demonstrate different requirement profiles for different vocations.

Spearman's Hypothesis Not Confirmed? Three Meta-Analyses of Black and White Prisoners, Northeast Asians, and Arabs and Jews

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Group differences in intelligence and their causes is one of the most fundamental topics in the social sciences and Spearman's hypothesis goes straight to the heart of it. Spearman's hypothesis states that differences between groups on the subtests of an IQ battery are a function of the cognitive complexity of these subtests: large differences between groups on high-complex subtests and small differences between groups on low-complex subtests, and it is virtually always confirmed. Exceptions are a comparison of Black and White prisoners, a comparison of Whites and Northeast Asians, and a comparisons between Sámi and Finns, where Spearman's hypothesis is not confirmed. We studied these groups and looked for other group comparisons where Spearman's hypothesis was not confirmed.

We carried our three meta-analyses comparing Black and White prisoners, Northeast Asians and Whites, and Arabs and Jews. First, we tested Spearman's hypothesis computing the correlation between g loadings of subtests of an IQ battery and the standardized group differences on these same subtests. Second, we tested Spearman's hypothesis separately for the Verbal subtests and the Performance subtests.

The meta-analysis on Black and White prisoners was based on 2 data points and a total N = 575; the meta-analysis on Northeast Asians was based on 15 data points and a total N = 2126; the meta-analysis on Arabs and Jews was based on 8 data points and a total N = 1443. In all three meta-analyses Spearman's hypothesis was not confirmed with sample-size weighed mean rs with values of, respectively, -.18, .01, and -.25. So, the results show that Spearman's hypothesis tested on the full test battery is not confirmed for these comparisons. However, when Spearman's hypothesis is tested on the Verbal subtests or the Performance subtests there are confirmations of Spearman's hypothesis in approximately half of the cases.

Spearman's hypothesis is confirmed in the majority of published studies, because larger group differences occur on the higher g-loaded Verbal subtests and smaller group differences occur on the lower g-loaded Performance subtests. However, certain groups show smaller group differences on the higher g-loaded Verbal subtests and higher group differences occur on the lower g-loaded Performance subtests, which leads to a negative correlation between g and d, and lack of support for Spearman's hypothesis. When this V/P profile is taken into account the support for Spearman's hypothesis increases strongly. Our findings based on three meta-analyses support Arthur Jensen's statement that Spearman's hypothesis is a law-like phenomenon.

Siblings' Sex Is Linked to Mental Rotation Performance in Males But Not Females

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Research into the origins of the gender differences in spatial cognition has explored a range of biological and environmental factors. The present study investigated the effect of sibling sex on gender differences in mental rotation in a sample of non-twin adult siblings. The following three hypotheses have been tested: (1) Males will score more highly than females on spatial play, self-efficacy and mental rotation; (2) Spatial play and self-efficacy will account for a significant proportion of variance in mental rotation; (3) Females with brothers will perform better than females with sisters on the mental rotation test. This sibling effect on mental rotation performance will be moderated by the sibling effect on spatial play and self-efficacy.

Participants were recruited via institutional email and advertisements in the United Kingdom (N = 570, mean age in years = 24.79, range in years = 55 years) and Russia (N = 1,521, mean age in years = 16.05, range in years = 57). All participants completed the test online. This involved a questionnaire gathering data on siblings, spatial play tendencies in childhood and self-efficacy ratings, followed by the mental rotation test. For the main analysis, participants were grouped according to whether they had only siblings of one sex: (1) males with only female siblings (N = 120), (2) males with only male siblings (N = 151), (3) females with only female siblings (N = 182) and (4) females with only male siblings (N = 206), in order to avoid competing influences of mixed sex siblings.

Hypothesis (1): In line with previous findings, males engaged in more spatial play, reported higher spatial self-efficacy in their spatial skills and performed better on the mental rotation test. These findings suggest that sex differences in mental rotation are modest but robust.

Hypothesis (2): Spatial play and self-efficacy were significant predictors of mental rotation performance.

Hypothesis (3): Contrary to previous findings in twins, females with brothers did not outperform females with sisters on the mental rotation test. A sibling sex effect on mental rotation performance was observed for males with brothers, who scored slightly higher than males with sisters. The results suggest that sex differences in mental rotation are driven by the group of males with brothers.

The main aim of this study was to explore whether having a sibling of a particular sex has an effect on an individual's mental rotation performance. A replicable advantage in mental rotation performance among females who have brothers has been demonstrated in twins. This effect has not been observed in the large non-twin sample used in this study. Although this study provided indirect support for the hormonal account of the sibling effect observed in twins, it would be premature to rule out the contribution of socialisation. Ultimately, this research may lead to better understanding of the causes of the persistent sex imbalance in STEM fields, and contribute to strategies that counter this through enhancing spatial ability.

Polygenic Scores for Intelligence and Academic Achievement

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It is widely accepted that intelligence and academic achievement are among the most heritable behavioural traits. This means that individual differences in these traits are substantially due to inherited DNA sequence differences – from 40% in childhood to 60% in adulthood. Nothing would advance research more than to identify some of these genetic differences so that they can be used in research as genetic predictors for individuals. Genetic prediction would make it possible to investigate developmental, multivariate and gene-environment interplay issues at a much greater level of precision.

Genome-wide association (GWA) research throughout the life sciences has shown that the biggest effect sizes are extremely small, typically accounting for less than 0.1% of the variance. This means that thousands of DNA variants of extremely small effects size are responsible for the heritability of complex traits. For this reason, GWA studies have used a «brute force» approach to detect these tiny effect sizes by getting larger samples, usually by GWA meta-analyses of many studies. The focus now is on genome-wide polygenic scores (GPS) that aggregate these tiny effects across thousands of associations, rather than a few genome-wide significant «hits». I will illustrate the use of GPS with intelligence and academic achievement data from 6000 unrelated individuals from my Twins Early Development Study (TEDS).

GWA studies of intelligence have not been very successful so far – the largest study accounts for only about 1% of the variance. Results are more encouraging in a recent GWA study for the proxy variable of educational attainment (years of education, *EduYears*). The *EduYears* GPS accounts for about 4% of the variance of intelligence and about 9% of the variance of educational achievement at age 16 in TEDS. Using TEDS data, *EduYears* GPS yields interesting results in terms of development (increasing effects), gene-environment interaction (none) and correlation (lots), and social mobility (genetic meritocracy).

Recent advances in research will add to the predictive power of a GPS for intelligence. For example, some additional predictive power will come from other designs such as studying individuals with extremely high intelligence and from other methods such as the use of rare variants and whole-genome sequencing. For now, the «brute force» method of getting ever-larger samples is the only guaranteed way to add to the predictive power of a GPS for intelligence. However, what is needed most is better measurement of intelligence in GWA research. Despite Spearman's «indifference of the indicator», GWA studies of intelligence have suffered from poor and highly heterogeneous measurement. This can be remedied by incorporating high-quality online measure of intelligence in large biobanks that already have GWA genotype data.

Genetic Influence on Educational Attainment and Occupational Status During and After the Soviet Era in Estonia[*]

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Social outcomes, such as socioeconomic status (SES), are often assumed to be explained solely by environmental factors. However, behavioral genetic research has demonstrated genetic influence on SES. Here, we study the etiology of educational attainment and occupational status using a large representative sample of Estonian population. We will also compared the genetic influence on educational attainment and occupational status in markedly different environments- during the Soviet Union and after the collapse of the Soviet Union. This study will be the first adequately powered research to compare the heritability of educational attainment and occupational status in markedly different environments.

The Estonian Genome Centre, University of Tartu (EGCUT) is a population-based biobank (N = 51,515), which includes about 5% of the Estonian population. The present analyses, based on the 20,000 participants who have been genotyped so far, estimate genetic influence on educational attainment and occupational status and on their covariance, using SNP-based genetic estimates (genome-wide complex trait analysis, GCTA) and genome-wide polygenic scores (GPS) for educational attainment and SES.

The analyses are ongoing, but preliminary GCTA analyses on anchor variables (height and weight) yield expected SNP heritability estimates and genetic correlations.

The most novel feature of the current study is that EGCUT makes it possible to compare results for two distinct eras of Estonian history: the Soviet era and the era after the collapse of the Soviet Union. If, as is widely assumed, the end of the Soviet era marked an increase in meritocratic selection of individuals to education and occupation, genetic influence on educational attainment and occupational status should also increase. As educational attainment is widely considered to be a good proxy for intelligence, this research advances the understanding of how heritability of educational attainment (intelligence) differs in two different societies.

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[*] Presentation is eligible for a Student Award.

Early Risk Mechanisms for the Development of Reading and Math Ability: Examining the Role of Genetically Informed Attributes of Both Child and Parent Executive Functioning

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Attention Deficit Hyperactivity Disorder (ADHD) is known to be highly heritable. ADHD problems are associated lower academic performance. Executive functioning difficulties are also heritable and are associated with risk for both ADHD and lower academic performance. Questions remain regarding the role of genetic and environmental factors that influence academic ability. Employing a longitudinal genetically sensitive adoption-at-birth design, the current study examined associations between birth mother ADHD, birth parent executive functioning, early child impulsivity/activation, child executive functioning, adoptive parent hostility, child ADHD and later academic ability.

The sample included linked sets of adopted children, adoptive parents, and birth mothers (n>300). Questionnaires assessed birth mother ADHD symptoms (child age 18 months–4.5 years), child impulsivity (age 4.5 years), adoptive mother and father hostility to child, child ADHD symptoms, and child executive functioning (age 6 years). The Woodcock-Johnson test examined child reading and math aptitude (age 7 years). The Woodcock-Johnson test was also used to examine executive functioning in the birth mother (age 27 months). Analyses will examine:(i) associations between birth mother ADHD and executive functioning on child impulsivity/activation and later executive functioning (ii) adoptive parent parenting (hostility) and child executive functioning on child ADHD symptoms and academic outcomes.

Results will provide insights into the genetic and environmental processes that influence ADHD and academic outcomes. Using an adoption-at-birth design, the study will examine parenting processes that are to be important for the development of ADHD and academic outcomes where the confound of passive gene-environment correlations has been removed. The study will provide evidence of the impact of two genetically sourced risks for academic outcomes: early child impulsivity, and child executive functioning. In addition, it will address questions as to whether the association between child impulsivity and child academic outcomes is better explained by child executive functioning.

A Variance Decomposition Approach to Identifying the Source of the Flynn Effect in the NLSY Family Data

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What are the cause(s) of the Flynn Effect (FE)? Currently, there is no consensus answer. We use the National Longitudinal Survey of Youth and a variance decomposition approach to isolate the source of the FE. We analyze variance into between-family, within-family, and within-individual components, and fit those components to PIAT-Math scores containing significant FE (Rodgers & Wanstrom, 2007).

Scholars disagree on the location of the Flynn Effect – between-families, within-families, within-individuals, or a combination of these? We analyze the NLSY data into variance components that separately reflect these sources, by partitioning the time between the mother's age at first birth and the child's time of taking the current PIAT-Math into three components: mother's age at first birth to mother's age at birth of the child, mother's age at birth of the child to child's age when first tested, and child's age when first tested to child's age at current test administration. Variance from these sources is used to explain variance in the PIAT-Math, using the 6,000+ NLSY79 mothers and the 13,000+ NLSY-Children.

In preliminary analyses using using multi-level modelling in relation to these three variance sources, and a 5% sub-sample of the NLSY data, the Flynn Effect is identified as emerging from the between-family component of variance. This finding at least partially rules out a number of causal explanations (e.g., differential treatment of sibling by parents), and provides support for explanations that emphasize family differences. At ISIR, we propose to present results from analyses of the whole NLSY dataset.

The findings in this study are used to develop a family-based theory that explains a number of empirical patterns associated with the Flynn Effect. We posit that many parents use varying mechanisms to assist their children in their intellectual development – e.g., parents optimize nutrition, school and community programs, vacation time, test-taking training, etc, to support their children's cognitive growth. Such parents provide an executive function to their developing children, and parents likely become more and more proficient in performing this function over time. Reasons to expect this increasing proficiency are proposed and examined.

Comparison EEG Correlates of Emotional Intelligence Among Different Ethnic Groups During Face Recognition Task

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By this time the question about association of emotional intelligence with genetic, psycho-physiological and social parameters related to the ethnic groups is poorly studied. The aim of this research is to investigate a role of genetic and socio-cultural factors in forming of the brain activity associated with indexes of emotional intelligence among different ethnic groups living at Siberian region. The main sociocultural factors were ethnic identity (Russians, Tuvinians and Yakuts) and size of location (city or country).

110 Russians from Novosibirsk, 54 Russians from villages near to Novosibirsk, 93 Tuvinians from Kyzyl, 28 Yakuts from Yakutsk took a part in this study. Average age is 23.4 ±3.6 among all groups. The allelic polymorphisms of serotonin genes and neurotrophic factors were used as genetic factor. Emotional intelligence was estimated with EmIn questionnaire (EQ) (Lusin 2006). Brain activity was recorded with 128 or 64 – channels EEG during execution of the emotional face recognition task on a screen of computer. We evaluated brain reactions by means of indexes of event related spectral perturbation (ERSP, Delorme and Makeig, 2004) in alpha/beta and delta/theta frequency bands.

The significant inter-ethnic differences in brain activity were obtained in theta and beta2 frequency bands, which might be interpreted as an index of different strategies in emotional processing. Also, the relationships between genetic, psychological factors and factor of ethnic group were obtained. Such relationships, probably, might be connected with features of social behavior in these communities.

Interrelation between level of emotional intelligence and choice of strategy of emotional processing was revealed in this study. One of strategies was associated with directed attention and EEG-reaction in alpha/beta band. Another strategy was associated with affective response to emotional stimulus and delta/theta EEG bands. We hypothesized that a main reason of ethnic differences connected with emotional intelligence is differences in culturally-based gender stereotypes of reaction to aggressiveness.

Intelligence and Self-Concepts as Predictors of Elementary School Achievements*

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1. Intelligence and academic self-concepts are important predictors of scholastic achievements (e.g., Spinath et al., 2006). Regarding achievement test scores, intelligence is usually the better predictor; regarding grades, intelligence and academic self-concepts are often comparably important – at least for high school students (Steinmayr & Meißner, 2013). For elementary school students where grades are ubiquitous achievement indicators the prediction of grades by intelligence and academic self-concepts remains a rather open question. Therefore, we analyzed the statistical prediction of grades by intelligence and academic self-concepts for two core school subjects and three elementary school grade levels. Subsequently, we compared the results across grade levels.

2. Intelligence tests (reasoning subtests of the German adaptation of the Culture Fair Intelligence Test; Weiß & Osterland, 2013) and academic self-concepts in mathematics and reading (Self Description Questionnaire I; Marsh, 1990) were administered to N = 865 elementary school students from 83 classes (grade levels 2/3/4: n = 255/326/284). Students' teachers copied the grades in mathematics and German from the last midterm report cards. We specified separate structural equation models for the three grade levels and the two school subjects (mathematics, German) to statistically predict grades simultaneously by intelligence and academic self-concepts. After establishing measurement invariance, path coefficients were compared across grade levels (multi-group analyses).

3. All models revealed good model fits (e.g., CFI and TLI $\geq$ .95). For mathematics, intelligence and academic self-concepts revealed path coefficients of comparable magnitude (intelligence and self-concept: $\beta \approx$ .45). These path coefficients did not vary substantially across grade levels. Both predictors explained statistically between 44% and 54% of the total grade variance. For German, intelligence and academic self-concepts also revealed path coefficients of comparable magnitude (intelligence: $\beta \approx$ .40, self-concept: $\beta \approx$ .35). Again, these path coefficients did not vary substantially across grade levels. Both predictors explained statistically between 24% and 35% of the total grade variance.

4. Using state-of-the-art methods (structural equation modeling, considering the hierarchical data structure) our study examined the statistical prediction of grades by intelligence and self-concepts for two school subjects (mathematics, German) and for three different elementary school grade levels. Intelligence and self-concepts were assessed with well-established and psychometrically sound instruments. In contrast to tentative assumptions (based on rather overoptimistic self-concepts in lower grade levels), our results indicated that intelligence and academic self-concepts were comparably important for grades – regardless of grade level or school subject. The particular relevance of ability (intelligence) and motivation (self-concepts) for educational success will be discussed.

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Intelligence or Personality Trait?
Measuring Individual Differences in Imagination[*]

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Imagination refers to the ability of creating mental representations of ideas that are not present at the time so is key to translating experience into conceptual knowledge. However, it is unclear if imagination is a cognitive ability or a trait disposition. As no reliable measures for imagination exist, its relationship with other cognitive and personality factors is poorly understood.

To address this, we developed and validated 3 new psychometric tests for imagination. 1) A conditional reasoning test, capturing the use of implicit justification mechanisms for imaginative behaviours. 2) An Implicit Associations Test, identifying automatic associations made between the self and imagination. 3) An explicit self-report measure assessing imaginative behaviour engagement across 7 domains.

In study 1, 219 participants (age: 18–58 years; 140 female, 78 male, 1 unknown; 109 lab-based testing; 110 remote online assessment) completed a) initial item pools for the new imagination measures, b) NEO-PI-R Openness to Experience, c) Vividness of Visual Imagery Questionnaire (Marks, 1973), and d) cognitive tests for working memory and visualisation ability. Data were analysed to identify the best performing imagination items for scale retention and concurrent/divergent validity of the 3 revised imagination tests.

In study 2, 84 participants completed a battery of IQ tests, the NEO-FFI and the revised imagination test over 3 weeks. Each week participants studied a different 2000 word article and then answered 8 multiple choice questions on its content and previous weeks' articles.

Study 1 suggested retaining 3 conditional reasoning problems, 14 imaginative behaviour engagement items, and an IAT with 2×10 attribute and 2×6 target stimuli. Revised imagination test scores weren't significantly inter-correlated and had zero-order correlations with cognitive test scores. The imaginative behaviour engagement scale correlated positively with Openness facets and with the VVIQ but the other imagination tests did not.

Preliminary analysis of study 2 suggested that all measures of imagination were positively associated with learning. The implicit imagination tests' correlations with learning decreased over time while associations between learning and the explicit imagination measure was stable. These results couldn't be attributed to individual differences in intelligence

The results have 2 important implications. First, they highlight the difficulty of developing implicit measures for personality that meet the established psychometric criteria of construct validity. Second, the findings suggest that imagination occupies a construct space that is relatively independent from cognitive ability and is more closely associated with personality, implying that imagination may be an investment trait and part of intelligence-personality interface. This notion is also supported by the preliminary results from the 3 week-long study on learning, which illustrated that imagination plays a role for the accumulation of knowledge and recall of information.

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[*] Presentation is eligible for a Student Award.

Early Risk Mechanisms for the Development of Reading and Math Ability: Examining the Role of Genetically Informed Attributes of Child ADHD, and Parental Hostility

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Attention Deficit Hyperactivity Disorder (ADHD) is known to be highly heritable. ADHD problems are associated with negative family factors and lower academic performance. Questions remain regarding the role of genetic and environmental factors underlying the processes through which ADHD symptoms are maintained and influence academic ability. Employing a longitudinal genetically sensitive adoption-at-birth design, the current study examined associations between birth mother ADHD, adoptive mother and father parenting practices, early child impulsivity/activation, child ADHD and academic ability.

The sample included a longitudinal linked sets of adopted children, adoptive parents, and birth mothers (n=361). Questionnaires assessed birth mother ADHD symptoms (child age 18 months–4.5 years), adoptive mother and father hostility to child, child impulsivity/activation, and child ADHD symptoms (child age 4.5 years). The Woodcock-Johnson test examined child reading and math aptitude (child age 7 years). Path analyses examined:(i) associations between birth mother ADHD on child impulsivity/activation (ii) adoptive parent hostility on child ADHD symptoms and academic outcomes.

There was a significant association between both adoptive mother and father hostility and later child ADHD symptoms. Adoptive parents and their adopted children were genetically unrelated: passive gene-environment correlation was removed as a possible explanation for these associations. Early child impulsivity/activation was associated with maternal and paternal hostility. These early behaviours were associated with later ADHD symptoms, which in turn were associated with later math, but not reading aptitude.

Findings highlight the importance of early child impulsivity evoking parent hostility in both mothers and fathers, with maternal and paternal hostility contributing to the continuation of attention problems and later impairments in math ability. Early interventions targeting maternal and paternal parenting practices may be important, especially where children have high levels of impulsivity.

IQ Does Not Fit Into the Plomin – Daniels Generalization?

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It was since 1987, that non-shared environment (ENS) and genotype have been considered the main sources of individual differences in psychology and behavior (Plomin, Daniels, 1987). However, to isolate any exact ENS factors is hard: these factors are usually inconsistent and influence just a concrete stage of individual development, whereas shared environment (ES) factors tend to lead to some long-term effects (Burt, 2009). This is why there is still debate concerning the idea of ENS playing a dominant role in the development of psychological characteristics and intelligence, in particular. The aim of our work was to review the growing body of results obtained in this area and analyze some of the interpretations provided.

We analyzed published works which reported the impacts of ENS and ES to various psychological characteristics. We only used the results obtained within large samples (over 1000 twin pairs). Our main interest was to identify the effects of ENS and ES on IQ in comparison with other psychological characteristics, such as: positive emotionality (Krueger et al., 2008); externalization and internalization (Burt, 2009); depression (Lyons et al., 1998); lie (Keller et al., 2005); aggression (Rhee, Waldman, 2002); prosocial behavior (Hur, Rushton, 2007); ADHD (Larsson et al., 2012); vocational interests (Bestworth et al., 1994); perceptual speed and accuracy, spatial ability, memory (Bouchard, McGue, 2003) and various verbal abilities (Davis et al., 2009; Kirkpatrick et al., 2011).

For the majority of psychological characteristics that we examined, the effect size of ENS was much greater than that of ES. Out of 43 analyzed samples, 26 showed that ES effect size was more than 5-times exceeded that of ENS, and only in 2 samples this was less than 2-times. But IQ shows dramatically different results: in 4 out of 6 samples the effect size of ENS was either equal or smaller than the one of ENS, and in the rest 2 samples ENS impact prevalence was just moderate. Similar results were obtained for verbal abilities. Thus, IQ and verbal abilities do not fit the general rule considering ENS as the main source of environmental effects on psychological differences.

IQ and verbal ability are similar in their significant dependence on ES. We tend to interpret this due to strong correlations between IQ and verbal functions development. Early language experience is crucial for the ability to learn language (Mayberry, 2002). Thus, verbal development is highly sensitive to ES in such a degree that the lack of language input within the critical period cannot be overcome by any further ENS influences. The flaws in language acquisition in turn, might cause underdevelopment of conceptual thinking and eventually result in lower IQ scores. It seems likely that in other psychological characteristics development, there is no critical period strongly requiring certain environmental influences, and therefore they are less dependent on ES .

Electrophysiological Correlates of Distinct Abstract-Reasoning Processing Stages in Humans[*]

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Visuo-spatial abstract reasoning tasks, such as Raven's Progressive Matrices Test, have been widely used as nonverbal tests of fluid intelligence (Gf). Despite the widespread application of matrix problems and available evidences about the spatial localization of abstract reasoning processes, little is known about the complex temporal dynamics underlying such a multidimensional construct as Gf. In this study we sought to provide a finer characterization of visuo-spatial abstract reasoning processes by investigating the brain oscillatory correlates of three distinct logical processing stages, representing the (1) rule inference phase (RI), (2) rule application phase (RA) and (3) response selection phase (RS).

Forty-eight young healthy participants (F=24, M=24) carried out a modified version of the SANDIA matrix task during high-density EEG recording (ANT Neuro 128 channels Waveguard EEG cap). Abstract reasoning trials were divided-and presented accordingly-following the three aforementioned processing stages (RI, RA, RS), with participants solving each stage in order to move forward. Additionally, to test for interaction between Processing Stages and specific Reasoning Processes, three sets of 30 trials each were created to test three distinct logic rules: conjunction (AND), disjunction (OR) and exclusive disjunction (XOR) rules. To control for perceptual processing, a set of matching problems composed by the same stimuli were included. EEG Data were analyzed using EEGLAB toolbox for Matlab.

Results showed higher accuracy and overall faster reaction times for OR rules (ACC=0.87; RT=2963.8 ms) in respect to AND (ACC=0.83; RT=3702.9 ms) and XOR (ACC=0.70; RT=3546.7 ms) rules. Event-related spectral perturbation (ERSP) analysis of brain oscillatory activity showed an early (~100 ms from the stimulus onset) and widespread burst of theta power followed by alpha desynchronization (~300 ms from the stimulus onset) in all the processing stages. Stage-specific oscillatory patterns were also observed: (i) a mostly left-lateralized, sustained delta and theta synchronization in fronto-temporal electrodes (FT7-FT8, F3/5, F4/6) was observed during RI; a long-lasting stimulus-related desynchronization in upper-alpha power (~12 Hz) was evident only during RI and RA steps in fronto-parietal leads.

The present data confirm and expand general observation about the role of brain activity in the alpha, delta and theta frequency bands during abstract reasoning, by adding relevant temporal and spatial processing information. Results stress out the primary role played by (left) prefrontal cortex delta/theta activity during the comprehension of a given logic rule, as well as the importance of a widespread alpha desynchronization through the entire abstract reasoning process. The interaction between temporal and spatial patterns identified for each processing stage allows to move forward in the identification of source of variance in individual Gf levels, as well as to possibly define more specific targets for brain electrical oscillatory stimulation and cognitive training interventions.

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[*] Presentation is eligible for a Student Award.

Conservatism and Cognitive Ability Revisited

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Stankov (2009) reported that social conservatism and cognitive ability are negatively correlated. At the individual level of analysis, conservatism scores correlated with SAT (r = -.35), Vocabulary (r = -.40), and Esoteric Analogies (r = -.23) test scores. At the national level of analysis, conservatism scores correlated negatively with measures of education (e.g., gross enrollment at primary, secondary, and tertiary levels) and performance on mathematics and reading assessments from the PISA 2003 (Programme for International Student Assessment) survey.

A recently completed research project based on international samples of participants (N = 8083 from 33 countries) employed similar non-cognitive scales. They included measures of religiosity, measures of pro-violence, amoral social attitudes, unmitigated self-interest, machiavellianism, proneness to aggression, social cynicism, grudge, materialism, social dominance, gender egalitarianism, power distance, reward for application, self-indulgence and communal rationalism and morality. The participants were also given a brief Number Series test that is known to be a measure of fluid intelligence (Gf).

The data were analyzed using EFA, CFA as well as techniques of multilevel and multigroup analysis embedded in Mplus. We also employed latent profile analysis.

These non-cognitive measures defined three social attitude factors (Religiosity, Morality and Nastiness). A Conservatism factor that appeared at the second order resembled the one reported by Stankov (2009). I shall report correlations between the Number Series scores and four non-cognitive factor scores at individual level. In addition, country-level correlations between Conservatism factor, Number Series scores and a host of political (political stability, government effectiveness, rule of law and control of corruption), educational (PISA mathematics achievement scores) and economic (gross domestic product, human development index) variables will be reported.

Overall, negative correlations between cognitive ability and conservatism replicate but the size of these correlations is somewhat smaller than previously found. I shall discuss these results in terms of the differences between the current and previous studies. Thus, the current study measures Gf while previous studies focused on the Gc markers. The current battery of non-cognitive measures included measures of morality and social axioms that were not a part of previous work. Finally, the sample of participants differed from the previous work in that current participants were somewhat older.

Are Changes in Mood Coupled With Changes in Cognitive Function?

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Changes in mood that occur normally in daily life are widely believed to affect the function of other psychological faculties – in particular, the one of cognitive ability. Only 5 previous studies tested this theory using a micro-longitudinal study design, which sees participants repeatedly assessed on mood and cognitive function over the course of several days or weeks. Unfortunately, the studies' findings are inconsistent and inconclusive, mainly because they assessed small samples on few occasions in controlled (i.e. lab-based) settings.

To address this issue, the smart-phone application moo-Q was developed, which allows repeatedly assessing large samples on mood and cognitive function in natural settings (i.e. experience-sampling method). moo-Q is freely available for download from the Apple store. It prompts users at random times during the day to complete brief measures of positive and negative affect, as well as three quick cognitive tests of processing speed, working memory and short-term memory. All measures were validated in preliminary lab-based studies.

Since its launch in August 2015 until January 2016, moo-Q was downloaded 24,158 times in 155 countries across the world. 69% of the sample identified as male. Reported ages ranged from 18 to 118 (mean = 31.44 years, SD = 10.10). 15,182 people completed moo-Q once, and 704 people completed moo-Q ten or more times. Latent class growth analysis could not detect systematic group-level heterogeneity in mood and cognitive function over the course of a day (e.g. morning/evening types). Also, neglidible coupling effects between changes in mood and changes in cognitive function were identified.

The results suggest that changes in mood that occur normally in daily life do not notably alter cognitive function, confirming the stability of inter- and intra-individual differences in cognitive performance. Furthermore, the study illustrates the utility and limitations of smartphone applications for collecting complex trait data on cognitive ability from extremely large samples across countries.

Twin Classroom Separation Dilemma: Evidence from 2 Twin Studies[*]

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There is little research to date on the academic implications of teaching twins together or separately, consequently policy is mixed across schools, education authorities, and countries regarding who decides. Some areas have a blanket policy of parental choice, others impose separation. However, policymakers, parents and teachers have insufficient evidence to make a potentially important decision when twins start school. This study attempts to address this by investigating potential benefits or adverse effects of separating twins at school in two large representative samples of twins from Canada and the UK.

Data were used from two samples with an age range of 7 to 16 years: Twins Early Development Study (TEDS; Haworth, Davis, & Plomin, 2012), which provided data from 8705 UK twin pairs (3039 MZ and 5666 DZ pairs); and Quebec Newborn Twin Study (QNTS; Boivin et al., 2013), which provided data from 426 Canadian twin pairs (182 MZ and 244 DZ pairs). Twin pairs taught together and taught separately were assessed for cognitive ability, academic achievement, and motivational constructs. One twin was randomly selected from each pair for all analyses. ANOVAs were conducted for sex and zygosity and for whether the twins were taught together or separately at each age for all variables. Further analyses were conducted using difference scores to assess within-pair similarity.

ANOVA results showed no significant differences in ability, achievement or motivation overall for ages 7 to 10 in Canada and ages 7 to 14 in the UK between twin pairs taught together and taught separately. Some mean differences emerged at age 12 (Canada) and age 16 (UK), with taught together twins performing better than separated twins but with mostly modest effects (3–18%). These differences varied across different school subjects and sex and zygosity groups. ANOVA results to assess within-pair similarity found marginally greater similarity for twin pairs taught together than taught separately.

Unlike previous research that investigated potential effects of separating twins at school, this study used two representative twin samples from two countries, over several assessment points in a large age range (age 7 to 16). The two samples have slightly different education systems: UK secondary education has ability selection for maths and English classes; Canada has no such selection. Results for cognitive ability, achievement, and motivation suggest that policymakers, parents and teachers can be assured of no adverse effects from teaching twins together or separately. Further, any greater similarity of non-separated twins over separated twins may reflect selection/streaming policies. The implications of classroom separation for twins is important for educational policy and provision.

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[*] Presentation is eligible for a Student Award.

Problems With Sampling in IQ Research: A Meta-Meta Analysis

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In order to draw valid inferences on the basis of IQ studies and to meaningfully estimate the size of (experimental) effects and group differences in IQ, it is important to use samples that are representative and comparable in terms of variation in IQ. In this study, we focus on two issues: (1) are IQ studies of (experimental) effects and group differences in IQ based on samples that show comparable and meaningful variation in IQs? And (2) are IQ effect size estimates or estimates of the size of existing group differences on the basis of meta-analyses of IQ affected by issues of sampling as evidenced by the samples' SDs differing from the population value of 15?

Most meta-analyses on group differences in IQ or effects on IQ use Cohen's d or the standardized mean difference (SMD), despite the fact that IQs are already standardized. The use of SMDs might introduce bias when samples are not representative and show SDs that are appreciably different across groups/conditions or from the population value of 15. We reanalyzed 24 published meta-analyses of IQ group differences or (randomized) experiments covering a total of 296 primary studies and 70,779 participants. We compared the SMDs based on Ms and SDs in the samples with effect sizes based on the raw mean IQ differences across conditions or groups. We also tested for variance homogeneity within each study and meta-analyzed the variation of IQ across samples.

61 of the primary studies (21%) showed variance heterogeneity between paired groups/conditions, suggesting actual or artifactual restriction of range in IQ. Replicating meta-analytic results using raw mean IQ differences instead of SMDs showed sizeable (>1.5 IQ points) discrepancies with the traditional method in nine of the meta-analyses (37.5%) in terms of mean effect estimate and/or in the estimate of the variation of population effect sizes (tau). Half of the meta-analyses showed variation in IQ in the samples that was either too small (11 times SD<14) or too large (once: SD>16).

This large-scale analysis shows problems related to sampling or variance heterogeneity in a large portion of IQ studies in the literature. These potential problems of sampling are relevant because they might lower the generalizability of results from these studies and because they might negatively affect the validity of traditional meta-analyses that use standardized mean differences. We discuss meta-regression methods to correct for this bias and to study the possibility of non-linear effects in meta-analysis.

Intelligence in Youth and Mental Health at Age 50[*]

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Cognitive epidemiology research has found that lower prior intelligence is associated with higher risk of mental disorders. Much of the cognitive epidemiology research on mental health has focused on psychiatric illnesses that were based on hospital admissions in young adults. There is less research on the links between pre-morbid intelligence and self-reports of common mental disorders, such as depression, sleep difficulties, and mental health status; the current study examines these associations in 50-year-old adults whose intelligence was tested about three decades previously.

Data was derived from the 5,793 participants in the National Longitudinal Survey of Youth 1979 cohort who responded to questions on health at age 50 and had IQ measured with the Armed Forces Qualification Test between ages 14 and 22. Mental health outcomes were: lifetime diagnosis of depression; the mental component score of the 12-item short-form Health Survey; the 7-item Center for Epidemiological Studies Depression Scale; and a summary measure of sleep difficulty. Sets of hierarchical logistic and generalized regression analyses were conducted. Six separate models were analyzed for each mental health outcome. A baseline model adjusted for childhood age and sex. Models 2 to 6 each adjusted for childhood SES, income, education, occupation status, or a composite indicator of adult SES.

Higher intelligence in youth is associated with a reduced risk of self-reported mental health problems at age 50 when age and sex are adjusted for: CES-depression (β = -0.16, C.I. -0.19 to -0.12, p<0.001) sleep difficulties (β = -0.11, C.I. -0.13 to -0.08, p <0.001), and SF-12 mental health status (OR = 0.78, C.I. 0.72 to 0.85, p<0.001). Conversely, intelligence in youth is linked with an increased risk of receiving a diagnosis of depression by the age of 50 (OR = 1.11, C.I. 1.01 to 1.22, p=0.024). Adjusting for adult SES attenuated a lot of the effect of IQ on CES-depression, sleep difficulty, and SF-12 mental health status; in contrast, adjusting for adult SES lead to an increase in effect size for a diagnosis of depression (OR=1.32, C.I. 1.16 to 1.51, p<0.001).

The present study is one of the few studies to examine associations between intelligence and both a history of depression diagnoses and current self-reported mental health problems in both men and women around age 50 years. An intriguing finding of the study was that higher intelligence was associated with lower rates of depression at age 50 but with a higher lifetime diagnosis of depression; adjusting for adult SES led to an increase in effect size in the latter relationship. Much of the impact of adult SES was explained by income because it had a greater strengthening effect than either education or occupation status. The current findings also suggest that the association between intelligence in youth and mental health outcomes do not differ by sex.

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[*] Presentation is eligible for a Student Award.

Why Does Intelligence Reduce Anger? An Experimental Approach

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Previous research has shown that intelligence negatively correlates with trait anger, and that cognitive control might be a factor underlying this relationship. However, the mechanism of this relationship remained unclear. The aim of the present studies was deeper understanding of the processes of cognitive ability involved in the regulation of anger. It has been found previously that low trait-anger individuals recruit limited-capacity cognitive control resources following the activation of hostile thoughts. Additionally, other studies revealed that intellectual processes may also reduce the level of the experienced affect related to anger, e.g., high cognitive control decreases the intensity of induced anger.

In study 1 (n=150) the relationship between intelligence, trait anger and cognitive control task (flanker test) were examined. In study 2 (n=181), the role of fluid intelligence in the inhibition of activated hostile thoughts by individuals differing in trait anger has been explored. It was expected that cognitive ability would moderate the relationship between trait anger and proneness to negative evaluation of neutral words primed by hostile stimuli. In study 3 (n=170), the influence of intelligence on induced angry mood was examined. Specifically, participants were randomly divided into two groups and underwent an anger, or neutral emotion induction, respectively.

The result of study 1 indicated that higher anger was associated with poorer cognitive control. However, this relationship was attenuated when cognitive ability was added to the model. Study 2 revealed that intelligence interacted with trait anger in the way that the tendency to negatively evaluate words primed by hostile stimuli by high trait anger individuals was found only at the low level of intelligence. Finally, the results of study 3 have shown that intelligence predicted emotional responses such that participants with lower cognitive ability control reported larger increases in anger following the anger induction.

The present project is the first attempt to experimentally examine the nature of the intelligence – anger relationship. We found that intelligent individuals are more likely to recruit their cognitive control capacity to inhibit hostile thoughts and angry mood.

Neural Correlates of Numerical Processing for Adults with Mathematical Overachievement and Underachievement

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There are wide individual differences in mathematical achievement. Little research has been conducted to investigate the differences in brain activation of numerical processing for the adults with salient contrast of mathematical achievement. Two groups of undergraduates, one with overachievement and the other with underachievement, were recruited. The groups also differed greatly in general intelligence that was measured with simplified Raven Progressive Matrices. Participants performed two number line estimation tasks and two number comparison tasks.

It was found that the overachievement group exhibited greater activation in the bilateral parietal lobes and stronger functional connectivity between the left and right parietal lobes, and the underachievement group showed greater activation in the bilateral frontal lobes and the greater functional connectivity between the parietal lobe and the frontal lobe.

The individual differences in brain activation might suggest the familiarity of mathematical knowledge, even for the simple numerical processing.

ISIR 2016 POSTER PRESENTATION

Abstracts for the remaining papers follow in alphabetical order
by first author's last name.

Relationship Between Creativity and Intelligence[*]

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Numerous studies exist on IQ and creativity. Nevertheless, there is yet no consensus on how these constructs are related. In our country, these studies are still on the initial level. This research aims at studying the interrelation between IQ and creativity. We tried to understand the quantitative proportion in which they are demonstrated and identify whether a child possessing high IQ has more chances for displaying a high level of creativity as well.

Junior school children were selected as target audience for this study insofar as manifestations of creativity significantly decrease among middle school children based on age-related characteristics and probably due to school system specifications. School children of 1st and 2nd grades were studied; 149 first-grade children and 70 second-grade children, the total number amounting to 219. For IQ assessment, the IQ Express Diagnostics Test MEDIS was used (as a control test we were used Raven's Coloured Progressive Matrices test for IQ), and for creativity assessment, Torrance Test of Creative Thinking was used.

The following quantitative findings were identified:
- 16,4% of children displayed IQ higher than average;
- 2,2% of children displayed very high IQ;
- 6,3% of children displayed high results for creative abilities;
- 1,3% of children displayed high creativity level and IQ higher than average;
- 5% of children displayed high creativity level and average and below-average IQ, among which 2,7% are children with average IQ and 2,3% – children with below-average IQ, respectively.

Thus, high level of creativity is mostly paralleled with average and below-average IQ. Children with above-average IQ and high level of creativity are few in number; and those children whose IQ is very high, on the contrary, have average and low indicators for creativity. As compared with high results for creativity

This research highlighted the fact that the intellectual and creative abilities are opposite qualities when being manifested in higher level which is important to be considered in the school system, employment, etc. Since these capabilities/abilities are also basis of personal peculiarities, different behavioral manifestations, etc., it is important to make appropriate conditions for the development of creative children with high intellectual results at schools, as well as the workplace. This research serves as a basis for further in-depth qualitative research.

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Creative Pedagogies for Empowerment:
Developing Multimodal Intelligences with Diverse Learners

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Current approaches to intelligence extend beyond monistic notions of intelligence measurement into multimodal models incorporating social and emotional, as well as cognitive intelligence. Creative Pedagogies for Empowerment is a longitudinal qualitative action research partnership project investigating the potential of interdisciplinary creative strategies, processes, and outcomes, in generating appropriate pedagogies to support the multimodal development of vulnerable and diverse learners with special educational needs and disabilities (SEND). It investigates the impact of collaborative, creative, pedagogical approaches on the social, emotional and cognitive intelligences of diverse learners, as well as on the practice of in-service and trainee teachers.

Creative Pedagogies for Empowerment's collaborative outcomes are qualitatively evaluated within the portfolio of holistic pedagogical strategies deployed within the SEND school, as well as through teacher trainee cohorts' evaluation. Data is incorporated within the school's overall scoring of students' social, emotional and cognitive progress, with positive results based on analysis of intensive interactions with students. Impact studies from the Project indicate positive development in students' wellbeing, communication, independent engagement, creativity and academic attainment. All participants continued investment in the creative research partnership denotes commitment to the Project's cooperative creative pedagogical strategies for the development of multimodal intelligences.

Evaluation of the Project's 7 years of collaborative research data confirms the impact of its innovative pedagogical strategies based on an annual creative project intervention. The ethnographic qualitative investigation of multimodal intelligence strategies has empowered SEND participants, inspired trainees and reinvigorated the practice of professionals, through its empirical exploration of theories of creativity, and multimodal intelligences. Project processes and outcomes have generated interdisciplinary pedagogical strategies enriching the practice of trainees and in-service teachers. This ongoing partnership model, linking teacher training cohorts with SEND professionals, demonstrates wider pedagogical potential for holistically augmenting diverse learners' intelligence capacities.

The Comparison of Impact of Intelligence and Self-Regulation on Adolescents' Academic Success in the Humanities, Mathematics, and Natural Science

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This study was aimed at identifying intellectual and regulatory predictors of academic achievements in the humanities, mathematics, and natural sciences. A low level of self-regulation (SR) is among of the main hindrances to students' realizing their intellectual potential in learning activity. We revealed that conscious SR supplies the certain traits of temperament and character, and alters functional conditions, thereby contributes the learning goals achievement. However, the role of SR and its specific relations with intelligence in maintaining high academic achievement is not clearly understood. We have set the following research question: What part of academic success variance in certain school subjects does explain by particular variables of intelligence and SR.

Methods. 1). «Self-Regulation Profile of Learning Activity Questionnaire – SRPLAQ-M» (Morosanova, 2014), measuring the level of SR of students' learning activity and different aspects of SR related to achieving learning goals: Planning of goals, Modeling of conditions, Programming and Results evaluation. 2). Russian adaptation of the KFT (The Munich Test of Cognitive Abilities for Gifted Students) (Averina, Shcheblanova, Perlet, 1991; Shcheblanova, 2004) was used for measuring intelligence level. It contains three scales—verbal (V), mathematical (Q), and non-verbal (N) intelligence. Each scale consists of two subscales with 25 to 30 tasks. 3). Year Grades of academic year to assess student academic achievement. Sample. Students of Moscow gymnasium for gifted children (N=87) aged 14–16 years.

The regression models of academic success in the humanities identified the verbal intelligence associated with vocabulary as highly significant and definitive for success in these subjects. As for SR, Programming was a significant predictor for Russian language (β= .30***), Planning for literature (β= .55***), and both Programming (β= .21**) and Modeling (β= .19*) for history. Predictors of success in algebra and geometry are based on the quantitative-relations test and spatial intelligence. Results evaluation proved to be a significant predictor of success in algebra (β= .26**), Modeling (β= .19*) and verbal intelligence (β= .27***) predicted success in geometry. The regression model for natural subjects (physics) turned out to be significant only for general levels of intelligence and SR.

The results of this study complement those studies that have shown the significant contribution of intelligence to high academic results. The Study contribution was new and interesting data on the relationships between some SR processes, intelligence and learning outcomes. The regression models of academic success in the humanities, mathematics, and natural sciences identified the verbal intelligence as highly significant for success not only in the humanities, but in the geometry as well. According to O.A. Konopkin (2011), intelligence, as one of the resources of SR, is of particular importance for its support. This conclusion makes a theoretical contribution to solving the problem of identifying the intellectual and regulatory predictors of academic success.

Differences in Brain Activity in Individuals with High and Low Maths Anxiety[*]

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Previous research on mathematical anxiety has revealed distinct patterns of brain activation in regions associated with negative emotions, such as actually feeling pain (Maloney et al., 2012). Suárez Pellicioni et al. (2014) investigated choosing solutions in mathematical additions and found that in large split from correct answer solution tasks P600/P3b component had a greater amplitude and delayed latency for the high math anxiety group as compared with their low math anxiety counter parts. We investigated brain activity in groups with different level of math anxiety during error recognition task in algebra, arithmetic and lexical tasks.

The study included 129 healthy volunteers 17–30 years old. EEG was recorded using 64 channels (63 EEG + VEOG), with 0.1–100 Hz analog bandpass filtering and digitized at 1000 Hz. The EEG electrodes were placed according to 10–10 system and referred to Cz with ground at Fpz. Electrodes impedance was maintained below 25 kΩ. Participants were to judge whether one of the presented algebra, arithmetic and lexic tasks contains an error (210 tasks, 70 of each type). Sample was separated into three groups with different level of math anxiety: low math anxiety (LMA, N=46), and high math anxiety(HMA, N=45). Individuals with medium level of anxiety were not included in the analysis. ANOVA analysis with Bonferroni correction was performed.

The results suggested differences for algebraic task. Area under the curve for ALGEBRAIC task was significantly different between HMA and LMA groups(p=0.05) in frontal and parietal and parietaloccipital areas. In ARITHMETIC TASK the difference between the groups was smaller, but still significant (p=0.05). For lexical task we found the same pattern. Overall, the area under the curve for group with high anxiety was much lower than for low math anxiety. There were no significant differences in temporal areas.

We investigated disparities in brain activity in individuals with different levels of math anxiety and. found evidence of different pattern processing between individuals with low and high anxiety. Activity in all types of task for HMA individuals was significantly lower than in LMA individuals. This is in line with previous studies (Suárez Pellicioni, et al., 2014). The results suggest that high math anxiety leads to less activity in areas connected with processing of difficult logical information and visual perception.

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[*] Presentation is eligible for a Student Award.

Mirror Neuron System, Brain and Intellect[*]

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One of the definitions of intelligence – the ability to adapt to the environment quickly and flexibly, that is, to find solutions to problems in a rapidly changing environment. Intelligent behavior is a characteristic of many representatives of vertebrates. Among them, the most complex forms of intellectual behavior have representatives of birds, cetaceans and primates. Homo sapiens are considered have the most advanced intelligence. The evolution of the brain and human intelligence is more a result of the properties inherent to the anthropoid ancestors and modern primates than absolutely unique properties. Among these features also include the ability to imitate, theory of mind, and the development of speech and linguistic system, where mirror neurons are likely to play a key role.

In this review we conducted a brief analysis of the basic research on the mirror neuron system, the evolution of the brain and intellect.

Mirror neurons are the neuroanatomical basis of imitation, empathy and the ability to understand the mind of another individual (theory of mind). Mirror neurons are likely to participate in the evolution of language and speech. Mirror neuron system may be associated with social behavior and emotional intelligence. Some aspects of simulation of similarity, theory of mind and the ability to primitive signs (analogue language) studied in higher primates. However, their complete realization is found only in Homo sapiens. This leads to the conclusion of a special organization of mirror neurons, which allowed making a kind of qualitative leap in the evolutionary process and selecting ancestors of Homo sapiens among the other members of the Hominidae.

The phenomenon of mirror neurons is associated with the brain and the evolution of complex intelligent human behavior. Mirror neuron system probably contributed to the evolutionary process of the emergence of consciousness, speech and language, social behavior, the development of culture and civilization. Studies of the mirror neurons can shed light on the neuroanatomical bases of psychological phenomena, contributing to a clearer representation of how intelligence and behavior of a Homo sapiens distinguish it from the other animal world and what similarities exist.

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[*] Presentation is eligible for a Student Award.

Iowa Gambling Task Performance
is Strongly Predicted by Analytical Intelligence

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One of the most popular tools to study decision making is Iowa Gambling Task (IGT). The IGT requires the participant to choose cards from 4 decks that have a varied intermittent gain and loss structure that the participants uncover during the experiment. However, predictors of individual performance on the IGT have been rarely studied in non-clinical samples (Buelow & Suhr, 2009). Our study tested the hypothesis about the leading role of cognition in decision making regulation in IGT. We considered IGT as a learning task where participants are faced with the necessity to establish and refine probabilistic representations of the reward and punishment structure of the environment. We examined the relationship between intelligence and a wide spectrum of IGT performance indices.

116 adults participated in the study. IGT was organized in 5 blocks of 20 trials (Kornilov et al., 2015). We analyzed cumulative Net Gain, preference of «good» decks over «bad» decks in each block, and cumulative preference of «good» decks. Participants' performance was averaged across 20 trials within each of the 5 blocks. To assess Fluid IQ we used the Matrix Reasoning and Three-Dimensional Rotation sub-tests from the ICAR (Condon & Revelle, 2014). Raw scores for subtests were standardized, averaged, and transformed into the IQ-scale. We also evaluated Verbal IQ using two verbal scales from the ROADS battery (Kornilov & Grigorenko, 2010). The General IQ score was computed using the scores from all 4 sub-tests.

We used a linear regression approach and tested 2 models: Model 1 included as predictors Fluid IQ and Verbal IQ; Model 2 included General IQ. Both models tested for cumulative Net Gain in each block revealed the significant contribution of IQ: Model 1 showed that Verbal IQ was a positive predictor of this index in Blocks 4 and 5; the same pattern of results was found for Model 2. Verbal IQ was a positive predictor of preference of «good» decks over «bad» decks in Blocks 2 and 4. General IQ was a positive predictor of this index in 4 out of 5 IGT blocks (2–5).

We did not find the contribution of Verbal IQ to the preference of «good» decks over «bad» decks cumulatively at the end of each block. However, we found that General IQ was a significant predictor of this index in Blocks 3–5.

Results reflect learning component of IGT: higher IQ allowed participants to develop correct representations of the IGT and win more money. Our study suggests that General IQ is a key contributor to better performance in decisions that require retrieving hidden patterns. We didn't find evidence for the contribution of Fluid IQ to performance; however, General IQ appeared to be a better predictor of performance, compared to just Verbal IQ. It suggests the need to examine the contributions of general vs. specific cognitive abilities in the regulation of decision making. We assume that decisions at the highest level of uncertainty was regulated by personality traits rather than intelligence based on the absence of contribution of IQ in performance at the 1st block of IGT.

Brain Activity During Error-Recognition Tasks: Effects of Mathematical and Trait Anxiety

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Mathematics plays an important role in the fields of science and technology. Moreover, modern technological societies require adequate levels of mathematics from all citizens. However, many people have difficulties with mathematics. Research suggests that these difficulties are to some extent related to mathematical anxiety (MA). MA has been described as a feeling of tension, apprehension, or fear that interferes with maths performance (M.H. Ashcraft, 2002). MA is different from trait anxiety (TA), which reflects the personal inclination to estimate an environment as potentially dangerous (C.D. Spielberger, 1971). The aim of this study is to compare the brain activity of people with different levels of MA and TA during lexical and mathematical tasks of different difficulty.

52 Russian native speakers (age 24.6 ± 2.91; 28 males; 1 left-handed) participated in the study. To assess TA level, we used the State-Trait Anxiety Inventory (STAI; C.D. Spielberger, 1983). MA was assessed using the Revised Math Anxiety Rating Scale (R-MARS; Plake & Parker, 1982). EEG was recorded using 128 channels (127 EEG + VEOG) during 3 types of error-recognition tasks: 30 simple sentences in Russian, 30 arithmetic and 30 algebraic tasks. 50% of tasks included error. The participants were asked to judge whether the task was correct or incorrect and indicate their response by pressing a keyboard button. Event-related spectral perturbations (ERSP; Delorme and Makeig, 2004) were used to assess the spectral-power changes in brain activity.

The effects of MA and TA were found in theta band (4–8 Hz) in time 150–350 ms after task onset and in beta1 (12–16Hz), beta2 (16–20 Hz) bands in time intervals 500–3000 ms after task onset. The high level of MA and TA were both found be associated with amplitude of EEG reaction on lexical and maths conditions. The increase of the amplitude of theta synchronization was specific for high level of MA in lexical condition and for high level of TA in maths condition. On the contrary, in beta2 band the effect of MA was found only for maths condition, not for lexical one. Moreover, the effects of MA and TA in the beta1 and beta2 band were opposite to each other: the amplitude of beta desynchronization decreased for higher level of MA, and increased for higher level of TA.

The study identified different brain correlates of MA and TA during the task. The results suggest that higher level of TA may lead to greater cognitive control during task solving, whereas higher level of MA negatively influences control. Future research is needed to explore the relationship between MA and the level of intelligence as well as with maths performance.

Intelligence and Math Achievement:
Cross-Cultural Study of Individual Differences and Relationship[*]

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Clear cross-cultural differences exist in both school mathematical achievement (PISA, 2012) and intelligence (Rushton & Jensen, 2005). It has been shown that intelligence is one of the most important factors of individual differences in school achievement. Cross-cultural differences are often explained by differences in the quality and organization of school education (Nisbett et al., 2012). However, the effects of school education could be directly or indirectly related to the socio-economic status (SES) of countries (Burkam et al., 2004). The current study focuses on the cross-cultural analyses of individual differences in intelligence and math achievement and their relationship in two countries – Russia and Kyrgyzstan – that have similar educational systems and are different in terms of SES.

Two samples of schoolchildren of Grade 9 were enrolled from public secondary schools: 274 Russian students (Mean = 15.7 years, SD = 0.5), and 289 Kyrgyz students (Mean = 15.7 years, SD = 0.4). These countries represent the middle (Russia) and the bottom (Kyrgyzstan) of the PISA ratings. According to the 2013 Human Development Report, Russia is included in the group of countries with high SES, whereas Kyrgyzstan is included in the group with medium SES. One-way ANOVA was used to estimate cross-cultural similarities and differences in math achievement using computerized test «Problem Verification Task» (Tosto et al., 2013) and intelligence using «Raven's Progressive Matrices». A multiple regression analysis was run on math performance as a criterion, with intelligence as a predictor.

A significant main effect of country on the Raven's Progressive Matrices scores was found: Russian students performed significantly better than Kyrgyz students at Grade 9 (η^2= .06, $p<$ .001). Regarding math achievement, we also found cross-cultural differences: Russian students performed significantly better than Kyrgyz students (η^2= .05, $p<$ .01). Similar trends for the associations between intelligence and Math achievement were observed on both Russian and Kyrgyz samples: intelligence explained 10% and 17% of the total variance in math achievement, respectively.

The current study has two main findings: (1) there were differences in psychometric intelligence at age 15 in Russia and Kyrgyzstan, with Russian students performing significantly better than Kyrgyz students, and (2) similar trends for the relationship between intelligence and Math achievement were observed in both countries. Cross-cultural differences in RPM scores could be associated with lower availability of pre-school education and lower quality of school education in Kyrgyzstan as compared with Russia. The similar trends for the relationship between intelligence and math achievement at final grade 9 at both countries might be associated with similar organization of educational systems.

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[*] Presentation is eligible for a Student Award.

Intelligence, Personality Traits and Behavior Problems Over Time

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The stability of intelligence over time and the independence between personality and intelligence are long-standing issues in the literature produced in developed countries. There is no information regarding its generalization for cultures less developed. This study evaluated the relationships of these variables by cross-sectional and longitudinal study, and its importance for life outcomes.

This paper refers to a larger project, which is ongoing, called «Longitudinal Study of Intelligence and Personality» conducted by the Laboratory of Individual Assessment of the Universidade Federal de Minas Gerais, Brazil. The sample consisted of 65 young adults (mean age = 22.6; SD = 2.5; 38% females) assessed between 2014 and 2016, which were previously assessed in the year of 2002 (mean age = 10.6; SD = 2.5). The interval of time between the assessments was 13 years on average. In 2002 were administered the Coloured and the Standard Matrices Progressives of Raven (SPM), the verbal scale of WISC-III, and the Attention Deficit/Hyperactivity Disorder (scale for teachers). For assessment in 2014–2016 were administered the SPM, the verbal scale of WAIS-III, the NEO-FFI.

The following results were found: 1) Moderate correlation between fluid intelligence assessed in 2002 and 2015 (.532). The same result (.543) was obtained for crystallized intelligence, 2) whatever the time of assessment, intelligence associated positively with Openness, a personality trait; 3) verbal intelligence instead fluid intelligence seems associate with behavior problems, and 4) Conscientiousness was the better predictor for use of illicit drugs in adult age.

This study found that intelligence was the most stable factor over time. In addition, verbal intelligence can be useful trait to predict antisocial behavior during childhood. However, child behavior problems seem not to have strong continuity through personality traits in adult age. Consistent with prior research in developed countries, intelligence was moderately related to Openness to Experience, and Conscientiousness was related to behavior problems in adult age (use of illicit drugs). Our longitudinal results are the first produced in Brazil.

Age Differences in the Interconnection of Self-Regulation and Intelligence with Secondary School Students' Academic Achievement[*]

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The role of cognitive and non-cognitive factors in academic success has been extensively studied in recent years. The results suggest that cognitive and regulatory features are independently associated with academic achievements. But the evidence was substantiated mostly on the sample of high school students. Junior adolescence according to various sources is the time sensitive to the conscious self-regulation (SR) formation. However, SR in this age is still insufficiently explored. In this regard, the age specificity of cognitive and non-cognitive factors interference in 12–13 years adolescents seems to be the issue of current interest. The aim of this study is to identify the contribution of the SR and Intelligence interconnection to the younger teens' academic success.

The research sample consisted of the secondary school students aged 12–13 (N=249, 131 men). Methods: 1) E. Wonderlic's Cognitive Ability Test (Russian version) used for diagnostics of General Intelligence level; 2) V. Morosanova's «Adolescent Self-Regulation Profile Questionnaire» consisting of 7 self-assessment scales: Planning, Modeling, Programming, Results Evaluation, Flexibility, Independence and Responsibility; 3) students' final year grades in core subjects (native language (Russian) and mathematics) as academic achievement indicators.

Correlation analysis has revealed significant connections between the Intelligence and final year grades in native language and mathematics. Math year grade also correlates with certain self-regulation characteristics: Planning, Modeling, Flexibility, Independence, SR General Level. Native language final year grade significantly correlates with Planning, Modeling, Programming, Results Evaluation, Independence and SR General Level. Regression analysis indicates that both Intelligence and SR can act as predictors of final year grades. Intelligence and Planning score significantly predict academic achievements. Parameters of regression models: for Math year grade – $F_{(2,160)}=16.67$, $p<.001$, $R2= .17$; for Native language – $F_{(2,160)}=18.71$, $p<.001$, $R2= .19$.

Our study has stated the fact of significant interconnections of the younger teens' academic achievement with their intelligence and self-regulation development. The research results made on the sample of 12–13 year students show that General Intelligence level and Planning make a significant contribution to academic success in young adolescence. Our previous research for high school students (15–16 years) give us reason to assume that the ratio of cognitive and non-cognitive factors contribution to academic achievement in different age groups will be changing. The role of self-regulation shall step-by-step increase, because the learning process promotes active development of self-regulation processes.

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[*] Presentation is eligible for a Student Award.

Unique Contributions of Cortical Brain Characteristics to Fluid Intelligence[*]

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Research demonstrated that variations of diverse brain characteristics predict differences in fluid intelligence. The most prominent neural parameters associated with fluid intelligence are gray and white matter volume. Other studies employing graph theory in order to analyze the brain's structural and functional network connectivity found that individuals with pronounced fluid intelligence show higher values with regard to global efficiency. It is reasonable to assume that the mentioned brain characteristics are potentially correlated with each other. Nevertheless, previous studies only investigated them independently of one another. In a novel integrative approach we identified unique contributions from each of the different brain characteristics in predicting fluid intelligence.

We measured fluid intelligence in a sample of 120 healthy participants by conducting a non-verbal intelligence test (BOMAT). In addition to that, we used MRI, DTI and resting state fMRI measurements in order to examine the following brain characteristics: gray matter volume (GMV), white matter volume (WMV), structural and functional network connectivity (NET DTI & NET REST) within the brain as indexed by global efficiency, a measure yielded by graph theory. Using multiple regression analysis we searched for unique contributions from each of the different brain characteristics in predicting fluid intelligence.

As expected statistical analyses showed that GMV (r = .34, p < .001), WMV (r = .19, p = .03), NET DTI (r = .23, p = .01) and NET REST (r = .28, p = .002) are significantly correlated with fluid intelligence. Importantly, we found significant correlations between GMV and all other brain characteristics as well (r = .27 - .78, p < .01). Therefore, we performed a multiple-regression analysis with GMV, WMV, NET DTI and NET REST as the independent variables and fluid intelligence as the dependent variable. Surprisingly, only GMV and NET REST provided unique contributions to the prediction of fluid intelligence (GMV, ß = .36, p = .03; NET REST, ß = .20, p = .03; other brain characteristics, p > .31). The pattern remained stable when controlling for the effects of age and gender.

In the past, brain characteristics predicting fluid intelligence were investigated independently of one another. Our work features a novel and integrative approach that highlights the important interplay of such brain characteristics. Our results show that the influence of certain brain characteristics on fluid intelligence, like WMV and NET DTI, is scaled down heavily when examined in combination with other brain characteristics like GMV and NET REST. Therefore we conclude that on a global level the volume and functional connectivity of gray matter play major roles in the neural composition of fluid intelligence, whereas the volume and network properties of white matter appear to have no unique contribution.

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[*] Presentation is eligible for a Student Award.

Microstructure and Functional Coherence of Specific Network Connections Within the P-FIT Model Predict Interindividual Differences in Fluid Intelligence

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Based on converging evidence from neuroimaging studies, human intelligence is closely linked to the anatomical properties and functional activation patterns of several brain regions located in the visual, temporal, parietal, frontal and cingulate cortex. This model is known as the Parieto-Frontal Integration Theory (P-FIT). Solving an abstract reasoning tasks involves multiple processing stages and thus requires the harmonic interplay of multiple brain regions. Since the P-FIT model includes a widespread network of regions, we assumed that a higher functional coherence at rest and an efficient layout of structural connections within the network would lead to a better performance during an intelligence test.

We measured fluid intelligence (Gf) in 85 healthy participants by conducting a matrix-reasoning test. In addition to that, we acquired MRI, DTI and resting state fMRI data to estimate structural and functional network properties of brain regions within the P-FIT. First, we used the anatomical MRI images to define subject specific P-FIT regions. Second, we used the resting state data to compute the functional coherence between each of the aforementioned P-FIT regions. Third, we conducted DTI probabilistic tractography to obtain the intra- and interhemispheric white matter tracts connecting the P-FIT regions. Fourth, we estimated the microstructure, indexed by fractional anisotropy (FA), of each tract. Finally, we correlated functional coherence and microstructure of the tracts with Gf.

Our statistical analyses showed that Gf is correlated with the FA of visual, cingulate and frontal interhemispheric tracts ($r = .22 - .35$, $p < .05$). The FA of intrahemispheric tracts is associated with Gf for visual-to-frontal, cingulate-to-frontal as well as visual-to-parietal connections ($r = .21 - .34$, $p < .05$). With regard to functional connectivity, we found that the interhemispheric coherence between visual, parietal, temporal, cingulate and frontal regions is related to Gf ($r = .23 - .33$, $p < .05$). The functional coherence of intrahemispheric tracts is associated with Gf for visual-to-frontal, visual-to-parietal-to-temporal and frontal-to-parietal-to-temporal connections ($r = .22 - .34$, $p < .05$). In general, Gf is related to more connections within the left than right hemisphere.

The P-FIT model is more than a loose cluster of brain regions associated with intelligence. It is centered around the idea of a widespread network that includes several interconnected brain regions working on the multiple processing stages of abstract problem solving. To our knowledge, this is the first study to examine the structural and functional interplay between the components within the P-FIT model. Our work demonstrates that the architecture of specific structural and functional network connections are correlated with Gf. These results go beyond a mere analysis of the single components within the P-FIT model but provide further insight into its network-wise framework. Nevertheless, future studies are needed to examine other forms of intelligence like verbal or numeric intelligence.

Face Distractors Enhance Processing of Subsequent Visual Information

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Under masking conditions the recognition of a briefly flashed visual target is often weakened when a masking stimulus is presented in the spatial and temporal proximity. It is well known that the configuration similarity of the mask and the target improves the masking effect, but the influence of mask and stimulus semantic categories is still unclear. We supposed that such ecologically significant stimuli as human faces capture visio-spatial attention to a significantly greater extent than neutral distractors (animal and man-made objects) do. The aim of our study was to compare target recognition under forward masking by faces with recognition under masking by other common images.

Thirty-eight healthy subjects participated in the behavioral experiments and twenty seven ones participated in the EEG experiments. Black and white drawings were used as targets and masks. Animal images were masked by faces and man-made objects, man-made object ones were masked by faces and animals. The duration of forward mask stimulus was 50 ms, the target duration was 17 ms for behavioral experiments and 100 ms for EEG ones. The stimulus was presented immediately after the end of mask presentation. In each session four target stimuli, belonging to the same category (animal or object), were presented to subjects. The latter were asked to identify the stimulus and to press one of the 4 buttons. The individual accuracy and reaction time (RT) were analyzed. EEG was recorded using a 40-channels.

Behavioral data analysis showed that animals and man-made objects evoked masking effect on target recognition. Accuracy decreased and RT increased in comparison with the image recognition without masking. Noteworthy, the faces did not influence effectively as masking stimuli. Analysis of ERPs revealed that amplitudes of P300 and N400 waves were largest when the stimulus was preceded by face mask. The most pronounced recognition differences between mask categories were observed in the parietal and the frontal region. These data suggest that faces processed automatically and increased attention to the subsequent spatial visual information.

Previous research has suggested that faces may constitute an exceptional stimulus category that could modulate visuo-spatial attention when presented as a task-irrelevant distractor. Our behavioral results indicate faster recognition of a target image when it is preceded by face in comparison with an animal and man-made object. P300 and N400 amplitudes are also increased in these conditions. The increase of P300 and N400 amplitudes reflects the increase in the attention level which leads to amplification of target processing under face forward mask. Our result allows to suggest that behaviorally/ecologically significant stimuli can promote deeper processing of subsequent visual information due to influence on attention mechanisms.

Modeling Method for Set of Genes Based on Steady State and Transition Probability of Codon

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The genes of organisms, which consist of A, C, G, T, played an important role in biological character. A gene consists of exon and intron. Exon play a role in protein synthesis directly and intron helps this synthesis. In exon, sequences are separated by word with length 3, which is called codon. Codon has 4^3 cases and each codon synthesizes a specific protein. In sequence of exon, change of only one nucleotide makes a big impact on biological behaviour because composition of protein is changed. Studies related with change of exon are becoming increasingly important issues. However, in case of human genome, kinds of gene are 25,000–30,000 and set of all gene has 35,000,000 nucleotides approximately. Hence, to analyze gene information, it is necessary to adopt method of information technology.

To analyze the genome sequence using codon property, we obtain the microbial genome sequence from NCBI. Set of microbial genome is composed of 6 different species which are Aceto-bacter, halo-group and so on. Also, for each microbial genome, position information of all genes is achieved from NCBI. Then, portion of genes is separated from genome. From sequences of gene, we calculate codon information which includes steady state and transition probability. Steady state probability of codon is achieved from frequency results of each word when length equals to 3. In addition, transition probability of codon can be obtained from frequency results of each word when length equals to 6. Using the calculation results, we can describe any genome by values of steady state and transition probability.

From results of proposed genome representation method using codon property, we can show that microbial genomes have various results of steady state and transition probability according to their species. For example, in halo-group, major components of steady state are CGA, CGG, GAC and TCG. On the other hand, in case of acetobactor, major components of steady state are TGC, GCC GGC GCA. Similar results are identified in transition probability of codon. Also, we examined classification result of microbial genomes using information of codon property which includes steady state and transition probability of codon. We use Euclidian distance as distance metric and phylogenetic tree as classification metric. From the phylogenetic tree, microbial genomes are classified into 6 species clearly.

In our proposed genome representation method, we adopted mathematical and statistical theory in gene analysis based on the property of codon.

Unlike conventional biology, we apply steady state and transition probability of codon to analyze genes in view of information technology. Hence, proposed method can be adopted to huge amount of genome data effectively.

Also, function of genes can be interpreted by our method because we use codon property. In addition, we can expect that our method could be applied to the analysis of specific gene in human genome.

The Smart Brain at Rest: Predicting Individual Differences in Intelligence from the Multivariate Pattern of Intrinsic Functional Connectivity Measured with EEG[*]

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The current study investigates whether individual levels of intelligence can be predicted from patterns of brain activity in the absence of a particular cognitive demand. More than a decade of research in cognitive neuroscience has established that intrinsic (i.e., task-independent) properties of functional brain networks (as measured with neuroimaging techniques such as functional magnetic resonance imaging, MRI, or electroencephalography, EEG) reflect fundamental organizational principles of the brain that restrict the repertoire of neural and behavioral responses an individual will show in the face of a cognitive challenge. We hypothesized that these intrinsic organizational principles of the human brain contribute to individual differences in intelligence.

In a sample of 59 healthy adult participants, neural dynamics during rest (awake, eyes closed) were measured with EEG (65 channels). Fluid intelligence was assessed with Raven's Advanced Progressive Matrices (RAPM). Functional connectivity was defined by Pearson correlations between the time-courses of all channels for each artifact-free epoch of each subject. Resulting connectivity matrices were averaged across all epochs of one subject, resulting in one connectivity matrix per subject. We then applied a machine learning approach and performed multivariate pattern regression analysis using linear Gaussian Process Regression to test whether multivariate patterns of connectivity in these matrices allow us to predict individual levels of intelligence.

The results of our multivariate pattern analysis demonstrated that individual differences in fluid intelligence can be predicted from the pattern of functional connectivity between EEG electrodes in new, previously unseen individuals (standardized mean squared error, smse = .78, p = .003). This prediction was mainly attributable to a relatively sparse pattern of connectivities dominated by frontal electrodes.

Our findings demonstrate that individual differences in intelligence can be predicted from easily accessible brain activation data. This study is the first to successfully predict intelligence from EEG neural dynamics independent of specific task-demands and at the level of the individual subject. It extends previous MRI studies that predicted intelligence by combining measures of brain structure and task-evoked activation (Choi et al., 2008). As collecting EEG resting data requires less effort – in terms of time and money – our approach offers a more efficient prediction of intelligence. Generally, our results imply that more and less intelligent brains not only differ in brain structure and task-induced activation, but also in the patterns of interaction between brain regions.

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[*] Presentation is eligible for a Student Award.

Relationships Among Processing Speed, Working Memory, Number Sense, Intelligence and Academic Achievement at Primary School Age

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Numerous studies demonstrate that academic achievement correlates with cognitive abilities such as intelligence, various aspects of number sense, visuo-spatial memory and information processing speed. According to the studies, the speed of information processing is regarded as a basic cognitive ability underlying cognitive performance of «higher order», in particular, intelligence (Rinderman, Neubauer, 2004). At the same time, the studies have shown that basic cognitive processes are susceptible to age-related changes (Fry, Hale, 2000). The current study focuses on the investigation of the relationships among cognitive abilities and academic achievement at primary school age.

876 primary school students of grades 1, 2, 3, 4 from public secondary schools (age range: 6.8–11.7 years; 52.6% boys) participated in the study. Processing speed, working memory and number sense were measured using computerized tasks from a web-based test battery: «Choice Reaction Time», «Corsi Tapping Block» and «Number Sense», respectively (Tosto et al., 2013). Intelligence was measured using the Raven's Progressive Matrices. Academic achievement was indicated by annual grades in Math, Language and Science. Firstly, Spearman correlation coefficient was calculated to assess the association between all cognitive abilities and academic achievement in three disciplines. Secondly, the structure of the relationship was analyzed using structural equation modeling (OpenMX package).

The correlation analyses has two main findings: 1) there were no direct association between speed processing and academic achievement in Math, Language and Science ($p > .05$), and 2) the strongest correlations were observed between intelligence and academic achievement ($.43 < r < .47$). Testing between structural equation models has shown that the model with an indirect effect of processing speed through intelligence, working memory and number sense on general school achievement has good fit indices (RMSEA $\leq .06$; CFI $> .95$; TLI $> .90$). The analyzed cognitive abilities explained 35% of the total variance of academic achievement. Intelligence has a large direct effect on general school achievement ($\beta = .52$).

The aim of this study was to test different models that explain the relationship between cognitive abilities and academic achievement at primary school age. The model which fits good to the data assumes that information processing speed as an elementary cognitive ability influences higher-order abilities, such as intelligence, working memory and number sense, which predict school achievement. The results are consistent with the previous studies on a sample of high school students (Rinderman, Neubauer, 2004). It was shown that intelligence is the «central core» in the relationship of cognitive performance and school achievement. The speed processing is considered as an important basis of individual differences in other cognitive abilities.

Intelligence is Negatively Related to Paranormal, Pseudoscientific, Conspiracist, and Dualistic Beliefs[*]

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Different kinds of beliefs, like paranormal, pseudoscientific, conspiracist, and dualistic ones are epistemically questionable: They all assume existence of supernatural phenomena at odds with scientific knowledge. At the same, such kinds of beliefs are held by a substantial part of the population. Some studies suggested that holding such irrational beliefs is related to intelligence, whereas others claimed that individual rationality is a different factor than cognitive ability. However, no study examined their relationship comprehensively.

Using six adapted questionnaires, we sampled 285 Polish participants on a wide range of pseudoscientific, paranormal, conspiracist, and dualistic beliefs (for the first time, such a wide battery was used). Three fluid intelligence tests: matrix reasoning, figural analogies, and paper folding, served for calculation of the fluid intelligence factor. Using confirmatory factor analysis, we modeled the data.

The model which assumed one factor encompassing all epistemologically questionable beliefs (the irrational mindset) fitted data perfectly. Crucially, we found a moderate negative relationship ($r = -.45$) between this mindset factor and the fluid intelligence factor. Thus, our data suggest that intelligence and rationality are related, and, not surprisingly, intelligent people are less prone to hold epistemically questionable beliefs.

These novel results suggest that people who tend to hold one type of irrational beliefs are very likely to hold other types of such beliefs. Moreover, in contrast to some highly popular views assuming that intelligence and rationality are unrelated («intelligence is computational power, but rationality is wisdom how to use that power»), our data suggested a moderate link between the two constructs.

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[*] Presentation is eligible for a Student Award.

Implications for Choosing an Incorrect Hierarchical Model of Intelligence

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Higher-order (HO) hierarchical models of intelligence have been most common and posit that a higher-order general factor affects measured variables (e.g., subtests or other outcomes) primarily indirectly, via multiple broad abilities; several current theories of intelligence conform to this view. Bifactor (BF) hierarchical models posit that both a general factor and a broad ability directly affect each measured variable directly; proponents argue that this type of model provides a better representation of the structure of intelligence than does a HO model. Here, we explore the consequences of using each model when it is incorrect. In particular, we wondered whether interpretations were more or less incorrect for one type of model when it was not the correct model.

The research used simulated data. For each model, covariance matrices were simulated to conform to both a HO and a corresponding BF model. The fit and the effects (factor loadings, direct, indirect, and total effects) were then compared when those matrices were analyzed via each approach. Comparisons included complex CFA models with cross-loadings and correlated errors, and SEM models in which cognitive abilities affected important outcomes (academic achievement areas).

The research is still in progress. Preliminary analyses show that the consequences of choosing the incorrect intelligence model differ for the two types of models (BF versus HO). The nature of differences depended on the particular analysis model, with CFA models and SEM models (cognitive abilities affecting different outcomes) showing different consequences. The ability of the higher-order model to examine both direct and indirect effects often mitigates errors in interpretation from that model, however.

Researchers have debated the efficacy of HO versus BF models of intelligence based on theory, logic, and model fit criteria. Here we started with the assumption that «all models are wrong» (Box, 1987, p. 424), but that some models are more wrong than others. Although this research is agnostic as to whether the HO model or the BF model better represents the structure of intelligence, it was designed to determine which model would produce more misleading interpretations if the researcher chose the wrong model. Findings suggest that the models do have different implications, and can produce differentially misleading conclusions.

The Emotional Language Stimulus Effect on Cognitive Tasks Performance[*]

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Most scientists who study intelligence agree that it is something more than just academic knowledge or the ability to perform particular tasks. Intelligence reflects a deeper ability to understand the outside world and the essence of things. Furthermore, there is a kind of intelligence called emotional (EI), which relates to the ability to identify your own emotions and those of others. One of the main models of EI includes four components, among which there is one associated with the ability to perceive and interpret emotions. Provided that emotions can be expressed both nonverbally and verbally, a certain group of emotional words we have hypothesized that the cognitive processing of emotional words would have a special character. In addition, we are in studying gender differences of this aspect.

This hypothesis was based on the series of experimental studies which have been carried out using the program E-Prime 2.0. Different types of emotional words were used as stimuli: nouns with diminutive suffixes with negative evaluation, stylistically marked verbs with negative connotation and emotional adjectives with diminutive suffixes. These stimuli were introduced in different kind of tasks: categorization, lexical decision and reading comprehension. The correlation of factors, the effect of which was reviewed regarding the dependent variable (reaction time) – 2×2×2. The first independent variable was the degree of emotionality of the stimulus, the second – sex of a subject, the third variable varied depending on a type of a particular experiment.

The analysis showed the statistical significance in all the experiments. It turned out that the factor of emotionality had a significant influence on cognitive processing. Statistical difference in reaction rate between men and women hasn`t been identified. However, the analysis of the interaction between the emotionality factor and the third variable that was varied in each experiment showed statistically significant difference between men and women. For example, the rate of factors interaction between emotionality and sex of subject of a sentence turned out to be statistically significant when a referent in the sentence was female ($p=0{,}02327$).

Thus, we can see that the factor of emotionality really affects the stimuli processing speed of men and women. In other words, the quality of our perception really depends on the type of stimulus. Despite the fact that there were no differences between men and women for the factor of emotionality, it is possible to observe features in the perception of these units when we put them in a social context. The results of the interaction of this factor with the third variable show that there are also important social factors in perception which can be considered for effective communication. Thus, this type of research can reveal the mutual influence of emotional intelligence and model social factors.

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Neural Correlates of Spatial Working Memory.
The Encoding Specificity of Cardinal and Oblique Orientations

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The analysis of neurophysiological mechanisms of cardinal and oblique lines identification points out that the prefrontal cortex areas (especially dorsolateral and ventrolateral ones) take part in that process. High orientation sensitivity of these areas is assumed to be connected with the necessity of using the external spatial coordinates in the operations of spatial working memory. Even in the absence of working memory-dependent tasks, the information about the spatial coordinates is considered involuntary. In order to prove this assumption the experiments with the short-term visuo-spatial memory model were conducted. The purpose was to identify the features of encoding and retrieval of the information about cardinal and oblique line orientations in the working memory.

There were two parts in the experiment design. The first one involved the simple observation of stimuli. The second one involved the presentation of stimuli pairs: standard and test ones. 40 subjects (20 males and 21 females) were asked to identify whether these stimuli were identical or not. The stimuli were square-wave grating patches of three orientations (180°, 90° and 45°). The 128-channel recording of ERPs was performed. The ERPs' amplitudes were measured in the electrode clusters, corresponding to the occipital parietal, temporal, central and frontal cortex areas. ANOVA RM with Task, Orientation, Area, Gender factors was performed. Dipole sources with the use of the weighted Minimum Norm Estimates method were also modeled.

The reaction time (RT) was significantly higher when standard and test stimuli did not match. The higher RT was obtained on the «horizontal» and «45°» standard stimuli than on the «vertical» ones. The increase of the RT in case of mismatch was significantly higher in males. The higher amplitude of the early P100 and N150 ERP components and the broader source localization area were obtained in the visual cortex areas. On the late stages of processing the decrease of P200 component amplitude and the increase of following negativity (after 300 ms) were found, especially in the temporal cortex. Also, the increase of late positivity (after 300 ms) was observed at the frontal cortex. The dipole sources had predominance in the occipital area in females and in the temporal area in males.

To conclude, the working memory task influenced either on the sensory stage of the information processing, or on the later stages of the analysis, which are connected with the stimuli maintenance and retrieval. Several features of these processes were obtained for the cardinal and oblique line orientations. Gender differences were also found.

The Role of Working Memory in Different Aspects of Mathematical Ability

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Maths performance is considered to be an important aspect of academic achievement, and maths ability is included as a component in measures of intelligence (e.g., Gustafsson, 1984). Previous research has identified a number of cognitive processes that contribute to individual differences in maths ability. One of the most investigated constructs is that of working memory (WM). Working Memory has shown to be a good predictor of numeracy (Alloway & Alloway, 2010) and maths skills (Alloway & Passolunghi, 2011), even when controlling for IQ.

For the purposes of this study, we further investigated the relationship between working memory and maths, as a function of task difficulty and controlling for maths performance as indicated by previous maths exam scores.

The total sample was 99 individuals, ranging in age from 17 to 26. Working memory was assessed with the Corsi Block test. The participants were shown grey boxes that turned yellow in a particular sequence, and the participant was instructed to reproduce the sequence. Maths ability was measured with a simple Problem Verification Task (PVT) and a more complex Number Series Task (NS). PVT is a set of maths equations where participants respond whether or not equation is correct or incorrect as quickly as possible. NS is a number sequence with a pattern of certain rules. The participant is to identify a given rule, and choose their response based on that rule as fast as they can. Throughout analysis, we controlled for the result of the maths exam score as an indicator of maths performance.

We observed positive correlation between NS and PVT even after controlling for the exam score (r= .42, p< .001). The correlation between NS and PVT was expected because both of these tests measure mathematical abilities. WM correlated positively only with the result of NS, not with PVT after controlling for the exam score (r= .29, p< .05). These results are parallel with previous studies suggesting that WM is connected to maths abilities. The results suggest that NS involve some processes, correlated with working memory, independent from those required for other mathematical tasks, WM may be particularly taxed in complex mathematical reasoning, when students need to remember a sequence of objects and relate them to one another.

Previous researchers postulated the role of WM in intellectual performance. Present research is focused on the connection of WM with maths abilities with control of maths performance. The different role of WM in PVT and NS may be a factor contributing to individual differences in maths performance. When a student struggles with complex mathematical tasks involving logic, it could be because of the WM problems. Understanding of the connection between WM and mathematics may be helpful for creating the educational programs and special training. Also, increasing WM may lead to improvement in complex maths reasoning.

Uncovering a Complex Interplay Between Intelligence and Time Perspective: Mediating Role of Stress[*]

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In the study we examine the complex relationships between time perspective (the characteristic way in which an individual partitions the flow of personal experiences into time-bound categories) and cognitive ability. Additionally, we consider cognitive, emotional and motivational mediators of this association measured before and after the completion of the intelligence test. More specifically, the study explored the potential mediating role of three test-related stress states in the relationship between fluid intelligence and time perspective before and after the completion of the intelligence test.

A total of 306 subjects took part in the study. Time perspective was assessed with the Zimbardo Time Perspective Inventory. Fluid intelligence was measured with Raven's Advanced Progressive Matrices Test. Stress states related to cognitive performance were measured with the Dundee Stress State Questionnaire. It measures three factors: task engagement, distress and worry, and was administered twice: just before and immediately after Raven's test.

Past Negative was positively correlated with the pre- and post-levels of distress and worry; high Present Fatalistic individuals showed lower post-task engagement and stronger post-task worry. Additionally, participants more focused on Past Positive perspective exhibited lower distress after completing the task. Individuals scoring high on Present Hedonistic had a tendency to worry before the task. Future-oriented people tended to score higher on post-task engagement. The Deviation from Balanced Time Perspective was negatively correlated with engagement (pre- and post-task), and positively correlated with distress (both measurements) as well as with worry (only post-task). These results indicate that greater distance from balanced perspective leads to higher stress during cognitive testing.

The study revealed that Present Fatalism and Past Negative perspectives were associated with higher stress related to intelligence-test performance, while Balanced time perspective reduced this stress. These results suggest that the stress accompanying individuals with high Past Negative, high Present Fatalistic and poorly balanced TPs was partially a response to the test performance. The obtained results suggest that TP may play a significant role in acquiring abilities (crystallized intelligence), but also that it probably influences test performance.

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[*] Presentation is eligible for a Student Award.

Is General Intelligence Not That General?
Evidence From SPMT and Conceptual Abilities Tests[*]

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In most discussions about intelligence, most scholars usually focus on the «g» factor measured by J. Raven's «Standard Progressive Matrices» test (SPMT) or other widely spread psychometric tool. However, the construct of «g» factor was originally based on testology paradigm which focused more on the design of intelligence tests rather than explaining the essence of mental abilities and underlying mechanisms. Tests of conceptual abilities, designed within a more contemporary theoretical framework, might be an alternative measurement of intellectual efficiency (Kholodnaya, Volkova, 2016). We aimed to test whether there was any correlation between the scores for conceptual abilities tests and the scores for SPMT as one of the most popular methods for measuring «g» factor.

Participants (N=95, aged 17–49) answered the tasks of SPMT. For assessing conceptual abilities, we used 2 tasks: «Generalization of Three Words» (GW) and «Concept Synthesis» (CS) (Kholodnaya, 2012). GW test measures the ability for categorical generalization of concepts. The task was to elicit the common feature of 3 words from different semantic fields and describe it in 1 or 2 words. There were 10 word triads, answers were rated 0, 1 or 2. CS test measures the ability to devise a set of semantic contexts based on 3 words from remote semantic domains. The task was to elicit semantic links between these words and to write them down in 1 or 2 sentences using all 3 words. There were 4 word triads, answers were scored 0, 1, 2 or 3.

For the statistical analysis we used the following variables. The sum of the scores obtained in all 10 triads was used as the variable for GW test. As a variable for CS test, we used the sum of the scores for all the triads divided by the number of the sentences produced. We used Spearman's rho to test the hypothesis about correlation between scores for SPMT, GW and CS. The correlation with p value less than 0.05 (after applying Bonferroni correction) was found only in 1 out of 3 pairs of variables – SPMT and CS (rho = 0.356, rho2 = 0.127, $p < 0.003$).

The obtained results do not reveal any strong correlation between the scores for SPMT and the scores for conceptual abilities tests. Interestingly, the current results agree with that of our previous studies: the lack of correlation between various «ecological» cognitive tasks solving and SPMT scores, but rather some correlations between «ecological» cognitive tasks solving and scores for conceptual abilities were found (Makarova, Shcherbakova, 2015; Nikiforova, Shcherbakova, 2016, in print). We interpret this as evidence of essential differences in cognitive mechanisms underlying solving SPMT, GW and CS (although the correlation between SPMT and CS scores was relatively low). However, the relationship between «g» factor and conceptual abilities remains a matter of debate.

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[*] Presentation is eligible for a Student Award.

Time to be Smart – Associations Between Intelligence and Time Perspective[*]

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Both intelligence and time perspective have been shown to correlate with a variety of psychological variables, such as health, delay of gratification, aggression, educational outcomes, and job performance. These similarities prompt the question of whether and how these seemingly distinct constructs are related. In the present studies we examine the relationships between time perspective (the characteristic way in which an individual partitions the flow of personal experiences into time-bound categories) and various aspects of intelligence (e.g., fluid, verbal, general). Moreover, subjectively assessed intelligence as a mediating variable has been assessed.

A total of 238 subjects took part in the study. Time perspective was assessed with the Zimbardo Time Perspective Inventory. Fluid intelligence was measured with Raven's Advanced Progressive Matrices Test. Verbal intelligence was assessed with a test of verbal comprehension designed to measure crystallized abilities. In this test, participants are asked to find a synonym for a target word among four different words. Subjectively assessed intelligence was assessed by having participants first read the general characteristic of intelligence taken from a public statement known as «Mainstream Science on Intelligence» issued by a group of 52 academic researchers in fields associated with intelligence. Next, participants assessed their own intelligence using a table with one row and 25 columns.

Past Negative and Present Fatalistic perspectives correlated negatively with fluid and verbal intelligences. Present Hedonism was negatively, and Future time perspective positively, associated with verbal intelligence. Subjectively assessed intelligence mediated the relationship between Present Fatalism and intelligence. Furthermore, the results revealed that subjectively assessed intelligence partially mediated the relationship between Present Fatalism and intelligence. Finally, Balanced time perspective positively correlated with fluid intelligence.

The current study has revealed that time perspectives are associated with various aspects of intellectual abilities. Time perspectives can be analyzed both as a process emerging from intellectual abilities, as well as a set of dispositions that allow individuals to effectively regulate their own psychological states (e.g., levels of stress, motivation) in order to optimize their cognitive performance. Thus, the aim of the present study was to empirically analyze associations between time perspectives and intelligence, as well as to provide some insight into mechanism of these relationships. Such analyses allow to better understand the nature of intelligence by broadening its nomological network and to identify some novel mechanisms influencing the effectiveness of cognitive processing.

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[*] Presentation is eligible for a Student Award.

Relationships Between Cognitive Abilities and Academic Achievement at High School Age[*]

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A number of studies have reported the relationships among different cognitive abilities and academic achievement across the school years (Rindermann et al., 2004; Deary et al., 2007; Rohde et al., 2007). It has been shown that intelligence is one of the most important factors of individual differences in school achievement. At the same time, previous studies revealed that academic achievement is largely related to cognitive abilities such as processing speed, working memory and number sense. Moreover, the cognitive processes are susceptible to age-related changes and have unique developmental trajectories at school age. The current study focuses on the analyses of the relationships among processing speed, working memory, number sense, intelligence and school achievement at high school age.

The sample includes 330 high school students recruited from Russian public schools (age range: 15.3–18.8 years, 37.4% males). To assess intelligence we used the Raven's Progressive Matrices (RPM). Information processing speed, working memory and number sense were measured using computerized tasks respectively «Choice Reaction Time», «Corsi Tapping Block», «Number Sense» from «Mathematics-number sense» web-based test battery (Tosto et al., 2013). For the measurement of school achievement we collected the final-year grades in Math, Language and Science. First, correlations between all cognitive abilities and school achievement in three subject areas were calculated. Second, structural equation models by means of the OpenMx package for R environment were tested.

We found weak correlations only for school achievement in Language with intelligence (r = 0.18, p < 0.05) and working memory (r = 0.14, p < 0.05). There are no direct correlations between processing speed and school achievement. Testing between structural equation models has shown that the model with an indirect effect of processing speed through intelligence, working memory and number sense on general school achievement has good fit indices (RMSEA ≤ 0.06; CFI > 0.95; TLI > 0.90). At the same time, there are no significant relationship between cognitive abilities and academic achievement (p > 0.05). The previous studies show higher correlations between cognitive processes and school grades in the normal sample than in the above-average sample (e.g., Rindermann et al., 2004).

The aim of this research was to test the different models that explain the relationship between cognitive abilities and academic achievement at high school age. The model assumes that information processing speed as an elementary cognitive ability influences higher-order abilities, such as intelligence, working memory and number sense, which predict school achievement. At the same time, we did not find any significant relationship between cognitive abilities and academic achievement. Thus, the model constructed on a sample of high school students is divided in two parts: cognitive performance and academic achievement. This finding might be explained by the fact that only more successful pupils continue their further learning in high school.

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[*] Presentation is eligible for a Student Award.

Testing the Testosterone Transmission Hypothesis:
An Investigation of Twin Performance On Spatial Ability Tasks

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Spatial ability is conceptualized to be a part of general cognitive ability (g). Males usually outperform females about one standard deviation above the mean on mental rotation tasks. According to the prenatal testosterone transmission hypothesis females with a male co-twin perform significantly better than females with a female co-twin on mental rotation tasks. This is believed to be the result of in-uterine transmission of testosterone occurring when females share the womb with a brother. Literature to support this hypothesis has been scarce. The effects of the testosterone transmission on a wider range of spatial skills remain to be addressed. The proposed poster presentation aims to offer a more fine-grain address of the testosterone transmission effects.

A sub-sample from the Twins Early Development Study (TEDS) was utilized. The total N was ~1,000 twins. TEDS is a well-established UK longitudinal twin registry that includes all twins born in England and Wales between 1994 to 1996. Participants age ranged between 19 and 21, the mean age was 20.4. The materials used are 6 tests of rotation and visualization (all in 2- and 3-dimensional), and 10 tests addressing a range of other aspects of spatial ability: paper folding, pattern assembly, cross sections, perspective taking, mazes, 2D drawings, 3D drawings, elithorn mazes, mechanical reasoning and shape rotation. The analyses involved ANOVAs and correlations.

The study found that overall males outperform females in all tests. No significant differences were found in the performance of same-sex males across zygosities. The same patterns of results were found for same-sex females with no differences across zygosities. The study has found support for the testosterone transmission hypothesis in one test only. In the 2D mental rotation task females with the opposite sex twin significantly outperformed females with a female co-twin.

Given the obtained results – a significant difference in the 2D mental rotation performance, the study concluded that there is a contradiction to the two previous papers in the field. Previous literature found differences in the 3D mental rotation. Previous literature did not test 2D mental rotation and used different measurement instruments for addressing the 3-dimensional aspects. With regards to future directions this study suggests that mental rotation could be a separate component of cognitive ability; and that the testosterone transmission hypothesis is valid on this cognitive ability only.

Validity Evidence of the Comprehensive Test of Nonverbal Intelligence-Second Edition (CTONI-2)

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There has been an increase in the ethnic/cultural diversity in the word. For example, in the United States in the twentieth century the Hispanic population has more than doubled since 1980, and since 1990 the population of non-white and non-black races has increased from 7.7% of the population to 12.5%. Such diversity has lead some to claim that traditional tests of cognitive ability do not provide an accurate assessment because of their heavy reliance on language. Therefore the use of nonverbal measures of intelligence has become increasingly important and prevalent.

The Comprehensive Test of Nonverbal Intelligence (CTONI) has been a popular nonverbal measure of intelligence for children and adults, designed to measure multiple aspects of fluid reasoning in different contexts.

There were 197 participants in this study. They were selected from a general psychology classes in a private, Midwestern university. The participants were recruited from a general education component of the university, and represented a relatively wide cross-section of academic majors. Participants were given the CTONI-2, Reynolds Intellectual Assessment Scales (RIAS), Shipley Institutes of Living Scales-Second Edition, Wide Range Achievement Test-Third Edition (WRAT-3), and an IPIP personality test measuring aspects of the five-factor model of personality.

The factor analysis showed that the items within a subtests were likely measuring a single construct, and that all six of the subtests were measuring a single latent variable. The Rasch analysis showed there were more items at the lower end of the ability spectrum than at the higher end, as the majority of the difficulties were negative. The Rasch-based test information curves showed that there were most precise for the students who were below average.

The pattern of the correlations was as expected. The CTONI-2 had the strongest correlation with the Shipley Block Pattern test (.70), and moderate positive correlations with other measures of intelligence: Shipley Vocabulary test (.50) and RIAS .61). It had low positive correlations with the WRAT-3 tests of academic achievement (range: .2)

This study is one of few studies done to date on the validity of the CTONI-2's scores, despite is being published for over 6 years. The results showed that the subtest scores appear to be one-dimensional and that the subtests appear to measure a single construct that is related to other measures of intelligence, moderately related to measures of academic achievement, and minimally related to measures of personality. Nonetheless, caution should be used in interpreting the scores, especially with high-ability adults, as the majority of the test's items appear to be most appropriate for respondents with average or lower cognitive ability.

Group Intelligence on Russian Far East[*]

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More and more knowledge is accumulated relatively higher human cognitive function. Recent neuroscience research in this area give more and more information about the individual human mental activity. Developing an image of the main resource – information – is impossible without a coordinated intellectual activity not only of individuals but of entire corporations. Lynn R. and T. Vanhanen in his work «Intelligence: an unifying construct for social sciences» (2012)- and, as the authors, the level of the group IQ say explains a significant part of group differences in the economy, the national income level, health, education, etc. The above facts clearly show that in our time the question of intelligence, its variability determinants is more relevant than ever.

13 children 8–14 years, v. Sobolinoye, Primorsky Krai, school, Russian;

28 children 7–14 years, v. Krasny Yar, Primorsky Krai, school, Nanai, Udege;

119 children 14–18 years of Vladivostok, school, Russian;

35 children 15–34 years, Magadan, pupils and students, Chukchi, Even, Koryak;

51 children 17–21 years, Magadan, students, Russian;

86 children 10–13 years, Magadan, schoolchildren, Russian;

958 children 7–17 years, Tomsk, school, Russian;

273 children 16 years, Birobidzhan, school, Russian;

374 children 8–18 years, Yakutsk, school and university, the Yakuts;

58 children 9–16 years, Yakutsk, school, Russian;

11 children 9–18 years, Yakutsk, school and university, Evens and Evenki.

257 children 8–15 years of Vilyuysk, university, Yakuts.

Total sample consisted of 2277 subjects.

On the basis of the provisions of the two-factor theory of intelligence Charles Spearman, autocatalytic intellectual growth of R. Lynn, genetic similarity theory F. Rushton, as well as the theory of co-evolution E. Wilson and C. Lumsden, we can formulate the following provisions of the hypothesis of this study: IQ Caucasoid colonists will be close to the average IQ of Caucasians in the Central part of Russia, but it will significantly exceed last (like IQ colonists), IQ indigenous peoples will be similar to that measured IQ of Arctic peoples in other countries (USA and Canada) IQ Yakutia (Sakha) will close to the average IQ of East Asian cluster (Japanese, Korean, Chinese)

This research – is the first research of IQ of peoples on Russian Far East since Bulanov's and Luris's researchs in 1920–30's. Some samples, like Yakuts had never been tested.

In this research using the Standard Progressive Matrices + (Raven) as non-verbal cross-cultural test with wide basis of validation.

Relating Emotion Perception Ability to Non-Verbal Intelligence and Big Five Personality Traits

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Two distinct constructs, ability EI and trait EI have been suggested, and mixed models proposed, which posit EI as a combination of intellect and various measures of personality and affect, claiming that both ability EI and trait EI are correlated with general intelligence and personality measures. However, empirical findings have not been consistent across different EI components. Particularly, some studies fail to confirm the hypothesis that conscientiousness is positively correlated with emotion perception ability. The current study aims to investigate the relationship among emotion perception ability, Big Five personality traits and non-verbal intelligence.

140 participants (72 females; mean age = 29.5 years and SD = 11.1) completed the Ekman 60 Faces Test online, where they were asked to identify the emotions from 60 static facial expressions. Six performance scores (up to 10) corresponding to the six basic emotions (i.e. happiness, sadness, surprise, fear, disgust and anger) as well as a total score (up to 60) were generated. They also participated in an adaptive version of Raven's Progressive Matrices test (maximum 5 questions; theta scores range from -1.1 to 1.2 with a mean SEM of 0.77) and a 20-item Big-Five personality questionnaire (resulting in five standardised trait scores). R package psych and ppcor were employed to conduct exploratory factor analysis and partial correlation analysis, respectively.

Results of exploratory factor analysis forcing six factors revealed a clear structure of five personality traits and one ability factor formed by the emotion perception indicators and the non-verbal intelligence measure, indicating the cognitive ability component in emotion perception. Negative, positive (i.e. happiness) and neutral (i.e. surprise) emotion perception abilities showed no correlation with any personality trait. However, when intelligence score was corrected for, partial correlation found marginally significant (p = .05) correlation between negative emotion perception ability and trait conscientiousness. Multiple regression also displayed significant prediction of negative emotion perception ability from non-verbal intelligence and conscientiousness.

The current study provides further evidence to the mixed model of emotional intelligence. It not only reveals the cognitive ability component in emotion perception, but also discovers its (partial) correlation with trait conscientiousness, when intelligence is corrected for. The results only hold for negative emotions, with two possible explanations: Ceiling effect is present with ability measures, and negative emotions are the most difficult, hence least influenced; Alternatively, it is likely that different neural mechanisms are established in emotion perception, thus, different emotions should be studied separately. Lastly, this study argues for a holistic view when constructs assessed by self-report measures and performance-based ability tests are under investigation simultaneously.

Relationships Between Big Five Personality Traits and Nonverbal Intelligence in High School Students

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Three of the five main dimensions of personality – Openness (Heaven et al., 2012), Neuroticism (Zeidner, 1995) and Extraversion (Ackerman et al., 1997; Lynn, et al., 1984) have been found to be associated with nonverbal intelligence. Two other factors, Consciensiousness and Agreeableness, as a rule, show no association (Furnham et al, 2005) or weak association with nonverbal intelligence (Kyllonen, 1997). At the same time, a number of studies identified age-related features of personal traits and nonverbal intelligence, which may moderate the relationship between personality traits and intelligence at school age The aim of the study was to analyze the relationship of Big Five personality traits and nonverbal intelligence on an extended sample of high school students.

The study involved 504 high school students – 254 female (50.4%) and 250 male (49.6%) students aged between 14 and 18 years (median = 15.5, SD = 1.1). To assess nonverbal intelligence Raven's Standard Progressive Matrices test was used. Personality traits were assessed with the Russian version of the questionnaire NEO-PI-R standardized on the Russian population.

Cronbach's alpha coefficients reached satisfactory values for all parameters (from 0.75 to 0.86). The correlation analysis showed that only Openness was associated with nonverbal intelligence. In particular, Openness correlated with successful performance in B series (r = 0.23, p<0.05) aimed at the ability to find analogies, and with E series assessing the ability for analysis and synthesis (r = 0.27, p<0.05). The total score on nonverbal intelligence moderately correlated with Openness (r = 0.27, p<0.05).

A possible explanation for these results might be provided by the investment theory, which assumes that personality traits can «promote» the formation of individual differences in intelligence (in Russian: Malykh, Tikhomirova, 2015; Gow, Whiteman, Pattie, Deary, 2005; Ackerman & Heggestad, 1997). The study showed that the structure of the relationship of Big Five personality traits and nonverbal intelligence at high school age in general is different from the relationship of these psychological constructs in adults. However, the direction of the causal relations in a dyad «Personality – Intelligence» can only be empirically verified in a longitudinal study.

Does the Relationship Between Symbolic and Non-Symbolic Estimation Abilities Change During Math Training at School?

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Previous studies provided evidence that the ability to perceive quantity, known as number sense (Dehaene, 1997), may provide the basis for individual differences in mathematical achievement at school ages (Tosto et al., 2014). Comparisons of non-symbolic numerosities and approximation of numerical magnitudes on a number line are two well-established number sense tasks. These two specific numerical estimation abilities were not uniquely associated with mathematics. Number line estimation abilities are more sensitive to training during school education (e.g., Siegler & Mu, 2008). The current study focuses on the analyses of the relationships between symbolic and non-symbolic estimation abilities, and school achievement at primary school age.

The sample included 501 primary school students of grades from 1 to 4 (age range: 6.8–11.7 years; 50.1% boys). The students were enrolled from one public secondary school. Symbolic and non-symbolic estimation were measured using computerized tasks from a web-based test battery: «Number Line» and «Number Sense», respectively (Tosto et al., 2013). In the «Number Line» task participants see a line on the screen, with a number on top of the screen. The task requires to place along the line the number displayed. The «Number Sense» task requires to judge whether the array contains more yellow or blue dots by pressing the responding keys on the keyboard. Math achievement was indicated by annual grades. Correlation and multiple regression analysis were used.

Similar trends for the means of the «Number Line» and «Number Sense» scores were observed: from grade 1 to 4 the means increased. At the same time, variation of «Number line» estimation abilities narrowed more intensively. Spearman correlation coefficient was calculated to assess the association between (1) two specific numerical estimation abilities and (2) analyzed numerical abilities and Math achievement at each grade of primary school. It has been shown that the relationship between the two analyzed numerical estimation abilities weakened from grades 1 (r = − .43; p < .01) to 4 (r = − .20; p < .05). We found that «Number line» estimation abilities were more strongly associated with math achievement than «Number sense» abilities at each grade (e.g., .54 vs. .40 on grade 2).

The current study has shown that the relationship between symbolic and non-symbolic estimation abilities changes during math learning at primary school with a decrease in the strength of these relations from grades 1 to 4. We found that both symbolic and non-symbolic estimation abilities explained 31%, 15% and 10% of the total variance in math achievement at Grades 2, 3 and 4, respectively. These results might be explained by the influence of the specific content of math education at each grade of primary school on symbolic and non-symbolic estimation abilities.

The Interaction of Cognitive, Creative and Conceptual Abilities as a Characteristic of Intellectual Resource[*]

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In modern psychology a common view on the actual problem of the relation between intelligence, creativity and real intellectual achievements is not found yet (Raven 2002, Golovei 2003, Ushakov 2003, Druzhinin 2008, Kornilova 2010, Volkova 2011, Kholodnaya 2012, Hazova 2014). We solve this problem through the introduction of an integral concept «intellectual resource», which includes different forms of mental experience and appears as the interference effect of different abilities: cognitive, creative, conceptual, where the last abilities play a leading role and relate to real intellectual achievements, because they are responsible for the generation of new mental contents. Sensitive periods for the development of conceptual abilities are older adolescence and early adulthood.

Participants of the study were Russian students of secondary schools aged 14 to 16 years, n=120 (late adolescence) and Russian university students for the same indicators in age from 19 to 21 years, n=110 (early adulthood). As a measure of intelligence (cognitive ab.) we used Raven's Standard Progressive Matrixes (SPM); as a measure of creative abilities we used verbal and non-verbal indicators (Torrens' tests: «Unusual use» «Unfinished figures»); as a measure of conceptual abilities we used research indicators according to the procedures: «Generalization of the three words», «The conceptual synthesis» by Kholodnaya. We also used the rating of academic success, the intellectual status in the group and teachers' expert evaluation as indicators of real intellectual achievements.

Exp. factor analysis showed that there was a close relationship between the analytical intelligence (the detection oa patterns in visual material), non-verbal creativity (the creation of complex visual ideas) and conceptual abilities (the design of «impossible» connections between concepts) in two samples. In the student sample the number of significant relations between the abilities increased. Conf. factor analysis identified the following latent factors: intelligence, creativity, conceptual abilities, int. achievements and int. resource. Regression analysis of these factors showed that the conceptual abilities made the largest contribution to the prediction of real int. achievements ($\beta=0,47$; $p<0,01$) and are presented with the largest weight in the int. resource model ($\beta=0,69$; $p<0,01$).

In later adolescence and early adulthood close polling connections between cognitive, creative and conceptual abilities are indicators of intellectual resource, where conceptual abilities play the main role. This new fact allows us to speak about the transition to the description and explanation of an individual's intellectual capabilities in the framework of the concept of «intellectual resource». Intelligence and creativity are two particular interrelated aspects of this resource, which core is conceptual abilities and especially the ability to conceptualize what is happening (the ability to spawn objective mental content in the form of latent signs and relations, of implicit regularities, alternative contexts, interpretations, etc. «inside» the individual mental experience).

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[*] Presentation is eligible for a Student Award.

The Role of Genetic and Environmental Factors in Covariance of Personality Traits and Intelligence

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In recent years, behavior genetics approach to the analysis of the mechanisms underlying the association between personality traits and intelligence has proved to be effective for understanding these relationships. The first studies of this topic show that the covariance of personality traits and intelligence is explained by common additive genetic factors (Luciano M. et al, 2006; Pincombe J. et al, 2007; Wainwrihgt M. et al, 2008). The current study presents the preliminary results of the analysis of the role of genetic and environmental factors in the covariance of personality traits and intelligence on a twin sample.

The sample included 130 MZ and 190 DZ Russian twins (mean age 15.7 years, SD = 1.2 years).To assess nonverbal intelligence Raven's Standard Progressive Matrices test was used. Personality traits were assessed with the Russian version of the questionnaire NEO-PI-R standardized on the Russian population. First, we performed a univariate genetic analysis of personality traits and intelligence. Second, to assess the role of genetic and environmental factors in the covariance of personality traits and intelligence we ran a series of bivariate twin models (for every trait). Structural equation modeling was used to assess the models (Open Mx package).

The preliminary results have showed that 50% of phenotypic variance of intelligence is explained by common environment, 34% – by genetic factors and 16% – by non-shared environment. The phenotypic variance of Big Five personality traits is largely explained by non-shared environment (43–65%). The contribution of common environment was low (0–15%), except for Extraversion (35%). A different pattern was found for genetic factors explaining 40–56% of the variance of Extraversion.We obtained weak phenotypic relationships between intelligence and two personality traits – Openness (r = 0.17) and Agreeableness (r = 0.11). The covariation between intelligence and Big Five personality traits was explained mostly by genetic (24–63%) and shared environmental (31–38%, 65% for Openness) factors.

The current study investigates genetic and environmental aetiology of the relationships between intelligence and Big Five personality traits in Russian adolescents. We found small phenotypic correlations between Openness and Agreeableness and intelligence which are explained by additive genetic effects and shared environment. The current study is underpowered due to a relatively small sample size, therefore, we are planning to extend the sample for future research.

Speed of Information Processing and Math Achievement: Variation and Relationships Across School Years[*]

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The speed of information processing is one of the basic cognitive characteristics related to both complex cognitive functions (Sheppard & Vernon, 2008) and life outcomes (Deary et al., 2001). It has been shown that the speed of information processing correlates with mathematic achievement at school age as faster thinking contributes to more efficient problem solving. At the same time, the speed of information processing is largely susceptible to age-related changes at school age (Cerella & Hale, 1994). Moreover, the content of a subject area may change conceptually (e.g., mathematics that children study at grade 4 differs substantially from mathematics studied at grade 9). Thus, it is important to study the relationship between the speed of information processing and math achievement through the school years.

The sample included 1751 schoolchildren of grades from 1 to 11 (age range: 6.8–18.8 years; 895 males). The students were enrolled from public secondary schools. The speed of information processing was measured using computerized task «Choice Reaction Time» (Tosto et al., 2013). In this task numbers 1, 2, 3, 4 appear on the screen one at the time at a random interval between 1 and 3 sec. The task requires to press the corresponding keys (1, 2, 3, 4 of the key board) as fast as possible. Math achievement was indicated by annual grades.

First, the data were analyzed in terms of norms and distributions for each measure. Second, we investigated whether any differences exist in relationships between the speed of information processing and math achievement at primary, secondary and high school ages.

In this cross-section study we found that the speed of information processing tends to decrease from 1.16 seconds at the first year of school education (Grade 1) to 0.47 seconds at the final year (Grade 11) with narrowing of variation. Similar trends for the means of the annual grades in mathematics were found, but without the changes in variation. The speed of information processing showed statistically significant small correlation with math achievement in primary school ($r = -.09$; $p < .05$) but not in secondary or high school ($p > .05$).

In the current study we found no substantial relationships between the speed of information processing and mathematical performance across the school years. We suggest that the individual differences in math achievement might be associated directly or indirectly with the different cognitive processes, especially at secondary and high school age. According to the previous studies, the speed of information processing is regarded as an elementary cognitive process underlying higher-order cognitive abilities, which predict academic achievement (Rinderman, Neubauer, 2004). Our further research will focus on the analysis of elementary and higher-order cognitive processes using structural equation modeling.

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[*] Presentation is eligible for a Student Award.

Cognitive Control, Fluid Intelligence and Balanced Time Perspective[*]

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Numerous studies established that a balanced time perspective (BTP) is associated with many positive outcomes. It is defined as an ability to switch between perspectives according to the situational demands. In the present study we examined the relationship between BTP, cognitive control and intelligence. We expected that there will be a positive association between fluid intelligence, balanced time perspective and cognitive control. Moreover, we expected also that the association between BTP and cognitive control will be mediated by fluid intelligence.

A total of 232 subjects participated in the study (122 female, 110 male). The mean age was 23.55 (SD=3.70) with a range of 18–39 years. Time perspective was assessed with the Zimbardo Time Perspective Inventory. Fluid intelligence was measured with Raven's Advanced Progressive Matrices and Culture Fair Intelligence Test. Cognitive control was measured by Antisaccade task and Go/no-go task.

Balanced time perspective was positively correlated witch fluid intelligence and cognitive control measures, which may mean that certain cognitive resources, are required to obtain balance in use of different time perspectives in a different life situations. Moreover, fluid intelligence mediated the relationship between BTP and cognitive control. These results confirm our hypothesis and show that BTP indeed has a common adaptive meaning with fluid intelligence and cognitive control.

The aim of the present study was to empirically analyze associations between adaptive meaning of BTP and its relation with fluid intelligence and cognitive control, as well as to provide some insights into mechanism of these relationships. The obtained results suggest that fluid intelligence and cognitive control may play together a significant role in development of flexible switching between different time perspectives.

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[*] Presentation is eligible for a Student Award.

Effects of WISC-V Composites on Academic Achievement: A Comparison of SEM and Multiple Regression Approaches in the New WISC-V and WIAT-III*

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Standardized cognitive and achievement batteries are used to determine appropriate academic placement and interventions. The majority of studies investigating the relation between cognitive test scores and academic achievement have analyzed data from the Woodcock-Johnson tests, and more research is needed examining other tests. At the 2015 ISIR conference, Caemmerer et al. reported the relations of youths' WISC-V CHC broad abilities on their achievement skills. The current study will expand this research by examining the WISC-V composites, which are part of the scoring structure created by the test publishers, and their relations with achievement skills. Multiple analytical approaches allow for a comparison of these relations and an examination of the predictive validity of the composites.

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.

Multiple regression analysis will be used to examine the possible effects of the five composite scores measured by 16 WISC-V subtests (Verbal Comprehension, Fluid Reasoning, Visual-Spatial Reasoning, Processing Speed, and Working Memory) on students' reading, math, and writing performance (measured by 14 WIAT-III subtests).

The results of the regression analysis will be compared to those found in structural equation models, with special attention to some of the more surprising findings from the Caemmerer et al. study. In particular, the effects of the processing speed, verbal comprehension, and visual spatial reasoning index scores on various academic skills, based on regression analyses, will be compared to the SEM analysis of the associated CHC abilities.

This study will contribute to the small proportion of the cognitive-achievement literature based on tests other than the WJ. Our findings have implications for evaluating the predictive validity of the WISC-V and understanding how youths' cognitive abilities relate to academic achievement. Previous research has studied tests of cognitive abilities using either multiple regression models or structural equation models, but few have made direct comparisons. A comparison of the results from structural equation modeling and multiple regressions will provide evidence of the consistency or inconsistency in findings across the methods. Furthermore, multiple approaches to analysis provide insight into how the cognitive abilities relate to each achievement area, both theoretically and in practice.

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* Presentation is eligible for a Student Award.

Brain Correlates of Math Task Expectation in Participants with High and Low Math Anxiety[*]

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The brain mechanisms involved in math anxiety (MA) are actively investigated (Artemenko et al., 2015; Suárez-Pellicioni et al., 2016).

The present study focuses on the brain correlates of math anxiety during the expectation of math tasks. We measured the area under the curve for P3b ERP component in high and low math anxious participants exposed to the cues before arithmetic, algebraic and lexical error-recognition task. We've expected that the P3b component will be higher for participants with high level of math anxiety in comparison with participants with low level of math anxiety due to the increased need in cognitive resourses.

The study included 90 healthy volunteers 17–30 years old. Levels of math anxiety was measured with Russian adaptation of sMARS test. EEG was recorded using 64 channels (63 EEG + VEOG) digitized at 500 Hz (Brain Products, Gmbh). The EEG electrodes were placed according to 10–10 system with referrence at Cz. Electrodes impedance was maintained below 25 kΩ. Participants were to judge whether one of the presented algebraic, arithmetic and lexic tasks contains an error (210 tasks, 70 of each type). Every trial was preceded with a cue that signals what type of task will be presented. Cue was presented for 500 ms. The pause between cue and the task was 2000 ms. We measured correlation between levels of MA and area of P3b component elicited by cue presentaton for every electrode.

Algebraic task elicited a late positive component (P3b) which was more enhanced and delayed in the HMA group, then in LMA.

Correlation was significant for right frontotemporal electrode sites (F8, FT8, FT10, r = [-0.28; -0.35], p = [0.035; 0.045] and for right and left temporal electrode (TP9, TP10, r=[-0.51; -0.55], p = [0.34; 0.38] sites for arithmetic and algebraic, but not lexical cues. While we consider TP9 and TP10 activation to be the result of artifactual activity due to increased muscular tension, the activity in right frontotemporal area is associated with true brain activity.

We found individual difference in brain correlates of math task expectation for people with high and low levels of math anxiety. Contrary to our hypothesis, higher MA was negatively correlated with P3b component elicited by cue presentaton. Results are discussed according to attention-control theory of anxiety (Eysenck, Derakshan, Santos, & Calvo, 2007;), «Chocking Under Pressure» theory (Beilock & Carr, 2005) and Deficient Inhibition Mechanism theories (DIM; Hopko, Ashcraft, Gute, Ruggiero, & Lewis, 1998) of math anxiety.

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[*] Presentation is eligible for a Student Award.

Soft Skills and Emotional Intelligence Assessment: Schools and University Networking*

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1. In 2010, Russian government established the new standards of education. There is a need to develop not only academic knowledge (hard skills) of graduate students, but also emotional intelligence (soft skills).

Universities need to get students with high level of hard skills and soft skills. However, universities have a problem connected with high schools education. Most of the high schools cannot develop both skills. To solve problem Tomsk State University (TSU) is implementing the program of networking with 70 high schools of the Tomsk region. In the networking with schools, university has a goal to develop hard and soft skills for high school graduate student. During the realization of program, university found the task of measurement the level of soft skills that is very difficult task.

2. To answer these questions theoretical analysis was made on international literature, and practices. The study was based on practices of measuring soft skills in the Plymouth School District, Catalina foothills school district, New technology high school, USA and researchers of David McKenzie a Lead Economist in the Development Research Group. Emotional intelligence review based on research of Goleman, Mayer, Caruso, Salovey.

TSU research group listed the main soft skills and created the list and the map of soft skills assessment. Measurement based on the group exercise, observation and essay. The group discussion centered on the problem situation, they have to resolve. The group of sociologists evaluated each candidate on the list of soft skill categories during group discussion.

3. Results and conclusions: As a research result students' level of soft skills development identified at different types of high schools. The average level of soft skills development measured of high school students (10 and 11 grades) in the Tomsk region. Researchers reached conclusions about the requirements for soft skills development, and these requirements were included in the rules of enrolment rules for new students in 2016. Researchers also listed soft skills, which not enough developed among 10s grades schools students, relying focusing on this list, university group developed new types and forms activities for 2016-2017 academic year for networking with schools to develop these soft skills.

This study is innovative for Tomsk State University, because research of soft skills and emotional intelligence in Russia is just beginning. The lack of known practices for measuring and developing soft skills leads to necessity of addressing to international experience. The purpose of reviewing measurements and development techniques is important to development measurement that appropriate for Russian society.

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* Presentation is eligible for a Student Award.

Evaluation of Early Childhood Development Programs: Effects on Cognitive and Socio-Emotional Development*

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Early childhood interventions (ECI) aim at maximizing physical, cognitive and social development of children. The effects of prosocial behavior on cognition and learning have been shown by interventions focused on developing social skills (e.g., Gauvain at. al, 2007). High-quality, intensive ECI programs have long-term outcomes on cognitive development, school achievement and completion for children from different economic backgrounds (e.g., Gorey at. al, 2011). Thus, it is important that every developmental program is evaluated using the proper diagnostic tools. This study aims at evaluating two of the developmental programs used in Russian kindergartens.

This pilot study followed 104 3–5 year old Russian children attending kindergarten in Tomsk at two waves across one academic year. Children were divided into four groups based on age and the program implemented in their classroom. Two programs were implemented: «Minipally» based on the evidence from a longitudinal study in Canada and «Alphabet of communication» recommended by the Ministry of Education in Russia. Both programs aim at improving social skills of children. Baseline and post-intervention data were collected to assess cognitive (IQ, vocabulary, numerical ability) and social (aggressive and prosocial behaviors, shyness) development. Aspects of the teacher-child relationships were also assessed.

Preliminary results (from the first 2 waves) suggest stability of the cognitive and social skills over time. After 3 months (March 2015–June 2015) of the programs implementations no strong effects have been found. This could be explained by the short period of time between wave 1 and wave 2. A trend was found towards improvements in numerical ability in 4–5 year old children participating in «Minipally». The trend could be explained by the fact that numerical ability is an objective indicator and is subject to fewer measurement errors, but this needs to be investigated further.

This pilot research investigates the effectiveness of developmental programs used in Russia. This is the first step of a longitudinal study that will further assessment waves and add more participants from a number of kindergartens. This study will focus on the effectiveness of intervention programs over a longer time span (September 2016–June2017), the potential effects of ECI on child cognitive development, the influence of teacher-child interaction on program effectiveness and cross-cultural comparisons.

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* Presentation is eligible for a Student Award.

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