International Society for Intelligence Research (ISIR)

20th Annual Conference

July 11–13, 2019 Minneapolis, MN (United States)

Renaissance Minneapolis Hotel, The Depot

www.isironline.org

TABLE OF CONTENTS

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Renaissance Minneapolis Hotel, The Depot
225, 3rd Avenue South,
Minneapolis
MN 55401
United States

Thursday 11th July 2019

8:00-9:00	Registration (also open night before)
9:00–9:10	President's Welcome Address: *Prof. William Revelle, Northwestern University*
9:10-10:10	Lifetime Achievement Award: *Prof. David Lubinski, & Dean Camilla Benbow, Vanderbilt University*
10:10-10:30	Cognitive enhancement and network effects *Dr Jonathan Anomaly, Oxford University and University of San Diego*
10:30–11:00	**MORNING COFFEE**
11:00–13:00	President's Symposium II: Science and Ethics of Genetic Engineering. *Gregory Cochran, University of Utah* *Stephen Hsu, Michigan State University* *Razib Khan, Insitome* *Bruce Lahn, University of Chicago* *Neven Sesardić*
13:00–14:15	**LUNCH**
14:15–14:30	Working memory, measured with a 3D video game, correlates with standard working memory tasks, fluid reasoning and spatial ability, but not with verbal ability *Ms Alicia Diaz, Edinburgh University*
14:30–14:45	A negative Flynn effect in recent cognitive ability scores *David Schroeder, Johnson O'Connor Research Foundation*
14:45–15:00	Looking for a Flynn effect: Examining shifts in cognitive ability within the SAPA project *Mrs. Elizabeth Dworak, Northwestern University*
15:00-15:15	Smaller Flynn effects for crystallized intelligence may be rooted in item obsolescence: results from archival data and a direct test of generational IQ changes *Dr. Jakob Pietschnig, University of Vienna*
15:15–15:45	**AFTERNOON TEA**
15:45–16:05	Academic acceleration in gifted youth and the fruitless concern about psychological well-being: a 35-year longitudinal study *Mr. Brian Bernstein, Vanderbilt University*
16:05–16:25	How intelligent and educated are the American elite? A study of 26,000 U.S. leaders across 30 sectors *Dr. Jonathan Wai, University of Arkansas*
16:25-16:45	Finding the missing Einsteins: searching for exceptional ability in talent searches, K-12, and higher education *Dr. Joni Lakin, Auburn University*
16:45-17:05	The path to STEM leadership: consistent priorities between age 25 and age 50 *Dr. Kira McCabe, Vanderbilt University*
17:05	Poster Session

Friday 12th July

9:30–10:00	The influence of familial factors on the association between IQ and educational and occupational achievement: a sibling approach *Ms. Emilie Hegelund, University of Copenhagen*
10:00-10:15	The association between polygenic scores for educational attainment and intelligence is mediated by fibre network efficiency *Dr. Erhan Genc, Ruhr University Bochum*
10:15-10:30	Gene-environment interplay in SES associations with IQ and educational attainment *Prof. Wendy Johnson, University of Edinburgh*
10:30-10:45	Is test-taking motivation a problem for intelligence research? No and yes *Dr. Gilles Gignac, University of Western Australia*
10:45-11:00	Why is narcissism the strongest predictor of subjective intelligence? *Dr. Marcin Zajenkowski, Faculty of Psychology, University of Warsaw*
11:00–11:30	**MORNING COFFEE**
11:30-11:50	Family networks versus genetics in social outcomes, England 1750-2019 *Prof. Gregory Clark, University of California, Davis*
11:50-12:10	Economic performance, strategic behaviour and intelligence *Prof. Aldo Rustichini, University of Minnesota*
12:10-13:00	Holden Memorial Lecture *Razib Khan, Insitome*
13:00–14:15	**LUNCH**
14:15-16:15	President's Symposium I: Standardized testing in college admissions *Stephen Hsu, Michigan State University* *Nathan Kuncel, University of Minnesota* *Charles Murray, American Enterprise Institute* *Richard H. Sander, University of California, Los Angeles* *Amy Wax, University of Pennsylvania*
16:15–16:45	**AFTERNOON TEA**
16:45-17:00	Using reaction time to differentiate group factors of openness to experience *Ms. Yuri Kim, University of Minnesota*
17:00-17:15	Measurement of attention control *Prof. Randall Engle, Georgia Institute of Technology*
17:15-17:30	Examining convergent validity of the ICAR and WAIS-IV *Mr. Jamison Carrigan, The University of Texas at Austin*
17:30-17:45	Machine learning psychometrics: improved cognitive ability validity from supervised training on item level data *Mr. Emil O. W. Kirkegaard, Ulster Institute for Social Research*

Saturday 13th July

9:30–9:50	Detecting the Scarr-Rowe effect using polygenic scores in two large US samples *Mr. Matthew Sarraf, University of Rochester*
9:50–10:10	Sex differences in social and spatial perspective taking: a replication and extension of Tarampi et al. (2016) *Ms. Elyssa Geer, Florida State University*
10:10–10:30	Gender differences in mathematics and reading a study on over 10,000,000 observations *Dr. David Giofre, University of Genova*
10:30–10:50	Intelligence and happiness stability: evidence from Russia *Ms. Nargiza Ibragimova, ERGO Research and Consultancy*
10:50–11:20	**MORNING COFFEE**
11:20–11:40	The relevance of lesion studies for understanding the reason for the positive manifold *Dr John Protzko, University of California, Santa Barbara*
11:40–12:00	Getting at underlying mechanisms of far transfer to Gf - the mediating role of near transfer *Dr. Anja Pahor, University of California, Riverside*
12:00–12:20	Intelligence is associated with intrinsic stability of functional brain modules *Dr. Kirsten Hilger, Goethe University Frankfurt*
12:20–12:40	Higher intelligence is associated with a more effective adaptation of brain activity to cognitive demands *Dr. Ulrike Basten, Goethe University Frankfurt*
12:40–14:00	**LUNCH AND BUSINESS MEETING**
14:00–14:20	The first longitudinal investigation of cognitive ability in adult adoptive families *Ms Emily Willoughby, University of Minnesota Twin Cities*
14:20–14:40	Tech tilt predicts jobs, college majors, and specific abilities: support for investment theories *Dr. Thomas Coyle, University of Texas at San Antonio*
14:40–15:00	Intelligence's place in the psychology curriculum *Dr Russell Warne, Utah Valley University*
15:00–15:30	**AFTERNOON TEA** Student Award Committee should meet to discuss Awards
15:30-16:30	Prof. David Lubinski interviews Prof. Randall Engle
19.00	BANQUET and presentation of Student Awards

INVITED TALKS AND SYMPOSIA

WELCOME ADDRESS

William Revelle [1]

[1] Northwestern University, revelle@northwestern.edu

LIFETIME ACHIEVEMENT AWARD ADDRESS
Profoundly gifted adolescents and top STEM graduate students at age 50: Creativity, productivity and lifestyle at midlife

David Lubinski and Camilla P. Benbow [1]

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PRESIDENT'S INVITED SYMPOSIUM II

Science and ethics of genetic engineering

Gregory Cochran [1], Stephen Hsu [2], Razib Khan [3], Bruce Lahn [4] and Neven Sesardić

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HOLDEN MEMORIAL ADDRESS FOR DISTINGUISHED SCIENTIFIC JOURNALISM

Being intelligent about the end of the 20th century

Razib Khan, Insitome, razibk@gmail.com

PRESIDENT'S INVITED SYMPOSIUM I

Standardized testing in college admissions

Stephen Hsu [1], Nathan Kuncel [2], Charles Murray [3], Richard H. Sander [4] and Amy Wax [5]

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[2] University of Minnesota, kunce001@umn.edu
[3] American Enterprise Institute, Zoe.Appler@aei.org
[4] University of California, Los Angeles, sander@law.ucla.edu
[5] University of Pennsylvania, awax@law.upenn.edu

Abstracts

Abstracts are presented in alphabetical order by first author's last name.

COGNITIVE ENHANCEMENT AND NETWORK EFFECTS

Dr. Jonathan Anomaly [1] and Dr. Garett Jones [2]

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[2] George Mason University

A central debate in the ethics of biomedical enhancement concerns the conditions under which people should be free to influence the genetic characteristics of their children. We argue that the case for using mate selection, embryo selection, or genetic engineering to create children who are likely to score higher on standard measures of intelligence and patience is strengthened by the fact that these traits are likely to have strong network effects. These network effects include increased cooperation in collective action problems, which contributes to social trust and economic prosperity. We then argue that if individual welfare is largely a function of group traits, we should strive to create political institutions and foster social norms that are likely to increase intelligence. We end by offering some conjectures about what these institutions would look like. A guiding feature of these institutions is that they can minimize coercive interference by fostering the emergence of socially beneficial reproductive norms.

HIGHER INTELLIGENCE IS ASSOCIATED WITH A MORE EFFECTIVE ADAPTATION OF BRAIN ACTIVITY TO COGNITIVE DEMANDS

Dr. Ulrike Basten, Ms. Rebecca A. Mayer, Ms. Rebekka Weygandt and Prof. Christian Fiebach [1]

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A prominent theory on the neural basis of human intelligence states that brains of more intelligent people are more efficient. Empirical evidence for this so-called neural efficiency hypothesis of intelligence is inconclusive as previous studies have associated intelligence with both weaker and stronger activation to cognitive challenges. This talk presents a new study on the role of task difficulty as a potential moderator of the association between intelligence and brain activation. For 63 healthy adult participants, we used fMRI to measure brain activity during a decision making task with 5 different levels of difficulty. Intelligence was assessed with a matrix-reasoning test (BOMAT-Advanced). In two brain regions, we observed an interaction of intelligence and task difficulty on brain activation that can be described as a moderating effect of difficulty on the association between intelligence and brain activation. In right DLPFC, participants with higher intelligence test scores showed a stronger increase of activity with difficulty than participants with lower scores. Conversely, in DMPFC, higher intelligence scores were associated with a stronger decrease of activity with difficulty. Consequently, in these two brain regions, intelligence-related differences in brain activation were more likely observed in the more difficult trials of our task than in the easier trials. In sum, the current study confirms that the brains of more intelligent people are not generally more or less efficient. Instead, observed associations may depend on task difficulty. The current findings furthermore suggest that in more intelligent people brain activation is more effectively adapted to task demands.

ACADEMIC ACCELERATION IN GIFTED YOUTH AND THE FRUITLESS CONCERN ABOUT PSYCHOLOGICAL WELL-BEING: A 35-YEAR LONGITUDINAL STUDY

Mr. Brian Bernstein, Dr. David Lubinski and Dr. Camilla Benbow [1]

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Studies have consistently supported the educational efficacy of acceleration for intellectually precocious youth. This educational practice has been widely documented for facilitating growth among precocious learners; and, short-term positive reports are repeatedly obtained from the students themselves (Assouline et al., 2015; Colangelo et al., 2004; National Mathematics Advisory Panel, 2008). Yet, teachers, parents, and counselors continue to express concern about possible long-term regrets and psychological maladaptation engendered by such practices. This study is designed to definitively answer the question of whether academic acceleration results in any long-term negative effects on the psychological adjustment and well-being of gifted children.

We utilize longitudinal data from the first three cohorts of the Study of Mathematically Precocious Youth (SMPY), where all participants were in the top 1% in intellectual ability when identified, at age 13, between 1972-1975 (Cohort 1, N = 1133), 1976-1978 (Cohort 2, N = 431), or 1980-1983 (Cohort 3, N = 237). Their educational histories prior to high school graduation were subsequently assessed at age 18. They were followed-up again at age 50 when they completed a number of standardized measures of psychological adjustment and well-being. These included five well-known scales of well-being: psychological flourishing, positive affect, negative affect (reversed), core self-evaluations, and life satisfaction. Participants' status on these measures were evaluated in two ways: First, as a function of age of high school graduation and, second, as a function of how much educational acceleration they experienced prior to high school graduation. Psychological well-being was not found to covary with either how early they graduated from high school or how much educational acceleration they experienced.

When structural equation modeling was employed to account for possible confounds (e.g., socioeconomic status), the aforementioned findings maintained their robustness and conclusions were not altered. In this context, a brief discussion is given on the assumptions of such ex post facto designs (Meehl, 1970), which frequently remove construct valid variance of the phenomena under analysis and, as such, are suboptimal.

Finally, following Lykken (1968, 1991), a constructive replication of these findings was conducted using an independent sample of high-potential students identified by other criteria. In 1992, SMPY surveyed 714 top STEM graduate students (48% females), during their first two years of graduate school at one of the top 15 STEM graduate training programs in the United States. These students were then assessed at age 50 with the same measures noted above. The lack of a relationship between educational acceleration on the long-term psychological adjustment and well-being of high-potential students was again confirmed.

Counselors, educators, and parents should take comfort in knowing that allowing children learn at their desired rate and depth does not result in long-term psychological maladjustment.

EXAMINING CONVERGENT VALIDITY OF THE ICAR AND WAIS-IV

Mr. Jamison Carrigan, Ms. Stephanie Young and Dr. Timothy Keith [1]

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To address the lack of freely accessible cognitive ability measures for primary researchers, Condon and Revelle (2014) developed the International Cognitive Ability Resource (ICAR), a public-domain assessment tool with four initial item types and several other types under development. The goal of the ICAR project is to encourage broader assessment of cognitive abilities in the social sciences and healthcare fields by providing flexible, unrestricted test items to researchers (Revelle et al., 2014). One of the main barriers to the utility of the ICAR is that no research to date has been conducted on its construct validity using a well established, theoretically-guided cognitive assessment battery.

The aim of the current study is to examine the relations between the ICAR items and the CHC broad abilities as measured by the Wechsler Adult Intelligence Scale—Fourth Edition (WAIS-IV). Correlations between scores on the respective assessments from a convenience sample will be examined for address the following research questions: **1) Is there evidence of the convergent validity of the ICAR when compared with a well-established, long-form measure of intelligence?** And, **2) Which CHC constructs are related to the respective ICAR subtests?**

Participants include a sample of ~100 university students. This sample combines students obtained through convenience sampling (*N* ~ 70) with students in a clinical sample (*N* ~ 35). These students completed a demographic questionnaire, an online version of the ICAR, and selected subtests on the WAIS-IV.

Correlations between the general factors from the ICAR and WAIS-IV will be examined and compared to those between other brief assessments of cognitive ability and traditional intelligence batteries. The general factor for the ICAR will include the four item types, and the general factor on the WAIS-IV will include the four composite scores (VCI, PRI, WMI, and PSI). Range and reliability corrected correlations between the total score on the ICAR16 and the FSIQ and GAI observed scores will also be examined.

Correlational methods of examining convergent and discriminant validity will also be employed. Correlations of variables hypothesized to measure the same construct will be compared with those thought to measure disparate construct (Campbell & Fiske, 1959). Correlations between composite scores on the respective ICAR item types and the WAIS-IV subtests will be evaluated.

It is expected that total scores on the ICAR will correlate with general intelligence scores on the WAIS-IV at a magnitude similar to those observed in correlations between the WAIS-IV and other brief measures of intelligence ($r > .7$) (Salthouse, 2014). It is also expected that the ICAR item types will be largely related to measures of fluid reasoning on the WAIS-IV, with the exception of the three-dimensional rotation task, which is expected to be most related to measures of visual-spatial abilities. Because the ICAR is untimed, low correlations are expected with measures of processing speed across all ICAR item type composites.

FAMILY NETWORKS VERSUS GENETICS IN SOCIAL OUTCOMES, ENGLAND 1750-2019

Prof. Gregory Clark [1] and Prof. Neil Cummins [2]

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[2] London School of Economics

In any society individuals are embedded in family networks: parents, grandparents, uncles, aunts, and cousins. Most social science disciplines - anthropology, economics, and sociology - assume these family networks play an important role in the social outcomes for children. It is certainly the case that even controlling for parent characteristics, the social characteristics of other relatives typically significantly predict child outcomes.

In this paper we show, however, using an extensive lineage of English families with rare surnames, 330,000 persons born 1750-2012, that there is good evidence that family connections played no causal role in child social outcomes. In this lineage we know which relatives were alive or dead when children were born. We also know which relatives were geographically proximate at birth, and which distant. The measured social outcomes for children were being at school aged 11-20, attainment of higher education, adult occupational status, and wealth at death. We find the characteristics of dead and of distant relatives were just as strongly predictive of social outcomes as living and proximate ones. The characteristics of relatives seemingly provide only information about the underlying characteristics of parents that are being inherited. Parents alone determined child social outcomes.

Another feature that would support the importance of social networks in status determination would be an asymmetry in effects between relatives on the paternal line compared to those on the maternal line. Through much of the period 1750-2019, paternal familial connections are believed to have been more important than maternal ones, in influencing social status outcomes. We find no such asymmetry in the predictive effects of relatives' status.

We further show that the size of the relative effects, at least in the case of grandparents, is of the magnitude a simple first order Markov model of status transmission would predict, where the outcomes of parents derive from their underlying transmittable status only with noise. Genetic transmission of social outcomes is one such first order Markov model. The English genealogy is thus consistent in its characteristics with genetics playing a surprisingly strong role in determining general social status.

TECH TILT PREDICTS JOBS, COLLEGE MAJORS, AND SPECIFIC ABILITIES: SUPPORT FOR INVESTMENT THEORIES

Dr. Thomas Coyle, Ms. Karrie Elpers, Mr. Miguel Gonzalez and Mr. Tyler Minnigh [1]

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Background: Specific cognitive abilities include ability tilt, based on the difference in math and verbal scores on standardized tests (SAT, ACT). Ability tilt yields math tilt (math>verbal), which predicts STEM criteria (science, technology, engineering, math), and verbal tilt (verbal>math), which predicts humanities criteria. The current study examined a new type of tilt: tech tilt, based on differences in technical scores and academic scores (math or verbal). (Technical scores tapped vocational skills for electronics, mechanics, cars, and tools.) The difference yielded two types of tilt: tech tilt (tech>academic) and academic tilt (academic>tech). To examine its validity, tech tilt was correlated with math and verbal scores on college aptitude tests (SAT, ACT) and jobs and college majors in STEM and humanities.

Predictions were based on investment theories. Such theories assume that investments in one domain (math/STEM) boost abilities in similar domains but retard abilities in competing domains (verbal/humanities). Tech tilt reflects a non-academic (vocational) ability, which should compete with academic abilities (verbal and math). Therefore, tech tilt was expected to correlate negatively with academic abilities (based on other tests). In contrast, tech tilt was expected to correlate positively with majors and jobs in STEM, which incorporates technical knowledge (e.g., electronics, mechanics).

Method: Data were from the National Longitudinal Survey of Youth (N=1950). Tech tilt and academic tilt were based the 12 tests of the Armed Service Vocational Aptitude Battery (ASVAB). Academic abilities were based on math and verbal scores on three college aptitude tests (SAT, ACT, PSAT). Tech tilt was the within-subject difference in tech scores (electronics, mechanics, cars) and academic scores (math, verbal) (tech minus academic; positive scores indicate tech tilt), yielding tech tilt (tech>academic) and academic tilt (academic>tech). College majors and jobs were classified as STEM (chemistry, engineering) or humanities (journalism, literature). Effects are standardized and are reported as significant at $p<.05$. The average of analogous effects is reported in parentheses (Mr).

Results: Tech tilt correlated negatively and significantly with academic abilities based on the math and verbal scores of the three college tests (Mr=-.25, range = -.41 to -.11), indicating that tech tilt was associated with poor performance on the college tests. In addition, tech tilt correlated positively and (generally) significantly with jobs and majors (Mr=.20, range = .01 to .35), indicating that tech tilt predicted STEM criteria. The effects replicated using different analytical approaches (e.g., regressions and structural equation modeling) and after controlling for general intelligence based on the ASVAB.

Discussion: The negative effects of tech tilt with academic abilities support investment theories, which predict that investments in one domain (non-academic, technical) come at the expense of investments in competing domains (academic). In addition, the effects demonstrate the validity of vocational aptitudes, extending prior research on ability tilt, which has focused on academic aptitudes. Future research should consider factors that moderate the effects of tech tilt (e.g., education and personality) as well as other types of tilt (e.g., spatial tilt).

LOOKING FOR A FLYNN EFFECT: EXAMINING SHIFTS IN COGNITIVE ABILITY WITHIN THE SAPA PROJECT

Mrs. Elizabeth Dworak [1], Dr. William Revelle [1] and Dr. David Condon [2]

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[2] University of Oregon

Using items from the International Cognitive Ability Resource (ICAR), this study will examine if there is a Flynn Effect across 12 years of cross-sectionally collected data from the United States (N=710,139). ICAR is an open-source multiple choice cognitive ability assessment used by the web-based Synthetic Aperture Personality Assessment (SAPA) project to examine the cognitive performance of its' participants. While we expect that some differences are due to temporal trends in self-selection, we hope to further examine if covariates, such as gender, education level, and college major are influencing natural changes in ability scores. Preliminary analyses comparing 18 and 19 year old participants from 2010 to 2012 and 2014 to 2016 showed similar matrix reasoning scores (*M*=0.23; *M*=0.23), verbal reasoning scores (*M*=0.36; *M*=0.36), and letter and number series scores (*M*=0.25; *M*=0.25) from 35 ICAR items. Other preliminary analyses comparing 34 and 35 year old participants between the same years showed a marginal decline in matrix reasoning scores (*M*=0.30; *M*=0.27), verbal reasoning scores (*M*=0.41; *M*=0.39), and letter and number series scores (*M*=0.31; *M*=0.29) from 35 ICAR items.

MEASUREMENT OF ATTENTION CONTROL

Prof. Randall Engle [1]

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Many of the most interesting findings and concepts in psychology rely on reaction time (RT) and a difference score between two RT's. Reliability of RT and even RT difference scores are pretty reliable in experimental studies. Tasks such as the Stroop, Attention Network Task, Erickson Flanker Task and others from personality and social areas such as the Implicit Association Test are easily replicated and often used in group settings such as classrooms. However, measuring individual and developmental differences with RT and RT difference scores represents a major problem. First, there are large individual and developmental differences in speed/accuracy tradeoff and very small changes in accuracy can correspond to quite large differences in RT. Second, when subtracting two conditions such as congruent and incongruent in the Stroop task, the higher the reliability of each condition, the less variability remains to distinguish among individual and developmental groups. I report results of an attempt to develop measures of attention control based on threshold accuracy measures and show the impact of those more reliable measures on several latent variables and on predictive validity of the Armed Services Vocational Aptitude Battery for a proxy of complex work.

SEX DIFFERENCES IN SOCIAL AND SPATIAL PERSPECTIVE TAKING: A REPLICATION AND EXTENSION OF TARAMPI ET AL. (2016)

Ms. Elyssa Geer and Dr. Colleen Ganley [1]

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Tarampi and colleagues (2016) conducted a study to better understand sex differences in spatial and social perspective-taking skills. Their findings suggested that adding social information enhanced female performance on perspective-taking tasks. In this preregistered replication, we tested an alternative explanation: that the tasks with added social information also provided additional spatial information which could explain improvements in performance. It is possible that their redesigned 'social' task also provided additional spatial information. We asked: Does social information lead to improved performance on a spatial task? Does additional spatial information lead to improved performance on a spatial task?3) Do either of these effects differ by sex?

We replicated Tarampi et al.'s (2016) study in a sample of 283 undergraduate students (134 males) using the two tasks from their study: the SOT (Hegarty and Waller, 2004) and the road-map test (Money et al., 1965; modified by Zacks et al., 2002). We used the conditions from their study (one with no social or additional spatial information [original tasks] and one with both social and additional spatial information [their social tasks]), and also added two new conditions that help isolate the potential effects of social and additional spatial information. We also included a math fluency task and several self-report measures of social skills and anxieties.

To replicate Tarampi et al. (2016), we ran two independent samples t-test comparing performance on each of the two perspective-taking tasks between females in the no spatial, no social condition (their spatial condition) and females in the spatial, social condition (their social condition). There was no significant difference in performance on the road map task ($t(74)=1.07$, $p=.289$) or the SOT ($t(74)=-1.06$, $p=.293$) suggesting that, contrary to the findings from Tarampi et al. (2016), females in their social condition did not out-perform females in their spatial condition.

To test our alternative hypothesis, we ran a 2(additional spatial information: yes, no) x 2(social information: yes, no) x 2(sex: female, male) for each of the perspective-taking tasks. For the Road Map task there was a main effect of sex ($F(1,275)=32.82$, $p<.001$) such that males outperformed females. In partial support of Tarampi et al.'s (2016) hypothesis, there was a main effect of social information ($F(1,275)=3.94$, $p=.048$) such that performance was better on the versions of the task that had additional social information. There was a main effect of additional spatial information ($F(1,275)=11.28$, $p=.001$) such that adding spatial information led to improved performance on the task, as we hypothesized. For the SOT there was a main effect of sex ($F(1,275)=25.42$, $p<.001$) such that males outperformed females, but there were no significant main effects for either social ($F(1,275)=2.79$, $p=.096$) or additional spatial ($F(1,275)=3.726$, $p=.055$) information.

The results for the road map task show some support that additional social information does improve performance on a spatial task, but this effect does not differ by sex as Tarampi et al. (2016) posited. These results also suggest that additional spatial information improves performance on a spatial task, regardless of sex, which lends some support to our hypotheses.

THE ASSOCIATION BETWEEN POLYGENIC SCORES FOR EDUCATIONAL ATTAINMENT AND INTELLIGENCE IS MEDIATED BY FIBER NETWORK EFFICIENCY

Dr. Erhan Genc, Mr. Christoph Fraenz, Ms. Caroline Schlüter, Prof. Manuel Voelkle, Prof. Onur Güntürkün, Dr. Sebastian Ocklenburg and Prof. Robert Kumsta [1]

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Individual differences in cognitive abilities are substantially influenced by genetic variability. Intelligence is a highly polygenic trait, with thousands of alleles contributing with small effects. An innovative way to assess the cumulative effect of genetic variation on traits of interest is to use polygenic scores (PGS), which are derived from large genome-wide association studies (GWAS). These PGS are increasingly used in intelligence research. Whereas PGS for IQ or educational attainment reliably predict interindividual differences in cognitive performance, the intermediate steps in the pathway from genes to cognitive abilities are largely unknown. Given the association between the brain's macrostructure and its structural network properties with cognitive performance, we tested whether the association between PGS and intelligence is mediated via brain volume and fiber network connectivity.

Structural network efficiency and intelligence was assessed in a sample of 300 healthy individuals. Intelligence was measured with a broad cognitive test battery. Polygenic scores - a summary genetic measure used to assess the combined effect of single nucleotide polymorphisms (SNPs) - for educational attainment were derived using data from the latest GWAS on adult educational attainment with a sample size of 1.1 million individuals. Furthermore, we used standard MRI along with DTI and fiber tractography to examine different estimates of brain volume as well as brain fiber network connectivity by means of graph theory.

Consistent with previous findings, PGS significantly predicted cognitive test performance (R^2=.062). Furthermore, participants with larger brains and more efficient fiber connectivity achieved higher IQ scores. Mediation analyses showed that the association between polygenic scores and intelligence was mediated by fiber network efficiency, both measured for the whole brain and for single brain regions predominantly located in fronto-parietal areas. Brain volume was not a significant mediator. The results of our study show that the pathway from genes to cognitive performance involves the shaping of fiber network efficiency. Overall, our findings represent a crucial step in the endeavor of identifying the missing links between genetic variability and cognitive performance.

IS TEST-TAKING MOTIVATION A PROBLEM FOR INTELLIGENCE RESEARCH? NO AND YES

Dr. Gilles Gignac [1]

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It has been long assumed that examinees need to apply their best effort when completing intelligence tests. However, individual differences in test-taking motivation exist, and these differences have been argued to compromise interpretations of IQ scores as valid representations of intelligence. To date, the association between test-taking motivation and intelligence test performance has been examined only relatively rarely. In study 1 (*N*=173), test-taking motivation was measured objectively with the Anagram Persistence Task. In study 2 (*N*=218), test-taking motivation was measured subjectively with a questionnaire. Across both studies, intelligence was measured with a battery designed to measure general intelligence. Study 2 also included a within-subjects design to evaluate the degree to which test-taking motivation might reduce across a 50 minute testing session. In both studies 1 and 2, the positive association between objectively and subjectively measured test-taking motivation and general intelligence was found to be curvilinear: the majority of the positive effect was isolated between relatively low to moderate levels of the test-taking motivation. However, across the 50 minute testing session in study 2, the percentage of insufficiently motivated examinees more than doubled from 6% to 13%. The results suggest that only a moderate level of test-taking motivation may be required for valid intelligence testing. However, testing that exceeds 30 minutes should probably be discouraged, given the increase in the insufficiently motivated.

GENDER DIFFERENCES IN MATHEMATICS AND READING A STUDY ON OVER 10,000,000 OBSERVATIONS

Dr. David Giofre[1], Dr. Enrico Toffalini and Prof. Cesare Cornoldi[2]

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The question of gender differences in mathematics is very important and captured the attention of scientists, practitioners, and teachers worldwide. Despite this importance, most of the research on gender differences in mathematics has been based on English speaking countries, e.g., UK, USA, or Canada, while only limited evidence is available on gender differences in other contexts and realities (Else-Quest, Hyde, & Linn, 2010).

Efforts to measure the mathematics achievement cross-nationally have produced two large-scale assessments, the Trends in International Mathematics and Science Study (TIMSS) and PISA. TIMSS is an international assessment of mathematics and science learning in eighth graders, conducted on a 4-year cycle. While, PISA is an international assessment of mathematics, reading, science, and problem-solving literacy in 15-year-olds, conducted on a 3-year cycle. These measures are in fact very robust and are very highly correlated with formal intelligence tests.

Results from TIMSS and PIRLS have produce an invaluable contribution to the evaluation of gender differences in mathematics. However, there are several limits with these two international assessments. For a start, the results tend to be limited with certain grades and age groups, mainly eight graders and 15-years old children only. Moreover, these studies are not performed every year, thus making it difficult to assess changes over the course of time. Finally, the mathematics` curricula in different countries might also present several differences, thus making the comparison between countries somewhat difficult. However, TIMSS and PIRLS are not the only evaluations and several alternatives mathematics assessments have been promoted in some countries.

The INVALSI (Istituto Nazionale per la Valutazione del Sistema Educativo di Istruzione e di Formazione) is a national examination of mathematics and reading competences of children in their 2nd, 5th, 6th, 8th, and 10th grades. This assessment typically involves, two subjects, i.e., reading and mathematics, and is periodically performed every single year. Data from the INVALSI are very valuable because, contrary to the aforementioned evaluations (PISA and TIMSS) they are performed yearly, and they allow to compare children across several grades. Finally, results from INVALSI can be differentiated among different Italian regions, and are hierarchically structured, thus allowing to control for the effect of the school and class settings. For all these reasons, this database seem to be particularly appropriate in order to test the development of gender differences across several years and several grades.

In this paper over 10,000,000 observations on mathematics and reading were analysed over the course of 8 years. This sample is representative of the Italian population. Rasch scores were calculated for each individual subject. Findings were then collapsed using a meta-analytic approach. Results showed a very important geographical gradient behind the gender gap in mathematics. Surprisingly, gender differences were more marked in some reached areas of the country. The present findings have very important implications for our understanding of gender differences on higher cognitive abilities.

THE INFLUENCE OF FAMILIAL FACTORS ON THE ASSOCIATION BETWEEN IQ AND EDUCATIONAL AND OCCUPATIONAL ACHIEVEMENT: A SIBLING APPROACH

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Intelligence test scores have been shown to correlate positively with educational and occupational achievement in numerous observational studies. However, because of the observational study designs, it cannot be ruled out that part of the observed associations is explained by unmeasured familial factors operating in childhood. Studies of twins and non-twin sibling pairs have found that both genetic factors and shared environmental factors are in fact responsible for part of the observed associations. However, the generalizability of the study findings to the general population is uncertain because the study populations are restricted to samples of twins or samples of biological and adoptive sibling pairs. It is therefore an interesting question how much of the associations can be attributed to familial factors operating in childhood in study populations that are more representative of the general population.

Using a large cohort consisting of nearly 365,000 siblings within more than 170,000 sibships, the present register-based study tried to come one step closer to an answer to this question by investigating the influence of familial factors shared by siblings on the association between IQ and educational and occupational achievement among young people in Denmark. The study population consisted of all Danish men with at least one full brother where both the individual and his brothers were born since 1950 and appeared before a draft board in 1968-1984 and 1987-2015 (N=364,193 individuals & 171,037 sibships). Intelligence was measured by Børge Priens Prøve at age 18.

Educational and occupational achievement was measured by grade point average (GPA) in lower secondary school, by time to receiving social benefits at ages 18-30, and by gross income at age 30. Covariates included the study population's year of birth, ethnicity, birth region, binary indicators of out-of-home care in childhood, psychiatric diagnoses in childhood, neurological diagnoses in childhood, perinatal diagnoses and congenital deformities, and parental socioeconomic position at birth.

The statistical analyses consisted of two distinct statistical analyses of all the investigated associations: A conventional cohort analysis and a within-sibship analysis in which the association under investigation was analysed within siblings while keeping familial factors shared by siblings fixed. The findings of the conventional cohort analysis and the within-sibship analysis were afterwards compared by visual inspection of the confidence intervals to determine the importance of confounding from unmeasured familial factors operating in childhood.

The results showed that an appreciable part of the associations of IQ with educational and occupational achievement could be attributed to familial factors shared by siblings. However, most of the associations were not attributable to such familial factors. In fact, visual inspection of the confidence intervals revealed that only the association between IQ and GPA in lower secondary school within siblings differed statistically significantly from the association observed in the cohort analysis after covariates had been taken into account. This might either suggests that proximal family factors, for which we have no information available, only influence educational achievement during upbringing or that these factors have a much smaller influence on later educational and occupational achievement in young adulthood.

INTELLIGENCE IS ASSOCIATED WITH INTRINSIC STABILITY OF FUNCTIONAL BRAIN MODULES

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Intelligence predicts important life outcomes like educational success, health, or longevity. Previous work demonstrated that variations in the modular organization of resting-state connectivity relate significantly to individual differences in human intelligence. However, while intelligent behavior implies greater flexibility in adapting to changing environmental demands, it is so far unclear whether and how dynamic changes in the configuration of brain networks, for example in their modular organization, relate to general intelligence. To clarify this relationship, we used multi-band fMRI resting-state data from *N* = 281 healthy adult subjects and estimated subject-specific time-dependent functional connectivity from fMRI time series. A modularity optimization algorithm was applied to determine individual time-variant module partitions and network metrics that captured fluctuations in modularity across time. We show that higher intelligence, indexed by an established composite measure, the Wechsler Abbreviated Scale of Intelligence (WASI), is associated with higher stability of brain network modularity. Post hoc analyses reveal that subjects with higher intelligence scores engage in fewer periods of very high modularity – which are characterized by a greater disconnection of task-positive from task-negative networks. Further, we show that attention-related brain regions of the dorsal attention network contribute most to the observed effect. In sum, our results suggest that higher general cognitive abilities are associated with more stable brain network dynamics, particularly in the dorsal attention systems of the human cortex. Our study demonstrates that the investigation of temporal dynamics of brain networks can contribute to our understanding of the neural bases of individual differences in general cognitive abilities.

GENE-ENVIRONMENT INTERPLAY IN SES ASSOCIATIONS WITH IQ AND EDUCATIONAL ATTAINMENT

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Several studies in the United States have indicated that genetic variance in IQ tends to be greater in youths from higher-SES backgrounds, and the Minnesota Twin Family Study (MTFS; ~2500 twin pairs) is among them. This is generally interpreted as an example of 'vantage sensitivity' -- people vary genetically more in ability to benefit from advantageous environments but not so much in how disadvantageous environments undermine development. Contrasting this is 'stress-diathesis -- people vary in genetic vulnerability to disadvantageous environments but not so much in how advantageous environments support them. In MTFS, genetic variance in educational attainment is greater among young adults from lower-SES backgrounds -- an example of stress-diathesis. School engagement is generally associated with both IQ and educational attainment; MTFS is no exception. There, its variance follows the stress-diathesis pattern. When it is considered an environment affecting later IQ and educational attainment, both show the stress-diathesis pattern for genetic variance, though shared environmental variance in educational attainment show the vantage-sensitivity pattern. I will discuss how these observations might help us understand how genes are involved in maintaining intergenerational socio-economic patterns.

USING REACTION TIME TO DIFFERENTIATE GROUP FACTORS OF OPENNESS TO EXPERIENCE

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Intelligence and the nature of its relationship with personality has been fraught with disagreement. Intelligence has been argued to be completely separate from personality; related, but distinct; or an aspect of it. However, intelligence has consistently shown meaningful relationships to the Big Five factors of personality, suggesting that intelligence could be an attribute of personality (Stanek, 2014; DeYoung, 2011). In the Big Five Aspects Scale (BFAS) model, each factor is partitioned into lower-level Aspects (DeYoung et al., 2007). Openness to Experience is comprised of Openness and Intellect. Intelligence is not equivalent to Intellect (intellect is defined as an individual's perceived intelligence or intellectual engagement); rather, intelligence is one of many facets encompassed by Intellect.

I presently seek to further explore the relationship between Big Five— specifically Openness and Intellect— and intelligence via cognitive ability. In this project, my collaborators and I assess both personality through the BFAS, and cognitive ability through reaction time on two speeded cognitive tasks. In the first task, participants are presented with a number (0 to 4 and 6 to 9) and must decide if that number is greater than or less than 5. In the second task, participants are presented with two tones and decide if the second tone was higher or lower in pitch. If intelligence is a facet of Intellect, we expect reaction time to negatively correlate with Intellect. Individuals with higher IQs tend to come to the correct decision more swiftly. We do not expect the Openness to have a significant correlation with reaction time

The design of the study also allows us to test implications of the Cybernetic Big Five Theory, or CB5T (DeYoung, 2015). The CB5T provides a mechanistic explanation for how personality produces goal-directed behaviors. Individuals who score highly on Intellect may have quicker reaction times in part because, as the CB5T proposes, intellect relates to the detection of logical patterns. For example, in the number task, deciding that 1 is less than 5 is less difficult than deciding that 4 is less than 5. Theoretically, individuals with high Intellect should be less hindered by the difficulty of decision (e.g. the stimulus number's distance from 5). Furthermore, according to the CB5T, Openness relates to the detection of correlational patterns in sensory or perceptual information. In the experiment, we also test the difficulty of perception. In the number task, the color of the stimulus number varies in how strongly or weakly it stands out from the color of the background. The CB5T predicts that individuals who score highly on Openness will be less hindered by variation in the stimulus number's saturation

We are thus seeking evidence for separate information processing as well as evidence for possible neural bases of the two personality aspects.

We are currently collecting participants and expect to have at least 300 by the conference.

MACHINE LEARNING PSYCHOMETRICS: IMPROVED COGNITIVE ABILITY VALIDITY FROM SUPERVISED TRAINING ON ITEM LEVEL DATA

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Has psychometrics overlooked machine learning methods? We investigated whether machine learning methods could improve the scoring of cognitive item data. To do this, we collected 7 large datasets of item data (total n = 37k). Most datasets provided response-level data i.e. which response subject gave, not just binary (correct/incorrect). Datasets collectively had many outcomes of interest, but we focused on a small number that mostly overlapped between datasets: age, sex, educational attainment and income (all [quasi-]continuous aside from sex). We then applied standard psychometric scoring methods, sum scores and item response theory (IRT) scores, to the data as well as a variety of supervised machine learning methods including random forest, lasso/ridge regression, deep neural networks, as well as unpenalized ordinary least squares (OLS) for comparison. Parameters were tuned using efficient leave one out cross-validation on a training set. Performance was measured on 20% hold out data.

Our results indicate that machine learning methods regularly outperform standard psychometric scoring methods. Across datasets, a mean gain in validity of 47%, 17%, and 13% were seen for age, education, and income, respectively. This gain was fairly consistent across datasets and test item types, i.e. machine learning methods were able to use all tested item types to extract extra validity, including vocabulary, memory, verbal fluency, matrices/Raven's, general knowledge, and math.

Of the machine learning methods, many were roughly equivalent. Ridge regression was overall the best method. This indicates that: 1) Sparsity of effects is not a good assumption for these data, i.e. that each response option was unique in utility. In other words: the different 'distractor' (wrong options) in multiple choice questions are differentially informative, not equivalent as assumed by the binary scoring methods. 2) that interactions between items do not seem to play important roles for predictive purposes, in line with traditional psychometric results.

We conclude that standard scoring approaches of cognitive data are missing extra validity present in the data, sometimes a lot of it, depending on the outcome. This finding has implications for tests used for practical purposes (such as selection, dementia screening), where their validity has likely been underestimated.

FINDING THE MISSING EINSTEINS: SEARCHING FOR EXCEPTIONAL ABILITY IN TALENT SEARCHES, K-12, AND HIGHER EDUCATION

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Standardized tests have played and continue to play an important role in gifted talent searches, K-12 education, and higher education selection. These tests measure *g* to a large degree (Frey & Detterman, 2004), but also tap into secondary quantitative and verbal reasoning factors. These assessments serve as gatekeepers to specialized services including summer programs and elite universities. One criticism of commonly used screening tests is that they disproportionately select students from more advantaged groups, which has led admissions decisions to move towards holistic review to improve the diversity and backgrounds of admitted students. This, however, means that selection becomes more subjective, especially when coupled with recent evidence that "universally screening" or testing all students actually improves the representation of students from disadvantaged backgrounds (Card & Giuliano, 2016). Instead of jettisoning effective screening tools, which are more sensitive to educational opportunity and enrichment, for subjective selection, we propose broadening the scope of screening tests to include measures of specific abilities that are less directly influenced by formal education. Like existing measures, these additional screening tools could be added on the basis of the incremental predictive validity of such tests on numerous real-world outcomes (Kuncel et al., 2004).

Richard Snow (1999) argued that the breadth and depth of admissions testing needed expanding, with spatial abilities being one set of measures that could be promising, given what we know about the structure of cognitive abilities. Research has indicated a link between spatial abilities and long-term STEM and creative outcomes (Wai et al., 2009; Kell et al., 2013). However, the question remains as to how to simultaneously expand the sets of measures used in admissions while adequately addressing the need to ensure talented but disadvantaged students are represented to their fullest capacity.

In this study we aim to examine which of a wide array of cognitive measures might be most fruitful in objectively identifying disadvantaged talent (e.g., low SES, from rural areas, underrepresented minority) across three nationally represented datasets: Project Talent (1960), High School and Beyond (1980), and the NLSY (1997). We leverage these older datasets and allow all measures to compete to determine to what extent 1. Broader screening can identify more disadvantaged talent proportional to their group representation and 2. Which of these assessments simultaneously have predictive validity for important educational outcomes.

Analysis of the Project Talent sample is complete. Findings so far indicate that spatial reasoning measures broadly—in particular 2D Spatial Reasoning—improve the proportional representation of low income, rural, and underrepresented minority talent, and that such measures have reasonable predictive validity on short- and long-term educational outcomes of interest. Next we intend to explore the extent to which these findings replicate in the HSB and NLSY samples. These findings build upon the fundamental understanding that all standardized tests measure cognitive abilities, and will help determine the empirical starting point from which expanding the breadth of admissions testing to help identify disadvantaged talent in gifted talent searches, K-12, and higher education, might be most fruitful,

THE PATH TO STEM LEADERSHIP: CONSISTENT PRIORITIES BETWEEN AT AGE 25 AND AGE 50

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In 1992, 714 first- and second-year graduate students (48.5% female) attending U.S. universities ranked in the top 15 by science, technology, engineering, and mathematics (STEM) field were surveyed. Participants provided their Graduate Record Exam scores, and they completed standardized interest, personality, and values questionnaires; they also were surveyed on their work and lifestyle preferences. Twenty-five years later, their publically available life records were evaluated to identify who became a STEM leader and who did not become a STEM leader (labeled "nonleaders"). Our approach classified all 714 participants. Following the Berkeley Studies of Creativity, Institute of Personality Assessment Research, we reasoned that if someone was truly eminent in their field, they should be publicly identifiable by leaders in the field. The results were as follows: Male STEM leaders (n=97), Female STEM leaders (n=55), Male nonleaders (n=271), and Female nonleaders (n=291).

We conducted a series of discriminant function analyses to determine whether Time 1 (age 25) data distinguished these four groups. Each analysis used a different and unique set of measures: a) abilities, interests, and values, b) specific interests, c) lifestyle preferences, and d) work preferences. Each analysis showed two clear discriminant functions, one that highlighted leadership differences, and the other that highlighted gender differences. These results tell an important story about the multiplicity of determinants that combine to produce STEM eminence. STEM leaders have distinctive abilities, STEM interests, fewer competing interests, and dedicate an inordinate amount of time to their career. These results highlight among the nonleaders more competing interests and lifestyle priorities relative to STEM leaders. There is no right or wrong, as different people require different things to create a meaningful and satisfying life.

Further analyses that examined leadership differences and gender differences among the participants included the extent to which age 50 data reflects similar priorities and preferences reported at age 25 during graduate school. We also examined the potential impact of having children. We found similar differences between leaders and nonleaders in their lifestyle and work preferences at age 25 and at age 50. Leaders reported working more hours than nonleaders, and they plan to work more hours than nonleaders over the next 15 years. On average, male leaders also reported willing to retire 5 years later than male nonleaders. Taken as a whole, these results show a consistent pattern of priorities among STEM leaders over the course of their lives.

GETTING AT UNDERLYING MECHANISMS OF FAR TRANSFER TO GF – THE MEDIATING ROLE OF NEAR TRANSFER

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The extent to which working memory training leads to improved performance on tasks that are of a different nature than those used for training remains unclear. Moreover, little is known about the mechanisms underlying these so-called far transfer effects to measures of G*f* such as matrix reasoning. Here we use mediation models to test the hypothesis that far transfer is mediated by near transfer. The sample consisted of healthy adults ($N_{cohort1}$ = 94; $N_{cohort2}$ = 177) that were randomly assigned to 10 days of N-back training or to a passive control group and completed a battery of tasks at pre-test and post-test. At post-test, performance on untrained N-back tasks (near transfer) improved in both active groups relative to pre-test (Cohort 1: *d* = .80; Cohort 2: *d* = .96), whereas little-to-no improvement was observed in the passive control groups (Cohort 1: *d* = .06; Cohort 2: *d* = .14). Similarly, post-test performance on matrix reasoning tasks (far transfer) improved in both active groups relative to pre-test (Cohort 1: *d* = .49; Cohort 2: *d* = .43) but showed very little improvement in the passive groups (Cohort 1: *d* = -.02; Cohort 2: *d* =.19). Multiple linear regression showed that training group was a significant predictor of post-test performance on matrix reasoning, even after accounting for pre-test performance and cohort effects. Subsequent analyses demonstrated that this relationship was mediated by performance on untrained N-back tasks, which was replicated in each of the cohorts (Cohort 1: IE = 0.03, 95% CI = 0.01–0.05; Cohort 2: IE = 0.04, 95% CI = 0.02–0.06). In contrast, training-related improvement on a Simon-like task did not mediate post-test matrix reasoning performance. These findings suggest that N-back training does not merely lead to task-specific learning, but, at least for some individuals, leads to changes in the underlying components of working memory that lead to far transfer effects.

SMALLER FLYNN EFFECTS FOR CRYSTALLIZED INTELLIGENCE MAY BE ROOTED IN ITEM OBSOLESCENCE: RESULTS FROM ARCHIVAL DATA AND A DIRECT TEST OF GENERATIONAL IQ CHANGES

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Background: Generational IQ test score changes (i.e., the Flynn effect) have been positive over most of the 20th century with recent studies indicating stagnation and a reversal in some countries around the turn of the century. For the positive Flynn effect, some of the best replicated findings relate to stronger fluid (i.e., reasoning) than crystallized (i.e., knowledge) gains. Whilst some researchers attributed these domain differences to ability differentiation or differential social multiplier effect functioning, conclusive evidence for a plausible cause is still missing. One viable hypothesis pertains to domain-specific effects of item obsolescence. This hypothesis suggests that weaker crystallized intelligence gains may be due to verbal items becoming content-wise outdated over time (or solutions becoming outright false), whilst solutions to non-verbal (fluid) tasks remain qualitatively unaffected. Consequently, test revisions of fluid intelligence (sub-)tests are often confined to mere updating of testnorms whilst in crystallized intelligence (sub-)tests, items are often revised or replaced altogether. These domain-specific differences in obsolescent test item treatment may conceivably mask crystallized IQ gains.

Methods: First, we meta-analytically investigated influences of age on test score gains on performance (k = 98; N = 10,769) and verbal IQ (k = 97; N = 10,749) for samples that had taken a WAIS or WISC test and one of its restandardizations at the same time-point. Second, we examined interaction effects of age and data collection year on an unrevised measure of crystallized intelligence in a large number of adult patients from 1978 to 1994 (N = 5,441). Finally, we provide a direct, targeted, and preregistered test of item obsolescence effects on crystallized IQ changes in a sample of German-speakers. We cross-sectionally administered three original and revised subtests (number series, sentence completion, similarities) of the IST, a well-established IQ test in German language, to a convenience sample of 158 healthy adults (78f; mean age = 23.7).

Results: Consistent with our predictions, meta-analytical data showed positive (albeit non-significant) associations of age with crystallized, but not fluid IQ gains. Moreover, we observed a significant interaction between participant age and data collection year in our longitudinal sample, indicating stronger IQ gains for older than for younger participants. In our cross-sectional sample, we observed a positive Flynn effect for number series, virtually none for similarities, but a negative one for sentence completion. Although IQs decreased over time in sentence completion (i.e., our most crystallized subtest; d = -1.076), scores on replaced and revised items were significantly larger than scores on the original items (d = 1.161 and 0.285), indicating non-replaced and -revised items as the drivers of decreasing IQs.

Discussion: We show convergent evidence from three studies for influences of item obsolescence on crystallized Flynn effect estimations. In the light of our findings, it seems likely that past evidence for crystallized IQ gains may have underestimated the Flynn effect and true domain differences are probably smaller than typically observed. In all, our results suggest that true fluid and crystallized IQ changes over time may have progressed at a more similar rate than previously reported.

THE RELEVANCE OF LESION STUDIES FOR UNDERSTANDING THE REASON FOR THE POSITIVE MANIFOLD

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The positive manifold is among the most reliable psychological findings worldwide. The explanation for *why* all cognitive tests covary, however, are many. Explanations tend to fall into one of three categories: common cause; sampling/network; or causal interactionist models. Fit statistics, we argue, are inadequate as a means to demarcate between models. Each model, however, is at its heart a causal model with causally testable predictions. One way to test the models against each other is to look at the manipulability of parts of each model and test the causal links the models imply. Brain lesions represent one such pseudo-causal approach to understanding measurement models. The basic pattern of the effects of brain lesions is: focal cortical lesions lead to local, not global, deficits. Here we review the evidence of not only what abilities are affected by which lesions, but critically which abilities are *unaffected* by which lesions. We find that hierarchical models, bifactor models, and some but not all versions of sampling/network models are able to accommodate the pattern of lesion evidence on the positive manifold. Causal interactionist models, some versions of sampling/network models, and correlated factor models, however, are unable to accommodate such evidence. The causal connections implied by our measurement models represent an additional way of demarcating between equally well-fitting models for understanding the structure of cognitive abilities and the cause of the positive manifold.

WORKING MEMORY, MEASURED WITH A 3D VIDEO GAME, CORRELATES WITH STANDARD WORKING MEMORY TASKS, FLUID REASONING AND SPATIAL ABILITY, BUT NOT WITH VERBAL ABILITY

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Introduction: This study presents the first 3D video game designed from the outset to tap spatial working memory: *Forgotten Depths.* The video game (a) follows the principles of game design (Adams, 2013) and (b) can be used for research and applied purposes. It consists of 12 level-maps of increased cognitive complexity (short-term storage capacity) that the participant has to remember while trying to exit from each level (processing requirement). The game includes a Mod feature so that researchers can create their own maps. Its psychometric properties have been tested in two independent studies. Measures of standard working memory were considered in the first study, whereas in the second study fluid reasoning (Gf), spatial ability (Gv), and verbal ability (Gc) were also measured for testing its convergent and discriminant validity. We expect substantial correlations with standard working memory measures, Gf, and Gv (convergent validity), but not with Gc (discriminant validity).

First study: The video game was played in a computer room, along with two standard working memory tasks (Dot Matrix and Corsi Block). One hundred and eleven undergraduates participated in the study (87 women). Mean age was 21.01 (SD = 4.65, range from 18 to 49). No sex differences in age were found ($t(109) = -.53$; $p = .595$). Reliability indices for the scores obtained in the video-game were excellent (α = 0.92, = 0.93), and convergent validity evidence with Dot Matrix and Corsi Block scores were substantial (r = 0.44** and r = 0.41** respectively). Latent relationship between video game and standard working memory measures were computed trough structural equation modeling, obtaining a remarkable correlation ($r = 0.70$, $p < .01$).

Second study: The video game was played in a computer room, along with standard working memory (Dot Matrix and Corsi Block), and intelligence tests (Advanced Progressive Matrices, Verbal Test –Primary Mental Abilities- and Spatial Reasoning –Differential Aptitudes Test). Ninety-three undergraduates participated in the study (81 women). Mean age was 20.35 (SD = 3.18, range from 18 to 44). No sex differences in age were found ($t (109) = -1.58$; $p = .123$). Reliability indices for the scores obtained in the video-game score were excellent ($\alpha = 0.87$). Latent relationship between video game and standard working memory measures were computed trough structural equation modeling, and their correlation was substantial ($r = 0.60$, $p < .01$). Furthermore, video game performance (a) still correlates with working memory when fluid reasoning (Gf) and spatial ability (Gv) is controlled for (r = 0.30**) and (b) doesn't correlate with verbal ability (Gc) (r = 0.10).

Discussion: Forgotten Depths can be used for measuring individual differences in spatial working-memory. Performance differences in the video game correlates with working memory, Gf and Gv but not with Gc, which is consistent with the prediction regarding its convergent and discriminant validity.

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ECONOMIC PERFORMANCE, STRATEGIC BEHAVIOR AND INTELLIGENCE

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The talk will survey recent results linking the analysis of economic performance (for instance, income) of individuals and the strategic behavior (that is, the behavior in interactive situations), and their Intelligence and its heritability.

In our study of economic performance, we set up the analysis in a standard economic model of optimal parental investment and intergenerational mobility, extended to include a fully specified genetic analysis of skill transmission, and show that the model's predictions on mobility differ substantially from those of the standard model. For instance, the coefficient of intergenerational income elasticity may be larger, and may differ across countries because the distribution of the genotype is different, completely independently of any difference in institution, technology or preferences. We then study how much of the educational achievement is explained by the Polygenic Score (PGS) for education, thus estimating how much of the variance of education can be explained by genetic factors alone. We find a substantial effect of PGS on performance in school, years of education and college. Finally we study the channels between PGS and the educational achievement, distinguishing how much is due to cognitive skills and to personality traits. We show that the effect of PGS is substantially stronger on Intelligence than on other traits, like Constraint, which seem natural explanatory factors of educational success. For educational achievement, both cognitive and non-cognitive skills are important, although the larger fraction of success is channeled by Intelligence.

The analysis of the effect of Intelligence on strategic behavior is experimental: we study the level of cooperation in repeated games (with four possible stage games) where players are separated in two groups of higher and lower Intelligence. The fraction of cooperation is similar in the early stages of the session, but diverges significantly between the two groups, with the high Intelligence reaching full cooperation, and lower Intelligence defecting. The difference in behavior is not due to an unconditional propensity to cooperate of higher Intelligence individual: with lower discount rates, where cooperation is not profitable, cooperation fails also in the high Intelligence group. The analysis of the data provides a complete explanation of the difference.

INTELLIGENCE AND HAPPINESS STABILITY: EVIDENCE FROM RUSSIA

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Over the past decade there has been growing interest in the association between intelligence and happiness. Within this literature, a new strand has emerged that investigates the link between intelligence and happiness stability or variability. This study explores the link between *intelligence (IQ)* and *happiness stability*, measured by the standard deviation of life satisfaction. Data for this study was taken from the RLMS, a series of nationally representative surveys designed to monitor the effects of Russian reforms on the health and economic welfare of households and individuals in the Russian Federation. A panel nature of RLMS individual data set was used covering 20 waves from the year of 1994 to 2015. The sample covers more than 71,000 observations of which around 27,000 are men and 45,000 are women. Using Ordinary Least Squared Regression analysis, we find that more intelligent cohorts are more stable in their happiness. This association is highly statistically significant (β=-0.004, ρ<0.01) even when we control for a large set of control variables. The results remain robust under a series of robustness tests.

DETECTING THE SCARR-ROWE EFFECT USING POLYGENIC SCORES IN TWO LARGE US SAMPLES

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Polygenic scores by virtue of their phenotypic correlations imperfectly but very directly index trait heritability, with the best polygenic scores derived for cognitive measures accounting for approximately 10% of the variance in these measures. By examining interactions between polygenic scores and cognitive measures as a function of childhood SES, it is possible to use these to detect Scarr-Rowe Effects, i.e. the reduction of IQ-heritability with lower childhood SES.

Two large genotyped samples of the US population were tested for Scarr-Rowe Effects, the Wisconsin Longitudinal Study (WLS) and the Health and Retirement Study (HRS), the former sampling the population of Wisconsin born in the 1930s and 40s, and the latter sampling the US population at retirement, specifically individuals born from the 1910s to 60s. A measure of childhood SES, along with individual polygenic scores (EA3) and cognitive ability measures were collected from 6256 individuals in WLS and 5275 individuals in HRS. Interactions were estimated using the Continuous Parameter Estimation Model, which allows for direct estimation the effect of one variable (childhood SES) on the change in covariance among two others (cognitive ability and EA3). Positive model β values indicate the presence of the Scarr-Rowe Effect, as increasing childhood SES predicts increasing covariance among EA3 and cognitive ability. This can be thought of in terms of increasing genetic expressivity of the polygenic score related to cognitive ability with higher childhood SES.

The effect, while small in magnitude, was present in the WLS (β = .08, p = 4.71 x 10^{-10}), and was robust to normalization of the SES parameter, could be recovered using a 'conventional' two-way interaction model, and did not yield sex differences (the effects were present and significant for both sexes, however). The effect was replicated in HRS (β = .05, p = .002, N=5275), was present in both sexes, and was robust to removing 'old' participants (those aged >55). The replicability of the Effect across these two databases also indicates substantial robustness, as they could be recovered using different operationalizations of both childhood SES and cognitive ability.

The use of polygenic scores in robustly detecting the Scarr-Rowe Effect yields a significant potential increment of power for studies investigating this effect, which are frequently handicapped by the use of smaller samples of twins. These results also remove ambiguities concerning the direction of causation. Here, lower quality childhood environments are directly suppressing the expressivity of genetic variants predictive of cognitive ability – preventing such individuals from attaining their full genetic potential well into late life.

HOW INTELLIGENT AND EDUCATED ARE THE AMERICAN ELITE? A STUDY OF 26,000 U.S. LEADERS ACROSS 30 SECTORS

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This study investigates the cognitive abilities and higher education backgrounds of 26,198 members of the American elite across 30 sectors. Broad groups include business leaders (e.g., Fortune 500 CEOs, 4-star generals, startup founders and CEOs), scientific achievers (e.g., Nobel Prize winners, National Academy of Science members), influential journalists and literary prize winners, (e.g., New York Times editors and writers, Pulitzer Prize winners), politicians (e.g., House members and Senators, Presidents and Vice Presidents), and elite faculty (e.g., Harvard University professors). We investigated school attendance for either undergraduate or graduate education: Harvard University, one of the 8 Ivy League schools, and a set of 34 most selective undergraduate and graduate schools based on average admissions test scores (e.g., SAT, ACT, GMAT, LSAT). Attending one of these 34 selective institutions indicated, based on standardized test scores, that the individuals were likely in the top 1% of cognitive ability given tests such as the SAT or ACT are proxy measures of general intelligence (*g*).

Top 1% in cognitive ability representation. Across all 30 groups, roughly half (54.2%) of individuals attended one of the 34 highly selective schools whose graduates are mostly in the top 1% of cognitive ability, ranging from 11.2%—25.9% (Four Star Generals, Four Star Admirals, House members) up through 78.9%—80.9% (Forbes most powerful men, Harvard Faculty, American Philosophical Society). Examples of groups that fell into the middle ranges included Fortune 500 CEOs (41.9%), Wall Street Journal editors and writers (50.8%), National Academy of Medicine members (60.5%), and National Academy of Sciences members (70.5%). Given that top 1% in ability people would be expected, on base rate, to make up 1% of these populations, this means top 1% in ability people were overrepresented in the American elite overall by a factor of about 54, ranging from 11 to 70 times for different groups, suggesting wide cognitive variation even across these highly select occupational and leadership groups.

Higher education representation. Of all American adults in the general population, about 32.5% have received a bachelor's degree. Within this 32.5%, about 1.9% have a degree from one of the 34 highly selective schools in our study, about 0.6% have a degree from one of the 8 Ivy League schools, and about 0.2% have a degree from Harvard University. This suggests that the percentages of individuals in each of these groups of leaders of U.S. society are quite high relative to population base rates. For example, if 54% of the 26,198 individuals in our sample attended one of the 34 highly selective schools and the base rate is about 1.9%, this suggests a factor of overrepresentation of roughly 28 times base rate expectations (calculated as 54/1.9). Across all groups, roughly 36% attended an Ivy League school, suggesting a factor of overrepresentation of roughly 60 times (36/0.6). Across all groups, roughly 16% attended Harvard University, suggesting a factor of overrepresentation of roughly 80 times (16/0.2).

INTELLIGENCE'S PLACE IN THE PSYCHOLOGY CURRICULUM

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Prior research has shown that psychology textbooks' treatment of intelligence is often erroneous and shallow (Pesta, McDaniel, Pozananski, & DeGroot, 2015; Warne, Astle, & Hill, 2018). However, it is unclear how much the broad college-level psychology curriculum contributes to the way intelligence is taught. To discern how intelligence fits into the broader postsecondary curriculum, we collected course descriptions and catalog information from 303 American colleges and universities. These institutions were drawn from a list of (a) leading universities, (b) leading liberal arts colleges, and (c) leading regional universities in the United States.

We found that college courses dedicated to mainstream intelligence science are rare, with only 12 courses including g-based theories of intelligence in their descriptions. We also found 195 courses dedicated to emotional intelligence (often offered in business or management departments) and 47 dedicated to multiple intelligences (frequently found in education departments). On the other hand, 200 courses on psychological testing included intelligence in their description, and for this reason we believe that some psychology students get exposed to at least information about intelligence. However, the near-total absence of classes dedicated to intelligence (only 4 at 303 universities) shows that many important aspects of intelligence research are missing from the postsecondary curriculum. We see the near-total abdication of teaching about intelligence as a possible contribution to the proliferation of classes on emotional intelligence and multiple intelligences in non-psychology departments and the widespread misconceptions about intelligence among the general public.

THE FIRST LONGITUDINAL INVESTIGATION OF COGNITIVE ABILITY IN ADULT ADOPTIVE FAMILIES

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Does the effect of rearing environment on childhood IQ persist well into adulthood? Despite decades of genetically-informed studies of IQ, this question has yet to be answered to satisfaction. Early adoption studies generally found that the IQs of young children correlated with those of their adopted parents, but that in adolescents this relationship was less stable and often disappeared altogether (Scarr & Weinberg, 1983). Newer research, by contrast, has suggested a substantial role of the family environment that amounts to about 4.4 IQ points (SE = 0.75) in 18–20-year-old Swedish adoptees (Kendler, Turkheimer, Ohlsson, Sundquist, & Sundquist, 2015). It is unclear, however, whether this relationship would remain robust after the offspring leave the family home and carve out their own lives, or whether it would show a "fadeout effect" of the parental environment, consistent with observations of many phenotypes (Polderman et al., 2015).

At the Minnesota Center for Twin and Family Research (MCTFR), the Sibling Interaction and Behavior Study (SIBS) has become the longest-running longitudinal study of adopted siblings in the world. This unique sample of 409 adoptive and 208 non-adoptive families includes a total of 1,164 parents and 1,232 offspring, with an average age of placement in adoptive homes of 4.7 months (SD = 3.4) McGue et al., 2007). These families were first assessed on ability and achievement measures beginning in 1998, when the average age of the offspring was 14.9 (SD = 1.9). As of fall 2018, these now adult individuals and their parents are in the process of being assessed for the fourth time. A total of 574 adopted and biological offspring between the ages of 26 and 40 have been interviewed so far on measures of achievement and ability, with a mean age of 32.2 (SD = 2.6).

At time of intake, IQ scores of biological children (N = 396; mean age = 14.8) correlated with their parents' scores at r = .365 ($p < .001$), and IQ scores of adopted children (N = 519; mean age = 14.9) correlated with parental scores at r = .09 ($p = .04$). At this time, we have assessed cognitive ability in about half of our sample of parents and offspring using the ICAR16 sample test, with comprehensive verbal IQ assessment on the way. ICAR scores of biological offspring (N = 165; mean age = 31.75) correlate with their parents' scores at r = .205 ($p = .008$), and adopted offspring (N = 171, mean age = 32.23) with their parents' scores at r = –.05 ($p = .497$). This association holds similarly for related cognitive phenotypes, such as GPA and educational attainment. Taken together, these incipient contrasting patterns of association are consistent with the diminishing effect of parental environment on measure of offspring cognitive ability well into adulthood.

WHY IS NARCISSISM THE STRONGEST PREDICTOR OF SUBJECTIVE INTELLIGENCE?

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Intelligence is regarded as highly agentic and socially desirable characteristic. Grandiose narcissists are typically preoccupied with the topic of intelligence, however the association between these constructs is still poorly investigated. In the current research the relationship between grandiose narcissism, objectively assessed intelligence and beliefs about intelligence were examined. In Studies 1 (n = 233) and 2 (n = 255) it was found that narcissism was the strongest predictor of subjectively assessed intelligence (SAI) and explained more variance (12% - 18%) in SAI than objective intelligence (measured with standard tests such as Raven's and Cattell's) and basic personality traits (Big Five). Additionally, narcissism did not correlate with objective intelligence.

Subsequently, we tested how narcissists perceive intelligence. In Study 3 (n = 362) we asked participants to judge how advantageous intelligence is for several life domains, e.g. life success, job performance, school achievements, income, social status, relationships, popularity and physical attractiveness. We found that narcissists believed that intelligence is beneficial mainly for social interactions and physical attractiveness. Finally, in Study 4 (n = 222) we examined how narcissists experience the situation of taking an IQ test. The results indicated that narcissists did not enjoy solving the cognitive ability test and reported low motivation in cognitive performance.

The current studies indicate that a belief in their intellectual superiority is an important building block of grandiose narcissists' self-concept. Furthermore, narcissists feel that high intelligence is a resource that buys people benefits in social interactions domains and they feel that they possess that resource. Moreover, they do not show genuine engagement in cognitive activities, but consider intelligence to be a source of benefits in multiple domains, including interpersonal relationships.

POSTERS IN ALPHABETICAL ORDER BY AUTHOR LAST NAME

UTILITY OF THE CATTELL-HORN-CARROLL THEORY OF COGNITIVE ABILITIES TO INTERPRET PERFORMANCE ON SPEECH-LANGUAGE TESTS

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The Cattell-Horn-Carroll (CHC) Theory of Cognitive Abilities (CHC Theory) has been well researched and validated as a comprehensive model of abilities and processes (Flanagan, Ortiz, & Alfonso, 2013; McGrew, 2009; Schneider & McGrew, 2018). It provides structure to clarify and categorize the various abilities and processes that impact functioning within and outside the classroom. Within the CHC framework, there are 17 second stratum or broad ability constructs including fluid reasoning, comprehension-knowledge, working memory, learning efficiency, and auditory processing to name a few. In addition, there are dozens of sub-abilities or narrow abilities that are specific measures of the broad abilities. Some of these narrow abilities are induction, lexical knowledge, auditory short-term storage, associative memory and phonetic coding.

CHC Theory has been applied to cognitive tests for decades. For example, the Woodcock-Johnson IV (Schrank, McGrew, & Mather, 2014) were designed with CHC as its blueprint or theoretical framework. The venerable Wechsler Scales, although a-theoretical, have been revised to include more and more CHC abilities and processes (Flanagan & Alfonso, 2017). Flanagan, Ortiz, and Alfonso (2017) have used CHC Theory to classify more than 1,000 subtests found on various cognitive, achievement, memory, and speech-language batteries to aid in test performance interpretation. Although several speech-language batteries have been revised or new ones have been released, their subtests have not been classified according to CHC Theory.

The authors examined the subtests of several speech-language batteries and using their expert knowledge and an extant database, classified each subtest according to its CHC broad and narrow abilities. A majority of the subtests appear to measure abilities and processes that make sense given that they are language-based subtests. For example, many subtests measure lexical knowledge, a comprehension-knowledge narrow ability and phonetic coding, an auditory processing narrow ability. However, other subtests seem to measure CHC broad and narrow abilities that are not intuitive such as working memory capacity, auditory short-term storage, retrieval fluency, and ideational fluency. Knowledge of the underlying abilities measured by speech-language subtests can aid in test performance interpretation and assist in making sound instructional and intervention recommendations. The utility of CHC Theory in the interpretation of performance on speech-language tests is explained and future research is suggested.

A LONGITUDINAL ANALYSIS OF THE EFFECTS OF COGNITIVE SKILLS AND NON-COGNITIVE SKILLS ON COUNTERPRODUCTIVE AND CITIZENSHIP WORKPLACE BEHAVIORS: A TEST OF ROBUSTNESS IN TWO SAMPLES

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Recently, there has been an increasing interest in how adolescent and childhood factors impact later adult behaviors and outcomes. Heckman (2012) noted the importance of both cognitive and non-cognitive skills on later educational and occupational success, while Vergunst et al. (2019) described a negative relationship between childhood disruptive behavior and later income level. However, there has been limited research on the impact of childhood influences on adult non-task job performance. Job performance, an indicator of occupational success, has typically been broken down into three categories: task performance, citizenship behaviors (positively adding to the social or psychological environment) and counterproductive behaviors (actions that harm the company and its members) (Rotundo & Sackett, 2002). General cognitive ability has been shown to be a robust predictor of task performance (Schmidt & Hunter, 2004), although less is known about the extent to which cognitive and non-cognitive skills contribute to the other two components of job performance, particularly from a longitudinal standpoint.

Building on the preliminary findings presented at ISIR last year (Anderson et al., 2018, oral presentation), this study employs two discrete longitudinal datasets spanning adolescence through middle age, to determine whether cognitive and non-cognitive factors contribute differentially to the behavioral components of job performance, and whether the findings are robust across the two samples.

Longitudinal research conducted by Roberts and colleagues (2007) suggests that both personality and intelligence at age 17 correlate with counterproductive work behaviors later in life, though their findings in regards to intelligence (a positive correlation) is counter to that of other studies (e.g., Dilchert et al., 2007). The current research will add to the existing body of literature on intelligence and counterproductive workplace behaviors, and extend this research area by examining citizenship behaviors and “soft skills” (a summary measure of the personality, school related behavior, and reversed externalizing behavior; see McGue et al., 2017) as well. Sample 1 will include over 400 individuals from the Minnesota Twin Family Study (MTFS) who were initially assessed at the target age 17 with the most recent follow-up when participants were in their early 40s. A second sample over 500 adopted and non-adopted offspring will allow us to examine the robustness of the effects found in sample one. These individuals were initially assessed in adolescence, with the most recent follow-up while the participants were in young adulthood.

Preliminary analysis from the first 307 individuals identified soft skills as significantly and moderately related to both counterproductive work behaviors and organizational citizenship behaviors. Similar to the findings presented by Roberts et al. (2007), general cognitive ability was significantly and positively associated with counterproductive workplace behavior. No relationship was identified between general cognitive ability and citizenship behavior.

THE G IN GRAMMAR: GRAMMAR USAGE IS AN INDICATOR OF GENERAL COGNITIVE ABILITY

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Grammar usage refers to how words, phrases, and punctuation are combined to create and communicate meaning. Here, we describe three findings that, taken together, imply grammar usage is an indicator of general cognitive ability. First, using an experimental design in which we manipulated the rate of grammar usage errors in a job application cover letter, we found that applicants (who would otherwise be viewed as strong candidates) were judged as less capable and less skilled if their letter contained grammar usage errors. Second, using a longitudinal pre-post design with ten weeks of distributed practice on typical grammar usage errors, we found that students' ability to identify and rectify common grammar usage errors is highly consistent over time and relatively unresponsive to intervention. Third, in that same longitudinal design we found that young adults' ability to identify and correct grammar usage errors on a five-minute assessment is highly predictive of their performance in a course designed not for writing but for analytical and statistical reasoning. Given the strong verbal ability component in many measures of *g*, we are not necessarily surprised that grammar usage shows similar characteristics to those seen with general cognitive ability. However, we may have serendipitously uncovered a five-minute measure of *g*.

COGNITIVE ABILITIES, DIVERGENT THINKING, AND THE ASPECTS OF OPENNESS

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Among the Big Five personality factors, Openness to Experience is notable for its significant, positive relationship to cognitive ability (Costa & McCrae, 1992). But the devil is ever in the details: DeYoung, Peterson, and Higgins (2005) noted that some facets of NEO-PI-R Openness (Fantasy, Aesthetics, Feelings) were correlated with crystallized ability whereas others (Ideas) were correlated with fluid ability and working memory. Later, DeYoung, Quilty, and Peterson (2007) used these results to buttress their argument in favor of the distinctness of their two "aspects" of Openness to Experience; namely, Intellect and Openness (hereafter, the term "Openness" will be used to refer only to the aspect, not the broad trait). We sought to replicate and extend these findings using an age-diverse sample of 331 individuals with scores on the Johnson O'Connor Ability Battery (JOAB) and the Synthetic Aperture Personality Assessment (SAPA; Condon, 2017).

Because the JOAB consists of many different tests, we wondered which abilities, if any, would be related to Openness rather than or in addition to Intellect. We hypothesized that all cognitive ability tests would be positively related to Intellect; we also predicted that a measure of divergent thinking (DT; operationalized using scores on the JOAB Foresight test) would be positively related to Openness. We set about testing these predictions using scores on DT as well as on a subsample of nine JOAB tests (N = 43,540) which recreated the four-factor model of ability discussed in Haier et al. (2009): Speed of Reasoning, hereafter "Speed;" Spatial; Numerical; and Memory; plus a single-test "factor" of Verbal ability (the JOAB English Vocabulary test). Among the 331 individuals with scores on both SAPA and JOAB, all five cognitive ability factors as well as DT were significantly positively correlated with Intellect, whereas only DT was significantly positively correlated with Openness.

Although these findings were largely in line with expectation, we were intrigued to note not only that DT was also related to Intellect, but also that Openness was marginally positively related to several cognitive abilities (namely, Speed and Spatial). Simultaneous regression analyses showed that a model in which the five cognitive abilities and DT predicted Intellect was significant (adjusted R^2 = .296), although only three of the predictors had significant coefficients (Speed, ß = .164; Verbal, ß = .317; DT, ß = .142). A model in which the five abilities and DT predicted Openness was also significant (adjusted R^2 = .083) and, as hypothesized, only the regression coefficient for DT achieved significance (ß = .297). Notable marginally significant results, however, were obtained for Spatial (ß = .124, p = .052) and, unexpectedly, Numerical (ß = -.113, p = .086) abilities. The latter is most likely a suppressor effect; that is, we may infer that the part of Numerical ability that is independent of Speed, Spatial, Verbal, Memory, and Divergent Thinking ability is negatively related to the Openness aspect.

CROSS-BATTERY RELATIONS OF CHILDREN'S COGNITIVE ABILITIES AND READING AND WRITING

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Research that incorporates multiple intelligence and achievement tests, known as cross-battery analyses, can better address questions about the broader influences of children's cognitive abilities on their achievement. Such cross-battery research will extend psychologists' understanding of how intelligence and achievement relate not just at the test-level, but at the broader construct level. Previous cross-battery studies were often limited to two tests and were mostly based on the Woodcock-Johnson tests (McGrew & Wendling, 2010). Thus, findings are not necessarily generalizable across other tests and indeed differences based on the tests used have been found. Whether or not intelligence tests measure the same abilities, despite differences across tasks, and whether or not cognitive-achievement relations are reproducible across several batteries, are questions with both theoretical and clinical implications.

Six intelligence tests (KABC-II, WJ III, WISC-III, WISC-IV, WISC-V, and DAS-II) and three achievement tests (KTEA-II, WIAT-II, WIAT-III) were included in a cross-battery cognitive-achievement analysis. Participants were 3,930 youth aged 6 to 16 drawn from 7 nationally representative standardization and linking samples provided by Pearson. The sample sizes ranged from 181 to 2,520 per sample. Samples were linked to each other by tests they shared in common. In order to simultaneously analyze several tests a planned missingness methodological approach was used, which addresses concerns regarding bias and power (Enders, 2010; Graham et al., 2006). Also, modern structural equation modeling techniques for handling missing data, maximum likelihood estimation, allow researchers to analyze the data without discarding incomplete cases.

A higher-order Cattell-Horn-Carroll model with 6 broad abilities (Gc, Gf, Gv, Gsm, Gs, and Glr) and *g* was tested; each latent broad ability variable was indicated by 7 – 12 measured variables, the subtests. This comprehensive cross-battery cognitive model was used to test 2 models, a broad writing and basic reading model. A broad writing latent variable was indicated by 6 subtests which measured students' spelling and written expression. A basic reading latent variable was indicated by 4 subtests which measured word recognition and pseudoword decoding. The fit of the 2 models was adequate to good. Gc, Glr, and Gsm were statistically significantly related to basic reading (β = .40, .25, and .22 respectively). And Gc, Glr, Gs, and Gsm were statistically significantly related to broad writing (β = .29, .29, .23, .22 respectively). When tested separately, *g* had large effects on both basic reading and broad writing (β = .75 and .82 respectively).

PUBLIC PERCEPTION AND PRESS COVERAGE OF INTELLIGENCE RESEARCH IN THE FRENCH REPUBLIC

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The French seem to be largely underrepresented among intelligence researchers (Becker, Rindermann & Coyle, 2018: fig. 5). We hypothesize that this might be due to poor knowledge among the general population, or to insufficient or unrepresentative press coverage of today's intelligence research. To verify these hypotheses, we use the data from the French participants (N = 54) of the International Genetics Literacy and Attitudes Survey (iGLAS), an international survey evaluating public knowledge of genetics and the heritability of intelligence and other behavioural traits. We also assess the themes covered in articles on human intelligence published between 1999 and 2019 in French nation-wide generalist newspapers (N = 103), local generalist newspapers (N = 15), and scientific magazines (N = 76), and we discuss in what measure these themes reflect the current evolution of intelligence research. For the French participants of iGLAS, the rate of correct answers on Genetic Knowledge items is 67%, a percentage comparable to that of other Western European countries. The two main themes covered in the French press appear to be, on the one hand, environmental factors presented as influencing IQ (33% in nation-wide newspapers, 0% in local newspapers, 19.74% in scientific magazines), whether positive (e.g. breastfeeding or fish consumption) or negative (e.g. pollution); on the other hand, high-IQ children and their social difficulties (18.4% in nation-wide newspapers, 26.7% in local newspapers, 5.3% in scientific magazines). Press coverage was scarcer for areas of intelligence research that are nonetheless very active nowadays, e.g. the neurobiological basis of intelligence (1.9% in nation-wide newspapers, 0% in local newspapers, 2.6% in scientific magazines) and genome-wide association studies related to intelligence (1% in nation-wide newspapers, 0% in local newspapers, 0% in scientific magazines). The number of iGLAS participants and collected newspaper articles is still increasing at the time of submission of this abstract and is expected to be substantially higher in July.

RELATIONS AMONG VERBAL ABILITY, SELF-COMPETENCE, AND TASK MOTIVATION IN THE TRANSITION FROM PRIMARY TO SECONDARY SCHOOL.

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A meta-analysis of TIMSS and PISA test found negligible sex differences (*d=*.01-.11) in mathematics achievement across 87 countries **(Else-Quest, Hyde, & Linn, 2010).**However, in a meta-analysis of school grades, girls outperformed boys across all subjects, size effects are small but consistent (*d*=.154-.374) **(Voyer & Voyer, 2014)**.

Under Eccles' (1983) model, motivation includes students' task value and self-competence**.** Some research shows that girls tend to see themselves more competent in languages than physics or mathematics, whilst the opposite is true for boys, even when there are no achievement differences. In addition, self-competence and task value tend to decline with age in a sex and subject-specific fashion during the transition from primary to secondary school, though the extents vary across countries. Moreover, self-competence seems to be related to high ability for boys but not so much for girls. We explored relations among these observations in Waves 5 and 6 (11 and 14 years old, n=13,000+) of the Millennium Study Cohort, an ongoing longitudinal study carried out in the UK since 2000, using regression. Our hypotheses were:

- Sex differences favoring girls in overall academic achievement and in each specific subject.
- Sex differences in self-competence and task-value (relatively higher in language than math in girls and the opposite in boys) in both waves.
- Verbal ability is most strongly associated with academic achievement, followed by self-competence and task value at both waves.
- Self-competence and task value decline between ages 11 and 14 is sex- and subject-specific: slower for language than mathematics in girls, and the opposite for boys.
- Verbal ability moderates relations between sex and self-competence and task value so that high-ability children experience relatively lower declines; this effect is not as strong in higher-ability girls than in higher-ability boys.

We will discuss how results may shed light on sources of the current tendency for girls to maintain higher academic achievement than boys.

RELATIONS BETWEEN GENERAL INTELLIGENCE, EMPATHIZING, SYSTEMIZING, AND THEORY OF MIND

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Background: Previous research suggests that measures of theory of mind, empathizing, and systemizing are unrelated to general intelligence. However, more recent research suggests that theory of mind is moderately related to general intelligence. The present study aimed to replicate the previously suggested relationship between theory of mind and general intelligence. Furthermore, it extends the literature by examining the relationship between general intelligence and empathizing and systemizing. In addition, as all of these measures have been related to college major choice (i.e., STEM versus humanities), the present study also examined the relationship between general intelligence, theory of mind, empathizing, systemizing, and feelings towards STEM and humanities majors.

Method: A general intelligence factor was calculated using the total scores of the 4 sections of the International Cognitive Ability Resource (ICAR). Supplemental analyses were conducted using a general intelligence factor calculated from the subsections of the ACT college admissions test and (to increase sample size) composite ACT scores. Empathizing and systemizing were based on the Empathy Quotient Short Form (EQ) and the Systemizing Quotient Short Form (SQ). Theory of mind was based on the Reading the Mind in the Eyes Revised Version (RMET). Feelings towards STEM and humanities were based on within-subjects difference scores from Likert scales on which participants ranked the extent to which they like and dislike STEM and humanities. Sample size was N = 431. Pearson's correlations were conducted for all variables. In addition, an exploratory mediation was conducted to determine if SQ mediates the relationship between general intelligence and feelings towards STEM majors using the PROCESS plug-in for SPSS.

Results: As expected, theory of mind, empathizing, and systemizing were all at least modestly related to general intelligence (r = .27, -.15, .27 respectively). However, the relationship between empathizing and general intelligence was unexpectedly negative. Also unexpectedly, theory of mind (RMET) was not significantly related to empathizing (EQ) (r = -.00). General intelligence and systemizing (SQ) were not significantly related to feelings towards humanities (r = .05, .02 respectively), and theory of mind was not significantly related to feelings towards STEM (r = -.04). Supplemental analyses using ACT based measures of general intelligence support the results of primary analyses. An exploratory mediation suggests that SQ significantly mediates the relationship between general intelligence and feelings towards STEM majors (β = .11, 95% BC CI [.07, .15]). However, this mediation only explains half of the variance shared between general intelligence and STEM difference scores.

Discussion: The results support a relationship between general intelligence, theory of mind, empathizing, and systemizing. However, the negative relationship between empathizing and general intelligence may suggest that empathizing is being used to compensate for low general intelligence. Theory of mind was not related to empathizing, possibly suggesting that people do not accurately self-report empathy. Unexpected patterns in the relationships between variables and feelings towards STEM and humanities may suggest that certain skills that are necessary to be successful in either STEM or humanities are not universally necessary in all fields.

GENERAL INTELLIGENCE (G) AND THEORY OF MIND DIFFERENTIALLY PREDICT PERFORMANCE IN A MULTIPLAYER GAME: A MULTILEVEL ANALYSIS OF INDIVIDUAL AND GROUP LEVEL EFFECTS

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Background: The current study used a multiplayer game to examine the effects of general intelligence (*g*) and theory of mind (ToM) in small (4 people) and large groups (8 people). The game rewarded groups that coordinated effectively and adopted a patient (rather than selfish) strategy. Multilevel analyses examined the effects of *g* and ToM at the group (mean of group) and individual levels (after removing group effects). A key question was whether the effects of *g* and ToM varied at the two levels and with group size.

Predictions were based on the functional intelligences proposition (FIP; Freeman et al., 2016). The FIP argues that diverse sets of abilities predict performance in complex games better than homogeneous sets of abilities, provided the abilities are: (a) relatively independent and (b) functionally relevant (well-suited to the task). These assumptions apply to ToM and *g*, which share limited variance. In addition, whereas ToM facilities social problem solving (via social inferencing and mind reading), which in turn facilitates coordination in multiplayer games, *g* taps the ability to adapt quickly to complex, dynamic games (like the game used here).

Method: *g* was based on the ACT, a college admissions test that correlates strongly with IQ and *g* obtained from diverse tests such as the ASVAB (r=.77, Koenig et al., 2008). ToM was based on the Reading the Mind in the Eyes Test (RMET), where participants infer emotions from eyes, and the Short Story Test (SST), where participants infer characters' mental states. College students (N=336) played six rounds of the foraging game, a multiplayer strategy game. Subjects collected tokens in groups of 4 or 8 in the first three rounds, with group size switched in the last three rounds. Tokens (dependent variable) regenerated under a complex proximity rule, which rewarded groups that adopted a patient strategy and refrained from quickly overharvesting. Multilevel analyses of *g* and ToM examined within effects (obtained after removing group effects), and between effects (based on group means). Effects are unstandardized coefficients.

Results: Initial analyses of tokens collapsed across groups and rounds. Between effects were positive and significant for all predictors (3.24, 4.35, 5.58) indicating that higher *g*/ ToM predicted more tokens. In contrast, within effects (ACT, RMET, SST) were negative and significant ($p<.05$) for all predictors but RMET (-1.32, -.46, -1.49), indicating that higher *g*/ToM generally predicted fewer tokens. The sign of effects replicated when accounting for group size (4 vs. 8) and round (1-3 vs. 4-6), with negligible differences between group sizes and rounds.

Discussion: The results supported the FIP. Between effects were *positive*, indicating that higher *g*/ToM predicted better group performance. In contrast, within effects were *negative*, indicating that higher *g*/ToM predicted lower individual performance. The latter finding suggests that individuals with higher *g*/ToM adopt a patient strategy to optimize token collection, whereas individuals with lower *g*/ToM adopt a selfish strategy that leads to overharvesting. Future research might consider personality traits (agreeableness) that contribute to strategic behavior in multiplayer games.

INTELLECTUAL PERFORMANCE IN CHRONOTYPES: EFFECTS OF SLEEP QUALITY

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Existing studies provide conflicting results regarding links between intelligence and the dimension of morningness-eveningness. This study aimed to deepen understanding of associations between intellectual performance and chronotype – an individual characteristic describing functioning during 24 hours day. Evening chronotypes often suffer lowered sleep quality like inadequate sleep length or other sleep problems due to social jet lag they experience (sleeping in biologically non-optimal hours). Lowered sleep quality, on the other hand, can impact on cognitive performance including working memory, which has detrimental effect on performance in tasks measuring fluid intelligence. This effect can be immediate and presumably best observable during the morning following night with lowered sleep quality. Thus, we expected that synchrony effect between chronotype and time of day on performance in tasks measuring fluid intelligence diminishes when sleep quality is controlled for. To test this hypothesis university students completed measures of chronotype and performed tests for fluid intelligence in the morning, while their sleep quality a night before testing was assessed by actigraphy and self-reports. The results will be discussed in terms of their relevance for synchrony effect.

INVARIANCE OF A WJ IV COGNITIVE ABILITIES MODEL FOR GIFTED, GIFTED/LEARNING DISABLED, AND NON-GIFTED INDIVIDUALS

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Intelligence test results inform diagnosis and support of individuals with exceptional characteristics, including those who are gifted or have a learning disability. Such exceptional populations have unique cognitive characteristics, however, and few studies have examined whether intelligence tests are comparable for these groups and the population as a whole. This study compared the structure and measurement of intelligence across gifted, gifted/learning disabled (GLD), and non-gifted individuals.

Data came from the standardization sample for the Woodcock Johnson (WJ IV) Tests of Cognitive Abilities, Oral Language, and Achievement. The sample contains 6,817 individuals ages 5 to 93and is representative of the U.S. population in terms of ten census variables. Individuals in the sample were identified as potentially gifted or GLD based on their WJ IV cognitive and academic scores. A multigroup means and covariance structures analysis was used to test configural, metric, and scalar invariance of a cognitive abilities model across gifted, GLD, and non-gifted groups.

An initial latent abilities cognitive model based on a WJ IV validity study by Niileksela and colleagues (2016) demonstrated adequate fit with the entire sample, $\chi^2(190) = 9597.29$, CFI = .872, RMSEA = .086, SRMR = .046, AIC = 9767.29 but demonstrated poor fit with the gifted group and would not run with the GLD group. Multiple revisions were attempted to improve the fit; some revisions were informed by non-significant and negative correlations among cognitive abilities in the gifted and GLD groups. The revised cognitive abilities model was hierarchical with a latent general intelligence (*g*) factor and measured variables for various Cattell-Horn-Caroll (CHC) broad abilities, with a combined Gf-Gc composite score due to a strong negative correlation (-.63) between Gf and Gc for the GLD group.

The cognitive model demonstrated configural and metric invariance across all three groups. Partial scalar invariance for the GLD/non-gifted model was achieved when the intercept for Gf-Gc was allowed to vary across groups; the Gf-Gc intercept for the GLD group (115.12) was more than one standard deviation higher than the intercept for the non-gifted group (97.97) given the same level of *g*. The gifted/GLD scalar invariance model would not run because the variance of *g*was near zero for the GLD group when measured intercepts were constrained to be equal across groups. Despite adequate fit of the overall model, the loading of Gs on *g*was small and not significant for the gifted (.02) and GLD groups (.03).

From a theoretical standpoint, the cognitive abilities of gifted and GLD individuals violated the positive manifold observed by Spearman. Results also challenge the utility of the typical CHC model of intelligence (and related scoring on intelligence batteries) for gifted and GLD populations. Specifically, full-scale IQ scores may underestimate the verbal abilities and fluid reasoning of GLD individuals and the role of processing speed in gifted intelligence is unclear. Although these results are due in part to selection effects, the same effects also apply to the real-life selection of gifted individuals and are therefore still relevant to practice.

MIGRATORY EVOLUTION OF IQ AND EMINENCE

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Eons ago a few sons of East-African haplotype A males and maternal group I1 females began migrating northward. About 275.000 years later some of their descendants settled down in a narrow polygon-shaped core of today's Europe as predominantly haplotype I-L22 males. There they, and some of their sons who eventually migrated to offshoot countries like the US, brought about 97% of all generally agreed major human accomplishments to fruition - mainly between 1400-1950 - as documented by Murray (2003) using standard historiometric methods.

This study examines the idea that current population differences in IQ and their covariant traits, including eminence, are largely punctuated migratory spin-offs of unforgiving prehistoric latitudinal geo-bio-climatic natural selection.

Test of this idea includes modeling of cognitive data (5^{th}. degree polynomial, binomial, and dual-line linear regression) for geographical areas within $\pm 25^{o}$ longitude. This indicates 1) that the latitudinal progression in migratory IQ is 11.5 times steeper within Africa than outside it, 2) that the IQ curve reaches an asymptote just north of the Mediterranean Sea ($\approx 39^{0}$ latitude), and 3) that IQ does not evolve under east-west migration (not even along a global longitudinal gradient).

A 5-part econiche/ecotype classification is then construed to check whether grading of average current ecologic ecotype IQs and covariate trait patterns corresponds with grading of physical average selective geo-bio-climatic econiche conditions. The hypothesis to be tested is that the 5-point series of punctually "frozen-in-time-and-space" ecotype IQs and their covariate trait patterns for those who settled down permanently in various geo-bio-climatic zones along the latitudinal gradient, mirror the corresponding series of prehistoric selective forces that dominated their permanent settling-down in econiches calling for site-specific fine-tuning of their covariant Gaussian ecotype trait pattern optimal for survival and reproduction right there. The other hypothesis is that extraordinary scientific and artistic success is virtually the evolutionary prerogative of high-IQ male European polygon settlers, the forefathers of which had survived the full lateral progression of harsh geo-bio-climatic selection through optimized polygene structures for IQ nexus traits.

With both hypotheses supported, it is concluded that the modern latitudinal co-distribution of geo-bio-climatic econiche characteristics, haplotypes, brain size, IQ, and behavioral traits including eminence is consistent with a migratory theory of serial progressive polygene and behavioral optimizations during prehistoric northbound migration. No doubt the recent explosion in large-scale genome wide association studies will throw further light on the evolutionary basis for modern individual and group differences predictable in terms of progressive northwardly extended structural polygene selection for IQ and covariant trait patterns, and it requires pervasive genetic and demographic evidence to causally explain the evolution of still more sophisticated social infrastructures, agriculture, industrialization, modern welfare states, and the supreme scientific and artistic accomplishments in core Europe.

Murray, C. (2003). Human Accomplishment: The pursuit of excellence in the Arts and Sciences, 800 B.B to 1950. New York, USA: HarperCollins Publ.

DIFFERENTIAL RELATIONS OF EXTERNALIZING TO INTELLIGENCE AND CREATIVITY

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Externalizing behaviors such as aggression and substance abuse have been widely found in the psychological literature to be negatively correlated with specific aspects of cognitive ability such as emotional intelligence, and more limited research links externalizing to lower general intelligence. Conversely, externalizing and other psychopathological characteristics may actually confer advantages in certain cognitive domains, such as creativity. The relationship between creativity and general intelligence has been widely researched, and though it seems intelligence is generally positively correlated with creativity, other factors play a role when it comes to individual differences in creativity. The present study sought to investigate the relationship between IQ, externalizing behavior, and creative achievement. We hypothesized that, somewhat paradoxically, despite their negative correlation with one another, both externalizing and intelligence would positively predict creativity. To this end, we administered measures of creativity, externalizing, and intelligence to participants from two independent samples.

Participants in Sample 1 (N = 304) completed the Externalizing Spectrum Inventory, and those in Sample 2 (N = 234) completed a collection of six self-report externalizing measures. Participants in both samples also completed the Creative Achievement Questionnaire and four subtests of the Weschler Adult Intelligence Scale. Structural equation modeling was used to examine the effects of externalizing and intelligence on creative achievement.

Latent variables corresponding to externalizing and intelligence were negatively correlated in both Samples 1 (r = -.15, p = .033) and 2 (r = -.24, p = .018). In Sample 1, creative achievement in the arts was positively predicted by both externalizing (β = .33, p < .001) and intelligence (β = .27, p .004). In Sample 2, creative achievement in the arts was positively predicted by externalizing (β = .25, p = .035), but not intelligence (β = -.06, p = .551).

Taken in tandem with past research, findings suggest that both externalizing and intelligence may positively contribute to creative achievement, despite their negative correlation with one another. This presents an example of statistical suppression, which should be considered by future researchers individually investigating the factors of externalizing and intelligence in relation to creativity. Implications for broader research on psychopathology, creativity, and cognitive ability will be discussed.

COGNITIVE ABILITIES, DIVERGENT THINKING, AND THE ASPECTS OF OPENNESS

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Among the Big Five personality factors, Openness to Experience is notable for its significant, positive relationship to cognitive ability (Costa & McCrae, 1992). But the devil is ever in the details: DeYoung, Peterson, and Higgins (2005) noted that some facets of NEO-PI-R Openness (Fantasy, Aesthetics, Feelings) were correlated with crystallized ability whereas others (Ideas) were correlated with fluid ability and working memory. Later, DeYoung, Quilty, and Peterson (2007) used these results to buttress their argument in favor of the distinctness of their two "aspects" of Openness to Experience; namely, Intellect and Openness (hereafter, the term "Openness" will be used to refer only to the aspect, not the broad trait). We sought to replicate and extend these findings using an age-diverse sample of 331 individuals with scores on the Johnson O'Connor Ability Battery (JOAB) and the Synthetic Aperture Personality Assessment (SAPA; Condon, 2017). Because the JOAB consists of many different tests, we wondered which abilities, if any, would be related to Openness rather than or in addition to Intellect. We hypothesized that all cognitive ability tests would be positively related to Intellect; we also predicted that a measure of divergent thinking (DT; operationalized using scores on the JOAB Foresight test) would be positively related to Openness. We set about testing these predictions using scores on DT as well as on a subsample of nine JOAB tests (N = 43,540) which recreated the four-factor model of ability discussed in Haier et al. (2009): Speed of Reasoning, hereafter "Speed;" Spatial; Numerical; and Memory; plus a single-test "factor" of Verbal ability (the JOAB English Vocabulary test). Among the 331 individuals with scores on both SAPA and JOAB, all five cognitive ability factors as well as DT were significantly positively correlated with Intellect, whereas only DT was significantly positively correlated with Openness. Although these findings were largely in line with expectation, we were intrigued to note not only that DT was also related to Intellect, but also that Openness was marginally positively related to several cognitive abilities (namely, Speed and Spatial). Simultaneous regression analyses showed that a model in which the five cognitive abilities and DT predicted Intellect was significant (adjusted R^2 = .296), although only three of the predictors had significant coefficients (Speed, ß = .164; Verbal, ß = .317; DT, ß = .142). A model in which the five abilities and DT predicted Openness was also significant (adjusted R^2 = .083) and, as hypothesized, only the regression coefficient for DT achieved significance (ß = .297). Notable marginally significant results, however, were obtained for Spatial (ß = .124, p = .052) and, unexpectedly, Numerical (ß = -.113, p = .086) abilities. The latter is most likely a suppressor effect; that is, we may infer that the part of Numerical ability that is independent of Speed, Spatial, Verbal, Memory, and Divergent Thinking ability is negatively related to the Openness aspect.

COGNITIVE OPERATIONS UNDERLYING SOLVING OF DOMAIN-SPECIFIC CASES BY NOVICES AND EXPERTS IN MEDICINE

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Development of expert performance in medicine is well described in literature (Patel et al., 1990; Boshiuzen, Schmidt, 1992; Mylopulous, Regehr, 2009). However, specific cognitive mechanisms and operations underlying intellectual productivity of 'novices' and 'experts' in medicine remain obscure. Our study aimed at: 1) defining a role that IQ plays in solving of domain-specific tasks by novices in medicine and medical experts; 2) describing cognitive operations that underlie solving of such tasks in both groups. We predicted that: 1) IQ is of minor importance for successful solving of domain-specific tasks in both 'novices' and 'experts' in medicine; 2) 'novices' and 'experts' in medicine involve different cognitive operations while solving domain-specific tasks.

Participants were 30 doctors of various medical specializations (10 males, aged 21 – 48, mean – 27 y.o.): 15 'novices' (< 3 years of practice), 15 'experts' (> 3 years of practice). After being tested with J. Raven's SPMT, they solved 5 professional cases during indepth interviews. Cases were based on real practice; required diagnosis and suggestion of treatment options for a somatic disease; did not require any narrowly-specialized knowledge; could be solved not through applying stereotyped superficial solutions, but through systematic analysis of the issue. For each case, a group of experts (N = 9) suggested an etalon answer. Interviews (t = 45 hours) were audio-recorded and then transcribed verbatim; written protocols were assessed by two experts who scored the answer for each case 0, 1, 2 or 3 depending on how close/far it was from the etalon. Based on the sum of the scores, participants were divided by median in 'successful' (0 – 6 scores, N = 15) and 'unsuccessful' (> 6 scores, N = 15) groups which did not overlap with 'novices' and 'experts'. Mann-Whitney test showed that 'experts' were more successful in solving cases compared to 'novices' ($p = 0{,}015$). No differences in IQ between 'novices' and 'experts' ($p = 0{,}058$), nor between 'successful' and 'unsuccessful' participants ($p = 0{,}298$) were found, which supports our prediction and corresponds to the results of our previous study (Shcherbakova, Makarova, 2016). We interpret these findings that mechanisms of experts' intellectual productivity differ from those underlying high level of psychometric intelligence.

Qualitative analysis of the interview's protocols revealed differences in cognitive operations that 'novices' and 'experts' involve while solving cases. 'Novices' tend to choose one solution and develop it ignoring any logical incongruencies and not accounting feedback; do not embrace all aspects of the problem situation; do not critically assess the results of their thinking; do not doubt hypotheses they suggested; prefer stereotyped solutions, simplified representations of problem situations and display 'naïve' intellectual behavior. 'Experts' actively seek for extra information; change their hypotheses after receiving feedback; do not operate with discrete symptoms but display systematic analysis of a problem; acknowledge their own mistakes; display insistence of their cognitive attempts.

Our future research will focus on examining patterns of electrophysiological activity displayed while solving domain-specific cases by medical 'novices' and 'experts'.

Supported by the Government of Russian Federation grant № 14.W03.31.0010

THE IRT DIFFERENCES IN RUSSIAN AND YAKUT SAMPLES

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Differences in intelligence of Yakuts and Russians has been founded by the direct research by Standard Progressives Matrice Plus version (non-verbal, cross-cultural test).

There was calculated the differences betwenn ethnic Russians (n=968) and ethnic Yakuts (n = 702) by the IRT theory (DIf, Lord (1980) and also Mantel-Haenszel method were used also).

Here the picture turned out like this. B9, B10, B11, B12, C11 are significantly shifted, and C3, C4, C12 are marginally significantly shifted in favor of the Russians; D3, D6, E1, E2, E3, E4, E6 are significantly shifted, and C7, D4, D8, E10 are marginally significantly shifted in favor of the Yakuts.

DIF in two of the three, at least, methods are detected by points B9, B10, etc. A connected group consists of paragraphs B9-B12. These tasks look quite simple, but for some reason represent a certain difficulty for the Yakuts.

The following explanations are possible.

1. In European culture there is a “scheme”, a kind of gestalt: Aa, AB, Bb, ab. It facilitates the filling of one of the elements in case of its absence;

2. It is more difficult for Yakuts to switch from a perceptual decision to an analytical one.

G LOADINGS OVER THE 20TH CENTURY: ANALYSIS OF CARROLL'S HUMAN COGNITIVE ABILITIES DATA SET

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The Flynn effect is a phenomenon of temporal dynamics of psychometric intelligence, namely the increase in intelligence scores over the 20th century. The research question of the current study was to estimate two more temporal characteristics of intelligence which presumably were changing over the 20th century. They are intelligence tests' g loadings, and the amount of variance explained by g factor.

The data on 21 intelligence tests (or subtests) present in at least 3 correlation matrix during 1930-1991 was extracted from Human Cognitive Abilities Data Set Archive. Among them there were 9 subtests of WAIS, some subtests Kit of Factor Referenced Cognitive Tests, SPM, CPM, etc. We have analyzed 77 correlation matrices with 214 tests in total. Principle component factor analysis was conducted on each correlation matrix which allowed to calculate factor loadings on the first factor for each intelligence test. We also estimated g factor variance (i.e. variance explained by a first factor without rotation) in each study. For each intelligence test the correlation between year of the study and g loading was calculated. Correlation coefficients took a range of values from -0.74 to 0.25. The meta-analysis based on the random effects model demonstrated that mean value was -0.165 ($p=0.04$). Besides for each intelligence test the correlation between year of the study and variance explained by g factor was calculated. Correlation coefficients took a range of values from -0.90 to 0.62. The mean value was -0.2 ($p=0.0179$). These results indicate that the Flynn effect) is accompanied by weakening of general intelligence factor (i.e. by decrease of intelligence tests' loadings on g factor and by decrease of factor g variance).

The obtained results can be considered in the framework of structural-dynamic theory of intelligence developed by D. Ushakov. The key notion of the theory is the individual's cognitive potential, which defines how quickly an individual forms cognitive systems that can provide the problem solution. The theory assumes that intelligence structure is being formed by investment of cognitive potential to different ability domains determined by influence of social and cultural environment. The increase of intelligence under favorable environment may follow any direction but its limit is determined by genetics behind cognitive potential. As soon as this limit is faced the increase may still keep going up in some directions but at the expense of other domains. Thus the redistribution of the cognitive potential from one domain to another is taking place. The Flynn effect registered by means of intelligence tests reflect development of rational constituent of cognitive potential over the 20th century caused by transition from industrial to postindustrial society. Along with that the diversity of environmental conditions is increasing, and due to general humanization and liberalization of society people obtain the possibilities to choose from a wider set of alternative scenarios of specialization and investment of cognitive potential. This phenomenon may manifest itself in g factor's weakening and decrease of intelligence tests' g loadings.

This research was supported by the Russian Foundation for Basic Research, project № 17-06-00574

ANALYSING VISUAL SEARCH STRATEGIES IN ARTISTS AND ENGINEERS – AN EYE TRACKING STUDY ON RPM

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Understanding visual search process and correlating to performance in fluid intelligence tests provides insights to the strategies applied (constructive, elimination techniques) and thinking styles. We explored the role of skill training on strategy for two diverse groups – fine art students (divergent thinking) and engineering students (convergent thinking style) with basic artistic skills. The standard Raven's progressive matrices (RPM) was considered. Two sections of RPM (D,E levels) was administered to 8 (3 subjects data points were discarded due to low % of eye data) students of fine arts (age = 23-31, 2 females) and 5 artistically inclined engineering students (age = 18-23, 3 females). Levels D,E were selected for their difficulty level and novel patterns. Questions in D and 10 questions of E are constructed based upon certain sets of rules. D-level contains multiple patterns in a single question presenting perceptual challenge, while the E-level exhibits patterns with simple arithmetic operations and identification of similarities thus testing for analytical ability. The questions were ported as a computer-based application implemented using a game engine (Unity-3D). The order of presentation of questions were rearranged to reduce spatial memory confounds by ensuring that no two questions follow the same rule of deduction and to disrupt repetitive pattern logic. Eye tracking data was collected with Tobii T-120 and X2-30 systems. Fixations and scan-path of each participant/question was analyzed.

The engineering students (score range: 24 to 12, M = 18.8, SD = 4.62) performance was better than artists (score range: 12 to 7, M = 10.8, SD = 1.93). Higher difference was noticed in the E-level (Engineering : M = 9.2, SD = 3.18; Artists : M = 3.2, SD = 1.32). The analysis of scan-path indicated that both sets of participants majorly apply either of the 3 pattern-identification techniques : horizontal (row-wise) , vertical (column-wise), diagonal (pair-wise scan of diagonal elements). It was observed all participants most questions were answered using horizontal scan-path though no significant advantage (performance) was observed for any of the three scan strategies. A Structural Similarity Index Method algorithm applied to compare image structural similarity in the respective scan-path directions found no significant difference too. Artists tended to fixate on the last row and the missing matrix element, while engineering students rarely do so. A possible explanation based on the thinking styles is, artists construct the missing element by evaluating multiple solutions while engineers deduce a single solution. A secondary possible process by artists can be an attempt to create a design to fit the missing element derived from the shape/structure continuity of the other elements.

The options (provided at the bottom of the matrix) were not considered by the engineering students (fixation count < 25.5%) indicative constructive technique, while artists (fixation count > 41.1%) seem to have applied the elimination technique. Though preliminary, the results point at possible preference of artists towards constructing an answer attributed to their training or ability in creating patterns. Further testing with larger participant set are required to arrive at stronger observations.

COGNITIVE PREDICTORS OF THE VARIATION IN STANDARDIZED TEST PERFORMANCE IN RUSSIA AND KYRGYZSTAN

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The Unified State Exam (USE) has been serving as a tool for assessment of learning outcomes at school and for university admissions in Russia since 2006. In our previous research, the variation of Mathematics and Russian USE performance remained largely unexplained after taking into account mathematical ability, intelligence, basic cognitive functions and differences in mathematical curricula (Voronin et al., 2018). The aim of current study is to provide more evidence on the variability in standardized test performance and to compare USE to Nationwide Testing (NT), a Kyrgyz replica of SAT. All school students in Kyrgyzstan have to pass Main NT for further college admission. Main NT assesses cognitive and academic skills and literacy in mathematics and in native language (Kyrgyz or Russian). The students can also choose to pass advanced NTs in specific subjects (Mathematics, Biology, Physics etc.).

The sample included 266 Russian students (mean age 17.7 years, SD = 0.4 years) and 829 Kyrgyz students (mean age 17.5 years, SD = 0.4 years). In both groups we assessed untaught numeric abilities (Number Line, Number Sense), mathematical skills (Problem Verification Task, Understanding Number), working memory capacity (Corsi Block), reaction time (four-choice simple reaction time) and general cognitive ability (Raven's Progressive Matrices). For Russian students we acquired Mathematics USE and Russian USE scores. For Kyrgyz students we obtained Main NT and Mathematics NT scores.

During the data preparation we identified a group of Kyrgyz students with high response speed and low accuracy in Number Sense task (35% of the Kyrgyz sample). Their data were clearly distinguishable within the response distributions in all cognitive tests but not in Raven's Progressive Matrices or NT scores. We excluded cognitive data of these students from further analysis.

Mathematics USE score was associated with all cognitive characteristics, correlations between 0.147 (Corsi Block) and 0.414 (Understanding Number). Russian USE score was associated with acquired mathematical knowledge (Problem Verification, 0.302, and Understanding Number, 0.280) and Number Line (-0.153). Raven's score was associated with Mathematics USE (0.466) but not Russian USE (0.115, ns). When introduced into regression model altogether (using SEM approach), predictors explained 35% of Mathematics USE variation and 18% of Russian USE variation. However, the separate contributions of cognitive predictors were non-significant, except learned mathematical skills (Russian USE) and intelligence (Mathematics USE).

For Kyrgyz sample, Main NT score was associated with all cognitive characteristics included, correlations ranged between 0.117 (Number Sense) and 0.336 (Understanding Number). The correlation between Main NT and Raven's score was 0.293. Neither of cognitive predictors were associated with Mathematics NT score (correlations under 0.107, ns). In regression model, all cognitive predictors explained 20% of Main NT and 3% of Mathematics NT.

The results of current study support out previous findings suggesting that cognitive characteristics and intelligence have limited power in explaining individual differences in Unified State Exam scores. In turn, although Nationwide Testing in Kyrgyzstan is similar to SAT in many aspects, the major part of its variability remained unexplained.

The study was supported by the Russian Science Foundation, grant 17-78-30028.

INTELLIGENCE, SENSORY DISCRIMINATION, AND IMPLICIT REWARD LEARNING

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Introduction: An implicit reward-learning task has been frequently used as a behavioral marker for phenotypes such as anhedonia and inattention. The task asks participants to discriminate between two similar stimuli, rewarding a portion of correct answers, using differential reinforcement rates for the two stimuli. Studies using this task have found negative associations between self-reported depressivity and participants' tendencies to develop a response bias toward the more frequently rewarded stimulus. Despite the widespread use of this task, to our knowledge, no one has examined task performance in relation to intelligence. Previous studies using different tasks have shown that intelligence is associated with ability to perform low-level sensory discrimination and explicit, but not implicit, reward learning. Our current study attempted to look at the effect of intelligence on performance on the implicit reward-learning task. We hypothesized intelligence would be positively associated with the ability to discriminate between stimuli, but not with levels of implicit reward learning.

Method: In the current study, participants (N = 303) were asked to complete an implicit probabilistic reward-learning task, which measured reward sensitivity, as well as the ability to discriminate between similar visual stimuli. We implemented signal to calculate participants' response bias toward one stimulus or the other, as well as the accuracy of stimulus discrimination, when controlling for bias, for each of three task blocks. Change in response bias from Blocks 1 to 2 was also calculated. Participants also completed four subtests from the Weschler Adult Intelligence Scale. Structural equation modeling was used to examine the effects of latent intelligence on latent variables corresponding to stimulus discrimination, response bias, and change in response bias.

Results: All manifest variables significantly loaded onto their corresponding latent variables, as expected. Intelligence positively predicted stimulus discrimination (β = .37, p < .001). However, intelligence predicted neither response bias (β = -.10, p = .32) nor change in response bias (β = -.07, p = .207).

Conclusions: Findings dovetail with previous work suggesting that people with higher intelligence are better ability to distinguish between stimuli differing in subtle, low-level sensory characteristics. Conversely, intelligence had no effect on implicit reward learning, as measured by response bias and change in response bias. This indicates that intelligence may not influence the ability to learn from reward cues that are not explicitly part of a task, also suggesting those with higher intelligence may be better at attending to the stated instructions and demands of these tasks. Future research using this task should take note of these findings and consider controlling for intelligence in individual difference analyses. Researchers should also consider the use of discriminability as a meaningful variable of interest (rather than a nuisance variable).

Acknowledgments

Sincere thanks to local host Prof. James J. Lee and co-host Prof. Matt McGue, for preparing a super 20th Annual meeting for ISIR

Sincere thanks are also extended to Cesca Eaton for preparing the program

In addition we have several further votes of appreciation:

Our thanks to The Institute for Mental Chronometry for their support for ISIR2019

We thank Elsevier warmly for their generous support of the Poster session and Reception

Our thanks to all the Reviewers who read submissions for this conference

Our thanks to all members who have given of their time most generously on numerous committees to enable the conference to run smoothly

Our sincere thanks to the judges of the Student Awards

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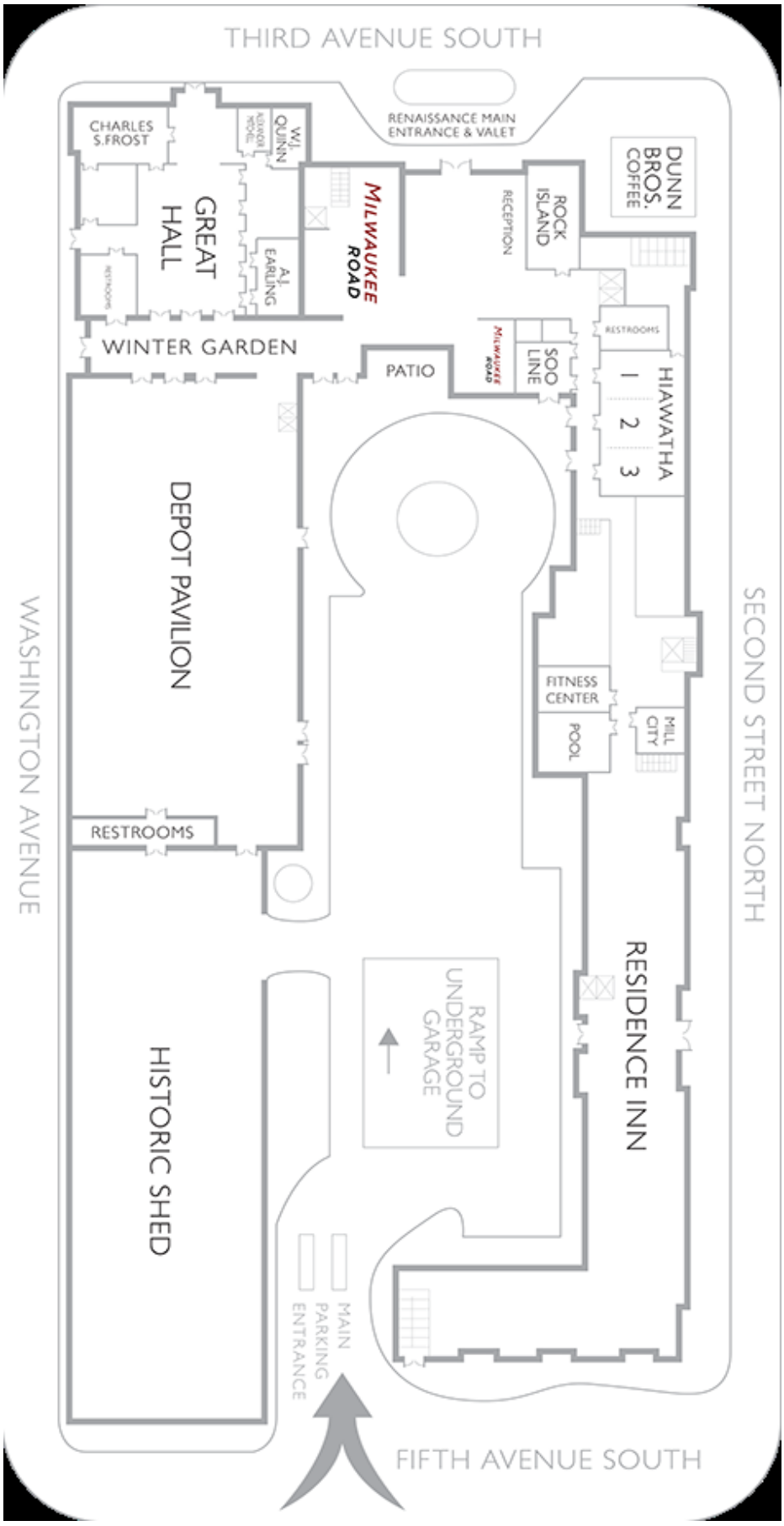
Minneapolis, MN 55401
Phone: 612-375-1700



Getting Around Minneapolis[1]

Metro Transit (https://www.metrotransit.org/)

- Metro Transit provides public transportation the Twin Cities via bus and METRO Lightrail routes. The METRO Lightrail's Blue Line train is a particularly easy and efficient way to travel between downtown and the MSP airport.

Uber

Lyft

Taxi services (many more available)

- Minneapolis Taxi / onCabs (https://oncabs.com/booking/minneapolis)
- MSP Airport Taxi Service (http://www.airporttaxiservicemsp.com/)
- Red and White Taxi Service (http://www.redwhitetaxi.com/)

Nice Ride (https://www.niceridemn.org/)

- Quick bicycle rental with 200+ locations to pick up and drop off

[1] Local information prepared by Jeffrey Dahlke and Casey Giordano

Restaurants near the Depot Hotel

(Sorted by distance (closest to farthest); 0.5 to 1.3 miles; additional details in separate handout)

Name Contact Information Address

Spoon and Stable https://www.spoonandstable.com/
Phone: 612-224-9850
211 First Street North
Minneapolis, MN 55401

The Bachelor Farmer http://thebachelorfarmer.com/
Phone: 612-206-3920
50 North 2nd Avenue
Minneapolis, MN 55401

112 Eatery http://www.112eatery.com/
Phone: 612-343-7696
112 North 3rd Street
Minneapolis, MN 55401

Aster cafe http://astercafe.com/
Phone: 612-379-3138
125 SE Main St
Minneapolis, MN 55414

Vic's Restaurant http://vicsminneapolis.com/
Phone: 612-312-2000
201 Main St. SE
Minneapolis, MN 55414

Seven Sushi and Steakhouse
https://www.7mpls.com/
Phone: 612-238-7770
700 Hennepin Ave S
Minneapolis, MN 55403

Oceanaire Seafood http://www.theoceanaire.com/
Phone: 612-333-2277
50 South Sixth Street
Minneapolis, MN 55402

Tugg's Tavern http://tuggsminneapolis.com/
Phone: 612-379-4404
219 Main St SE
Minneapolis, MN 55414

Restaurant Alma https://www.almampls.com/
Phone: 612-379-4909
528 University Ave. SE
Minneapolis, MN 55414

Bar La Grasa http://www.barlagrassa.com/
Phone: 612 333 3837
800 Washington Ave. N
Minneapolis MN 55401

Crave https://www.craveamerica.com/
Phone: 612-332-1133
825 Hennepin Ave
Minneapolis, MN 55402

Pizza Luce https://pizzaluce.com
Phone: 612-333-7359
119 North 4th Street
Minneapolis, MN 55401

Butcher & the Boar http://butcherandtheboar.com/
Phone: 612-238-8888
1121 Hennepin Ave.
Minneapolis, MN 55403

Lotus Restaurant https://www.lotusmplsmn.com/
Phone: 612-870-1218
113 West Grant Street
Minneapolis, MN 55403

Places to Visit

University of Minnesota's Minneapolis Campus

(Sorted by distance (closest to farthest); 1.9 to 2.3 miles; additional details in separate handout)

Name Contact Information Address

Weisman Art Museum
http://wam.umn.edu/
Phone: 612-625-9494
333 E River Pkwy
Minneapolis, MN 55455

Coffman Memorial Union
http://sua.umn.edu/locations/coffman/
Phone: 612-625-5000
300 Washington Ave SE
Minneapolis, MN 55455

Elliott Hall (Psychology Dept.)
https://cla.umn.edu/psychology
Phone: 612-625-2818
75 E River Pkwy
Minneapolis, MN 55455

McNamara Alumni Center
http://mac-events.org/
Phone: 612-624-9831
200 SE Oak St
Minneapolis, MN 55455

Museums, Athletic Venues, & Historical Sites

(Sorted by distance (closest to farthest); 0.4 to 11.3 miles; additional details in separate handout)

Name Contact Information Address

Mill City Museum http://www.millcitymuseum.org/
Phone: 612-341-7555
704 South 2nd St.
Minneapolis, MN 55401

Guthrie Theater https://www.guthrietheater.org/
Phone: 612-377-2224
818 S 2nd St
Minneapolis, MN 55415

Stone Arch Bridge and St. Anthony Falls
Scenic area on the Mississippi River, activity trails, and the famous falls that powered Minneapolis' milling industry for decades.
100 Portland Ave, Minneapolis, MN 55401

U.S. Bank Stadium https://www.usbankstadium.com/
Phone: 612-777-8700
401 Chicago Ave
Minneapolis, MN 55415

Walker Art Center https://walkerart.org/
Phone: 612-375-7600
725 Vineland Pl
Minneapolis, MN 55403

Minneapolis Sculpture Garden
https://walkerart.org/visit/garden
Phone: 612-375-7600
726 Vineland Pl
Minneapolis, MN 55403

Foshay Museum and Observation Deck
http://www.wminneapolishotel.com/
Phone: 612-215-3783
821 Marquette Avenue
Minneapolis, MN, 55402

Science Museum of Minnesota
https://www.smm.org/
Phone: 651-221-9444
120 W Kellogg Blvd
St Paul, MN 55102

Mall of America https://www.mallofamerica.com/
60 East Broadway
Bloomington, MN 55425

Minnesota Historical Society
http://www.mnhs.org/ Multiple locations
(see website)

Leisure Activities in the Twin Cities

Running Options

Minneapolis' Mississippi River trails are easily accessible from downtown. The trails exist along both the east and west banks of the Mississippi and can be accessed at the St. Anthony Falls / Father Hennepin Park area.

A map of popular trails and parks can be found at https://minneapolisrunning.com/twin-citiestrail-map/

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