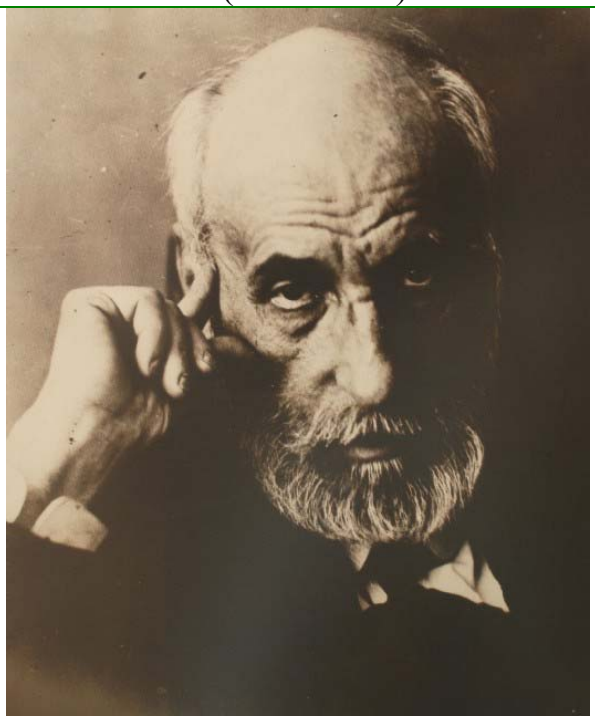
International Society for Intelligence Research

---December 17-19 2009---

Juan Huarte de San Juan (1529-1588)	**Santiago Ramón y Cajal** (1852-1934)
	
Juan Huarte de San Juan drew a remarkably cogent picture of individual differences in human thought. Huarte's distinction between problem solving by memory or by imagination is mirrored in contemporary theories that distinguish between the ability to do abstract reasoning and the ability to apply previously learned solution methods (E.B. Hunt, In Press, *On human intelligence*. Cambridge).	His pioneering investigations of the microscopic structure of the brain were so original and influential that he is considered by many to be the greatest neuroscientist of all time [Jacobsen, Marcus (1993). *Foundations of neuroscience*. Springer. pp. 237]

Program

10th Annual Conference

Hotel TRYP Centro Norte (Madrid, **SPAIN**)

Acknowledgements

Organizers

Roberto Colom & Mª Ángeles Quiroga
Universidad Autónoma de Madrid & Universidad Complutense de Madrid

Advisory Committee

Thanks to the Templeton Foundation for their support and Elsevier for sponsoring the reception.

International Society for Intelligence Research (ISIR) Program 2009

All sessions will be in "*Salón Princesa Dácil*"

DAY 1

8.00-8.05: Earl B. Hunt Lifetime Contribution Award

Symposium 1: Imaging g

Organizer: Roberto Colom (UAM)

8.05-8.20: Neuroanatomical overlap between general intelligence and cognitive functions (*Roberto Colom, Richard J. Haier, Kevin Head, Juan Álvarez-Linera, Mª Ángeles Quiroga, Miguel Burgaleta, Pei Chun Shih, Francisco J. Abad, Sergio Escorial & Manuel Martín-Loeches*)
8.20-8.40: Attenuated brain correlates for specific cognitive ability after controlling for *g*: A cortical thickness approach (*Sherif Karama, Roberto Colom, Wendy Johnson, Ian Deary, Richard Haier,* Claude Lepage, *Hooman Ganjavi, Alan Evans, & The Brain Development Cooperative Group)*
8.40-9.00: An MRI/SEM study of *g*, lower-order factors, and the brain (*H. Steven Scholte & Jelte M. Wicherts*)
9.00-9.20: Brain Networks for Factors of Intelligence Assessed in Males and Females With fMRI and DTI (*David H. Schroeder, Cheuk Y. Tang, Emily L. Eaves, J. C. Ng, D. M. Carpenter, I. Kanellopoulou, X. Mai, Christopher A. Condon, Roberto Colom, & Richard J. Haier*)

Paper Session
"Biology & Genetics"

Chairman: Wendy Johnson

9.20-9.40: Negative correlations between corpus callosum area and intelligence in a representative sample of healthy young males (*Hooman Ganjavi, Alan Evans, John Lewis, Penny MacDonald, Sherif Karama, & The Brain Development Cooperative Group)*
9.40-10.00: Investigating the relation between basal ganglia volume and intelligence *(Penny A. MacDonald, Sherif Karama, Hooman Ganjavi, Alan Evans, & The Brain Development Cooperative Group)*

10.00-10.20 (Break)

10.20-10.40: Mental rotation of 2- and 3-dimensional objects: Sex differences, effects of training and changes in cortical activity (*Aljoscha C. Neubauer & Sabine Bergner*)
10.40-11.00: If Neuro *g* is the answer, What is the Question? (*Rogier A. Kievit, Kees-Jan Kan, Jelte Wicherts, & Denny Borsboom*)
11.00-11.20: Neural basis of the differential heritability between crystallized intelligence and fluid intelligence (*Kun Ho Lee & Yu Yong Choi*)
11.20-11.40: Common genetic effects on Mathematical and Spatial Abilities: Behavioural Genomic investigation (*Yulia Kovas, Sophia J Docherty, Ken Hanscombe, Oliver S P Davis, & Robert Plomin*)
11.40-12.00: The factor model, the mutualism model, and the bonds model: implications for genetic association (*Conor Dolan, Kees-Jan Kan, Han van der Maas, & Sophie van der Sluis*)

12.00-13.30 (Lunch)

13.30-13.50: Mutualism, sampling and reciprocal environmental effects in intelligence (*Han L.J. van der Maas*)
13.50-14.10: The longitudinal structure of nonshared environmental effects on cognitive ability throughout the lifespan: A genetically informed approach (*Christopher R. Beam, William T. Dickens, & Eric Turkheimer*)
14.10-14.30: Why Don't Smart Kids Have Sex? A Twin-Control Study (*K. Paige Harden*)
14.30-14.50: Associations between IQ and cigarette smoking among Swedish male twins (*Karin Modig Wennerstad, Karri Silventoinen, Per Tynelius, Lars Bergman, Jaakko Kaprio, & Finn Rasmussen*)
14.50-15.10: Genome-Wide Association Studies of Cognitive Abilities: Transition from SNP-Genotyping to Whole-Genome Sequencing (*James J. Lee & Christopher F. Chabris*)
15.10-15.30: Brain size genes and a genome-wide association study of working memory (*Timothy C. Bates*)

15.30-16.00 (Break)

Paper Session
"Prediction"

Chairman: David Lubinski

16.00-16.20: Childhood intelligence, social class of origin, childhood behavior disturbance and education as predictors of occupational social status attainment in midlife: Longitudinal evidence from the UK (*Sophie von Stumm, Sally Macintyre, G. David Batty, Heather Clark, & Ian J. Deary*)
16.20-16.40: Predictors of Persistence in High-Intensity STEM Careers among Top STEM Graduate Students: A 10-year Longitudinal Study (*Kimberley Ferriman Robertson, David Lubinski, & Camilla Persson Benbow*)
16.40-17.00: Specialized or general? The differential prediction of general executive functioning skills and mathematics-specific cognitive processes on mathematics and reading psychometric outcomes (*Sara A. Hart & Stephen A. Petrill*)
17.00-17.20: Fluid intelligence and math learning interaction: A longitudinal multilevel approach (*Ricardo Primi, Maria Eugénia Ferrão, & Leandro S. Almeida*)

17.30-18.30: Career Interview (Charles Murray)

18.30-21.00: Elsevier Wine Reception and Poster Session

Symposium 1
"Imaging *g*"

Organizer: Roberto Colom

Since the publication of the parieto-frontal integration theory of intelligence (P-FIT) (Jung & Haier, 2007) research has made some progress to further clarify the biological roots of human intelligence using neuroimaging tools. The monograph recently published in the journal '*Intelligence*' supports this statement. This symposium presents still unpublished recent findings regarding *g* and its relation with several intelligence and cognitive factors.

Colom et al. quantify the neuroanatomical overlap between *g* and several key cognitive functions (working memory, executive functioning, mental speed, and controlled attention) using a VBM approach. It is shown that overlapping areas are mainly concentrated in bilateral frontal and parietal regions, which is consistent with a generalization of the P-FIT model to several basic cognitive functions.

Karama et al. studied a representative sample of children and young adolescent using a cortical thickness approach. The main finding show that brain correlates for cognitive performance is greatly attenuated when *g* is statistically removed.

Scholte and Wicherts applied VBM (voxel-based morphometry) and DTI (diffusion tensor imaging) to determine which structural characteristics of gray and white matter are related to *g*, Verbal Comprehension, Processing Speed, Perceptual Organization, and Working Memory. They found that *g* might no be considered a unidimensional construct.

Finally, using *f*MRI and DTI, Schroeder et al. report correlations between differences of activation in certain brain areas during the *n*-back task and *g*, as well as with *g*-partialled estimates of speed of reasoning, numerical ability, and spatial ability, but not memory. Informative sex differences are also found.

Neuroanatomical overlap between general intelligence and cognitive functions

Roberto Colom[1], Richard J. Haier[2], Kevin Head[2], Juan Álvarez-Linera[3], Mª Ángeles Quiroga[4], Miguel Burgaleta[1], Pei Chun Shih[1], Francisco J. Abad[1], Sergio Escorial[5] and Manuel Martín-Loeches[4]

Jung & Haier's (2007) parieto-frontal integration theory (P-FIT) is thought to account for individual differences in intelligence, but there is some evidence showing that frontal and parietal brain areas are also relevant for other central cognitive functions. Using a VBM approach, here we test whether regional gray matter volumes are correlated with the covariates of interest (general intelligence, memory span, attentional control, and mental speed) treating total gray matter volume as the nuisance variable in the design matrix. After computing the correlation analyses for each covariate separately, a conjunction approach is applied to show where gray matter correlations overlap for (a) *g* & memory span, (b) *g* & attentional control, and (c) *g* & mental speed (voxels with correlations in common for each pair of covariates). The sample was comprised by 104 participants (59 females and 45 males, mean age = 19.9, SD = 1.7). The administered 21 measures are described in detail elsewhere (Colom et al., 2008). The results show that overlapping areas are mainly concentrated in bilateral frontal and parietal areas. This general finding is largely consistent with a generalization of the P-FIT model to several key cognitive functions.

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Attenuated brain correlates for specific cognitive ability after controlling for *g*: A cortical thickness approach

Sherif Karama, Roberto Colom, Wendy Johnson, Ian Deary, Richard Haier, Claude Lepage, Hooman Ganjavi, Alan Evans, & The Brain Development Cooperative Group

It has frequently been suggested that brain correlates for cognitive performance could be in large part attributed to *g.* In order to test this, we examined the association between cortical thickness and cognitive ability in a representative sample of children and adolescents (N = 207, Mean age = 11.8; SD = 3.5; range = 6 to 18.3). Participants completed a set of cognitive ability tests (calculation, letter, and comprehension from the WJ-III, along with similarities, vocabulary, block design, and matrix reasoning from the WASI). The measurement model pointed to three first-order factors (WJ-III, verbal WASI, and non-verbal WASI) and one general factor thought to represent *g*. Following from that model, *g* scores predicted WJ-III, WASI verbal ability, WASI non-verbal ability and the seven specific ability scores. Residuals (i.e. variance unpredicted by g) were used to define *g*-independent scores for the three group factors and the seven specific subtests. Scores where *g* had not been partialled out (g-dependent scores) and *g*-independent scores were then submitted to a cortical thickness analysis as described in Karama et al. (2009). When compared with the *g*-dependent scores, associations between cortical thickness and the *g*-independent scores were greatly attenuated for all subtests and first order factors. In fact, *g*-independent scores yielded no associations with cortical thickness. This was in contrast to g-dependent scores which were generally positively correlated with cortical thickness in a large network of areas. These findings are consistent with the view that cortical thickness correlates for cognitive performance could in large part be attributed to the pervasive influence of *g*. It is possible that the use of other cortical metrics (e.g. cortical surface area) in more homogeneous groups and in groups of older individuals would yield different results.

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An MRI/SEM study of *g*, lower-order factors, and the brain

H. Steven Scholte & Jelte M. Wicherts

University of Amsterdam

Numerous recent neuro-imaging studies have addressed the relation between IQ and various neurological measures, in order to determine find aspects of brain physiology associated with general intelligence or *g*. However, all but a few studies have used psychometric models to disentangle the relation between neurological measures, *g*, and lower-order ability factors. In addition, most structural neuroimaging studies have used either Voxel Based Morphology (VBM) or Diffusion tensor imaging (DTI). In the current study, we scanned 80 young and healthy adults who were administered the Dutch version of the Wechsler Adult Intelligence Scale- 3rd edition (WAIS-III). We employed both VBM and DTI to determine which structural characteristics of gray and white matter are related to *g*, Verbal Comprehension, Processing Speed, Perceptual Organization, and Working Memory. Structural Equation Modeling (SEM) is used to test various models of these multivariate relations. Results show promising percentages of explained variance, but stand in contrast to the notion of neuro *g* as a unidimensional entity. Furthermore, results indicate that while neural correlates of Verbal Comprehension, Perceptual Organization, and Working Memory are mainly found in the gray matter it is the white matter that correlates with Processing Speed.

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Brain Networks for Factors of Intelligence Assessed in Males and Females With fMRI and DTI

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Neuro-imaging studies of intelligence implicate the importance of a parietal-frontal network (Jung & Haier, 2007). One unresolved issue is whether this network underlies a general factor of intelligence (*g*) or more-specific cognitive factors. A second unresolved issue is whether males and females use different parts of this network. In this study, we obtained intelligence factors (general, speed of reasoning, spatial, memory, numerical) from a large set of tests completed by 6,929 young adults, 40 of whom (21 males, 19 females) also completed functional MRI (fMRI) during a working memory *n*-back task along with diffusion tensor imaging (DTI). With the fMRI data, we identified brain areas activated during the memory task and computed correlations between percent activation and scores on the intelligence factors. Individual differences in activation in certain brain areas during the *n*-back task were correlated with the general intelligence factor (*g*), as well as with *g*-partialled estimates of speed of reasoning, numerical ability, and spatial ability, but not memory. For females, the correlations were primarily bilateral, whereas they were unilateral for males. Moreover, the DTI measures indicated that stronger pathways between hemispheres were related to superior performance on the cognitive tests in females, whereas in males, greater interhemispheric communication appeared to be related to weaker performance. Although these findings must be interpreted with caution in light of the modest sample size, they correspond well with other findings on sex differences in brain structure and function (Halpern, 2000).

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Jung, R. E., & Haier, R. J. (2007). The Parieto-Frontal Integration Theory (P-FIT) of intelligence: Converging neuroimaging evidence. *Behavioral and Brain Sciences*, *30*, 135-154.

Paper Session
"Biology & Genetics"

Negative correlations between corpus callosum area and intelligence in a representative sample of healthy young males

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The corpus callosum is the largest fibre tract in the human brain and is responsible for much of the communication between the two hemispheres. Research with epileptic patients who underwent corpus callosotomies reveals that the corpus callosum is integral to interhemispheric communication which is required for a variety of cognitive and perceptual processes.

Compared to other mammals, the human brain is highly lateralised. This allows for a greater degree of specialisation of the hemispheres and is partly responsible for the higher intellectual capacity of humans. Not surprisingly, it has been postulated that the size and/or morphology of the corpus callosum could be related to individual cognitive ability. There are conflicting theories as to the nature of this relationship and conflicting data in the literature. Consistent with the theory that a larger corpus callosum may be more advantageous for processing power, Luders et al (1) found a positive correlation between IQ and thickness of the posterior corpus callosum in healthy adults. In contrast, Allin et al (2) found a negative correlation between the area of the posterior corpus callosum and IQ in a somewhat younger healthy population. A recent study by Hutchinson et al (3) had similar findings. These data are consistent with the notion that a smaller corpus callosum represents a more "high performance" brain that relies less on interhemispheric communication. Our group set out to investigate the relationship between corpus callosum size and intelligence in a relatively large healthy representative sample.

We examined the relationship between corpus callosum size and IQ using data collected through the NIH MRI Study of Normal Brain Development. This study uses a mixed cross-sectional and longitudinal design to create a database with MRI, clinical, and behavioural data from approximately 500 children aged 4.6 to 18.3 years. One hundred and ninety-eight subjects had IQ testing and MRI data that passed quality control. Corpus callosum area was measured using a semi-automated system based on the Clarke technique (4). IQ measures included the full-scale WASI-IQ and the performance and verbal intelligence subscores. Statistical analyses were performed with SPSS Student Version 16.0. Using a linear regression model correcting for total brain volume, a negative correlation was found between total corpus callosum area and WASI Full Scale IQ (p=0.033). When subjects were divided into a group of children

(age < 12) and a group of adolescents (age ≥ 12), the relationship only remained significant for the under 12 group (p=0.015). Further, when the subjects were divided by gender, the negative relationship only emerged for males and a gender by IQ interaction was shown.

These data imply that the correlation between corpus callosum and intelligence is a function of age and gender. This is a possible explanation as to why there is conflicting data in the literature. It is well established that male and female brains differ (5, 6). One possible explanation for our findings is that the developing male brain may rely on interhemispheric processing as a compensatory mechanism for a lower IQ while the female brain uses a different structural apparatus. The recruitment of the opposite hemisphere could alter rates of pruning and myelination in the corpus callosum, ultimately changing its overall area.

In conclusion, this study demonstrates a negative correlation between IQ and corpus callosum area in a relatively large representative sample of healthy young males. These findings shed light on our understanding of gender differences and the role of the corpus callosum in intelligence.

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Investigating the relation between basal ganglia volume and intelligence

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Given reciprocal connections to virtually all cortical and limbic regions, the basal ganglia are ideally positioned to influence aspects of behaviour ranging from habitual motor responses to abstract reasoning. Indeed, the basal ganglia are increasingly implicated in diverse cognitive functions.[1] Basal ganglia volumes are reduced in a number of patient groups with associated cognitive processing abnormalities and poor performance on measures of intelligence.[2,3,4,5]

Methods. In the current study, we investigated the relation between basal ganglia volume—adjusting for total brain volume—and intelligence quotient (IQ) measured by the Full Scale Weschler Abbreviated Scale of Intelligence (WASI-IQ) and its performance (WASI-performance) and verbal (WASI-verbal) subscales, in 303 healthy children (male=142) aged 6 to 18. This relation was contrasted with correlations between cortical grey matter volumes—in frontal, temporal, parietal, and occipital regions—and our intelligence measures. These data were obtained from the NIH MRI study of normal brain development (Evans and Brain Development Cooperative Group, 2006). The images were processed through the CIVET pipeline, developed at the MNI for automated structural image analysis (http://wiki.bic.mni.mcgill.ca/index.php/CIVET). The participants were selected using a population-based epidemiologic sampling strategy to obtain a sample that reflects the population of the United States.

Results. A Bonferonni correction for multiple comparisons, considering correlation among measures, was applied, reducing α to 0.01. A significant positive correlation was obtained for the left basal ganglia volume and scores on the WASI-IQ (r = .160, df = 300, p = .005). The only other region that correlated significantly with performance on any intelligence measure was the left temporal grey volume, which predicted scores on the WASI-performance subscale (r = .163, df = 300, p = .005). Correlations between WASI-performance scores and left basal ganglia (r = .138, df = 300, p = .016) and right parietal grey (r = .139, df = 300, p = .016) volumes approached significance. The left temporal grey volume and WASI-IQ correlation (r = .147, df = 300, p = .011) also approached significance.

This pattern of findings did not arise because brain regions with less predictive power were more correlated with total brain volume. Stepwise multiple regression analyses were performed with volumes from all bilateral regions of interest as predictors, excluding total brain volume, and with each WASI-IQ, WASI-performance, and WASI-verbal scores as the dependent measures. Only left basal ganglia and left temporal grey volumes significantly predicted the WASI-IQ (t = 2.538, p = .01 and t = 2.563, p = .01 respectively) and WASI-performance scores (t = 2.233, p = .026 and t = 3.321, p < .001

respectively) and only left basal ganglia was a significant predictor of performance on the WASI-verbal subscale ($t = 3.051$, $p < .005$).
Conclusion. In the current study, left basal ganglia volume was the strongest predictor of performance on tests of intelligence, correlating more strongly with test scores than all cortical regions selected for comparison. This brain structure-behaviour relation further promotes the increasingly accepted view that the basal ganglia are intimately involved in higher order cognitive functions.

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Mental rotation of 2- and 3-dimensional objects: Sex differences, effects of training and changes in cortical activity

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The well-documented sex difference in mental rotation favouring males has been shown to emerge only for 2-dimensional presentations of 3-dimensional objects, but not with actual 3-dimensional objects or with augmented reality presentations of three-dimensional objects. Training studies using computer games like Tetris or Blockout have demonstrated training effects on mental rotation performance. Here we wanted to study the combined effect of a two-week mental rotation training (including a variety of rotation tasks from psychometric intelligence tests as well as Tetris) on 2-dimensional vs. 3-dimensional versions of a classic Shepard-Metzler task (presented in a pretest-training-posttest design) and their accompanying cortical activation patterns assessed via EEG. For reasons of comparison two additional tasks drawing on aspects of math competence (charts, subtractions) were presented during pretest and posttest. A preliminary analysis of the behavioral results in the currently tested sample of 55 adolescents (around 15 years of age) reveals clear training effects on both 2- and 3-dimensional mental rotation performance (as operationalized by speed and accuracy). These training effects are accompanied by time-related changes in cortical activation patterns. Training effects were also observed for the subtraction but not for the chart task. Training effects appear to be weakly moderated by participants' sex, particularly during 2-dimensional mental rotation.

If Neuro *g* is the answer, What is the Question?

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The relationship between intelligence and properties of the brain has been a topic of interest in intelligence research since the fifties. Recently, several papers (including a special issue of Intelligence) have looked into aspects of brain physiology and function associated with intelligence and intelligent behavior. In most of these studies, a series of physiological markers, either static (e.g., grey matter density, head size) or dynamic (e.g. fMRI measurements during ravens) are correlated with IQ scores. Such significant correlations are taken as representing, at least in part, an attribute often referred to as 'Neuro *g*'. However, such general correlations, although of interest, do not make explicit the exact relationship between the measurements, i.e. to what extent they should be considered causally influential, predictors, spurious correlations or actual measurements of intelligence. In this paper, we examine the conceptual status of 'neuro *g*', which psychometric and conceptual assumptions are present in current work, and to what extent they are justifiable given the available evidence. We discuss possible hypotheses on the relationship between *g* and the brain, translate these hypotheses into common psychometric models and apply these models to empirical datasets concerning the relationship between grey matter and general intelligence.

We will discuss the benefits of models that make explicit assumptions concerning the relationship between g and the brain, and examine their empirical support. We argue that to learn more about the elusive relationship between intelligence and brain properties and functioning, we need to make explicit the diverging causal and associational hypotheses possible in cognitive neuroscientific research. Finally, we discuss two promising avenues of future reductive scientific approaches, and see how current body of work can serve as a foundation to expand our knowledge of intelligence and the brain.

Keywords: Structural Equation modeling, Intelligence and the brain, Latent Variable Modeling, Conceptual analysis

Neural basis of the differential heritability between crystallized intelligence and fluid intelligence

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In the psychometric tradition, it is widely accepted that crystallized intelligence (gC) is largely dependent on prior experience and learned knowledge, thereby being less heritable than fluid intelligence (gF). However, accumulating evidence from behavioral genetic studies on general intelligence suggests higher heritability of gC than gF in contradiction to the theoretical assumption. Furthermore, the Flynn effect, secular gains in IQ test scores possibly relying on social environmental changes, is more salient in gF-related test scores than in gC-related test scores. Here we demonstrate neural and genetic bases of gC and gF by applying structural equation modeling (SEM) to both anatomical and functional magnetic resonance images of monozygotic and dizygotic twins (n=88). Behavioral scores of the twins on intelligence tests clearly demonstrated that gC is more heritable than gF. The SEM analysis of their brain images showed that the thickness of inferior frontal cortex and anterior temporal cortices (known to be responsible for verbal and semantic processing) is significantly heritable but the neural activation during performing gF tasks is not (P<0.001). The brain regions with high heritability were largely overlapped with the areas whose thickness well predicts individual differences in general intelligence, especially in gC. Moreover, a newly devised SEM analysis revealed that these cortical areas shared a higher genetic variance with gC (peak a^2 in common = 0.20) than gF (peak a^2 in common = 0.07). These findings provide a biological mechanism underlying the differential heritability between gC and gF.

Common genetic effects on Mathematical and Spatial Abilities: Behavioural Genomic investigation

Yulia Kovas[1,2,*], Sophia J Docherty[2], Ken Hanscombe[2], Oliver S P Davis[2], Robert Plomin[2]

Introduction: Diverse aspects of mathematics yield similar high heritability estimates in early school children, with the genetic effects largely being found to be general across domains, while the effects of the environment are found to be largely specific. Extending the multivariate genetic analyses beyond the heterogeneous domains within mathematics, it is found that substantial genetic overlap also exists between mathematical ability and reading and general cognitive ability (*g*). We hypothesised that a high genetic overlap would also be observed between mathematical and spatial abilities. We tested this hypothesis by conducting quantitative genetic and behavioural genomic analyses using the data form the Twins' Early Development Study (TEDS).

Method: In a UK representative sample of 4381 pairs of 12-year-old twins, we investigated the extent of the observed and aetiological overlap between mathematics (web-based measures of 3 aspects of mathematical ability assessed as part of the UK National Curriculum) and spatial ability (derived from two web-based tasks of spatial reasoning which require the mental representation and manipulation of visual-spatial information). Our recently conducted genomewide association scan identified first quantitative trait loci (QTLs) together explaining 3% in general mathematical ability in 10-year-old children (p = 7.277e-14). Our behavioural genomic analysis examined whether this set of single nucleotide polymorphisms (SNPs) was also associated with the spatial ability when the same children were 12 years of age.

Results: Multivariate genetic analysis revealed substantial genetic overlap between spatial reasoning and Understanding Numbers (genetic correlation=.61), Non-numerical Processes (.87) and Computation and Knowledge (.61) components of Mathematics. The set of genetic markers found to be associated with mathematical ability at 10 was also associated with spatial ability at 12, although explaining a very small proportion of the variance in this trait. Interestingly, stronger associations were observed for this set of genetic markers with different abilities at the same age (different aspects of mathematics, reading, and g) than with the same ability (mathematics) at different ages.

Conclusion: Consistent with the 'generalist genes' hypothesis, genetic effects on spatial ability are highly correlated with genetic effects on diverse domains of mathematics. Some of these 'generalist' QTLs of very modest effect have been already identified.

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The factor model, the mutualism model, and the bonds model: implications for genetic association

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Genetic association studies of general intelligence usually involve the regression on genetic markers of some phenotypic measure that represents general intelligence. The phenotypic measure is usually based on the factor analytic representation of g. Other models, which will give rise to a positive manifold, but do not include the construct of general intelligence are the mutualism model (Van der Maas, et al. 2006), and the bonds model (Bartholomew, et al., 2009). The aim of the present talk is to consider the implications of these different models for genetic association studies. Specifically we address the question whether the limited success to date of genetic association studies may be due in part to reliance on the factor analytic representation. To this end we simulate genetic effects in all three models and evaluate the effect on the power to detect genetic effects using the factor analytic representation.

Mutualism, sampling and reciprocal environmental effects in intelligence

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Bartholomew, Deary and Lawn (2009) reintroduced sampling theory as an explanation for the positive manifold of general intelligence. Relations with modern evolutionary genetic variants of sampling theory will be considered. Four explanations of the positive manifold (biological unitary g, sampling, mutualism and Dickens's reciprocal environmental effects) will be compared with respect to a list of empirical phenomena. I conclude that mutualism, sampling and reciprocal environmental effects (Dickens, 2006) all play a role in explaining the positive manifold. An unitary causal g factor is highly improbable. However, the interpretation of g factor as an index (like general health) remains feasible.

The longitudinal structure of nonshared environmental effects on cognitive ability throughout the lifespan: A genetically informed approach

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A substantial amount of the phenotypic variance in cognitive ability is not accounted for by genetics (Plomin & Spinath, 2004). This finding is consistent with the third law of behavior genetics, which states that the nonshared environment accounts for a significant amount of the phenotypic variance in behaviors and traits (Turkheimer, 2000). Nevertheless, the nature of the nonshared environment remains difficult to pin down. Several conjectures have been put forward. First, it may be simple measurement error. Second, it could be developmental noise (Molenaar, Boomsma, Dolan, 1993). Third, it may be consistent within-pair environmental differences (Plomin & Daniels, 1987). Fourth, Turkheimer and Waldron (2000) argued that the nonshared environment represents non-additive and stochastic events, which would explain the low degree of nonshared environmental mediation across multiple measurements and phenotypes. Finally, Dickens and Flynn (2001) argued that it consists of the time-limited effects of within-pair environmental differences. According to this view, nonshared environmental events cause within-pair differences, but these differences decay quickly over time.

The goal of the present study is to model the longitudinal properties of the non-shared environmental effects for general cognitive ability and to test the decay of environmental disturbances in a sample of children and in a sample of middle-aged to older adult twins. For these analyses, we reconstructed correlation matrices from the published findings of 209 twin siblings aged 5-18 years from the Netherlands Twin Registry (Hoekstra, Bartels, Boomsma, 2007), and used a sample of 445 twin siblings aged 40-90 years from the Swedish Adoption/Twin Study of Aging (SATSA; Finkel & Pedersen, 2004). Although our results do not suggest rapidly decaying non-shared environmental influences over time, they do suggest that the longitudinal structure in adults is different from the structure in children. Early in life, it is largely unsystematic and uncorrelated (correlations between consecutive E latent variables close to zero) whereas late in life, it stabilizes and becomes relatively constant (correlations between consecutive E variables close to unity). Thus, it appears that some stabilizing phenomenon occurs between childhood and adulthood that leads to stable within-twin pair environmental effects.

We hypothesize that there are two underlying mechanisms. First, we argue that increasing phenotypic stability of general cognitive ability in adulthood is responsible for within-twin pair stable environmental effects. Second, it is plausible that adult environments are more consistent and more closely determined by the phenotype of the individual than environments during childhood. However, these hypotheses have not been subjected to empirical scrutiny. Future research should focus on cognitive ability measurements during childhood, adolescence, and young adulthood to identify the developmental period in which environmental effects stabilize.

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Why Don't Smart Kids Have Sex? A Twin-Control Study

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Epidemiological research has shown that adolescents with higher intelligence postpone sexual intercourse and a wide variety of other partnered sexual activities, such as kissing [C Halpern, K Joyner, R Udry, C Suchindran, 2000, Smart teens don't have sex (or kiss much either), *J Adol Health* **26**: 213-225]. These associations have been interpreted as evidence for a protective effect of intelligence on sexual health: Smart teenagers are thought to better anticipate and avoid the risks of sexual activity, including sexually transmitted infections, unwanted pregnancy, and greater difficulty achieving educational and occupational goals. Previous research, however, has compared unrelated adolescents, thus associations between intelligence and sexual activity are confounded by both environmental differences between families and genes. An alternative explanation for the association between intelligence and sexual activity may common genetic or environmental third variables. The current study tests whether twins who differ in their cognitive ability and their academic achievement also differ in their age at initiating various partnered sexual activities. Results are interpreted in light of theories on the relation between intelligence and health risk behaviours.

Associations between IQ and cigarette smoking among Swedish male twins

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It has been suggested that certain health behaviours, such as smoking, may operate as mediators of the well-established inverse association between IQ and mortality risk. The aim of the present national twin study was to determine the interrelations between IQ at age 18, childhood and attained social factors and smoking habits in young adulthood and mid-life. We studied the association between IQ at age 18 and smoking in later life in a population of 11 589 male Swedish twins. IQ was measured at military conscription, and data on smoking was self-reported by the twins at the age of 22 - 47 years, information on social factors was extracted from censuses. Logistic regression models estimated with generalised estimating equations were used to explore possible associations between IQ and smoking among the twins as individuals as well as between and within twin pairs.

A strong inverse association between IQ and smoking habits emerged in unmatched analyses over the entire range of the IQ distribution. In within-pair and between-pair analyses it transpired that shared socioeconomic and/or psychosocial factors explained most of the inverse IQ - smoking relationship. In addition, these analyses indicated that non-shared and genetic factors contributed only slightly (and non-significantly) to the IQ – smoking association. Analysis of twin pairs discordant for IQ and smoking status displayed no evidence that non-shared factors contribute substantially to the association. The question of which shared environmental factors might explain the IQ – smoking association is an intriguing one for future research.

Genome-Wide Association Studies of Cognitive Abilities: Transition from SNP-Genotyping to Whole-Genome Sequencing

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We have recently completed a genome-wide association study of several physical and psychological traits. After the application of quality control procedures, our dataset includes over 400 samples and 700,000 single-nucleotide polymorphisms (SNPs). Here we report the results of SNP associations with high-level cognitive abilities measured by Raven's Advanced Progressive Matrices and the Multidimensional Aptitude Battery.

Although some of our results are promising, our overall conclusion is that the study design employed is incapable of securing decisive evidence for an association between genetic variation and high-level cognitive abilities. This conclusion is consistent with those derived from research on the genetic architecture of other complex traits. We discuss some of the theoretical and methodological reasons for the inadequacy of this design.

We also discuss a new research initiative intended to overcome the limitations of past gene-trait association studies. The Personal Genome Project (PGP) will ultimately enroll ~100,000 volunteers, obtaining the full DNA sequence of all 46 chromosomes and extensive phenotypic data (medical records, anthropometric measurements, environmental exposures, questionnaire responses, behavioral traits, etc.). It is hoped that the full PGP data will allow a good first approximation to the entirety of the genome X environment -> phenome mapping. We point out some features of the PGP design that make it especially suited for investigating the genetic and evolutionary basis of variation in cognitive abilities.

Brain size genes and a genome-wide association study of working memory

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Head size and working memory are both heritable traits with strong links to general ability. Here we present the results of a 500k genome scan for individual differences on the WAIS letter-number-sequencing measure of working memory in over 700 families of twins. The discussion focuses on the genes in the Microcephaly family, with significant association for working memory found but in SNPs not showing signs of recent selection, and on genome-wide data, with some suggestive results, but none below the threshold of $5*10^{-7}$. Implications of these results are discussed.

Paper Session
"Prediction"

Childhood intelligence, social class of origin, childhood behavior disturbance and education as predictors of occupational social status attainment in midlife: Longitudinal evidence from the UK

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Modern-day social position trajectories are substantially determined by educational qualifications, and the significance of intelligence for status attainment is captured in its high correlation with education. However, intelligence is only one part of a complex nexus of inter-correlated variables that together predict social status attainment; others include social class of origin and childhood behavior disturbance. Beyond the identification of an accurate set of status attainment predictors, it is also important to clearly disentangle the individual effects of such causal variables. In this context, certain methodological criteria must be fulfilled to obtain meaningful results: a) a longitudinal research design, b) a large, representative population sample incorporating all social strata, c) a precisely defined social, legal, geographical and temporal context, d) a relative maturity of the sample, e) a careful discrimination between sexes, f) a latent trait conceptualization instead of single-indicator measures, and g) a statistical approach that accounts correctly for attrition and other missing data.

The proposed conference contribution presents results of a recent longitudinal study on a cohort sample from the United Kingdom called the 'Aberdeen Children of the 1950's'. This study, which fulfils all of the previously outlined methodological criteria, examined social status attainment in 6,281 males at midlife (46 to 51 years) with predictor variables that included latent traits of childhood intelligence, childhood behavior disturbance, and parental social class, as well as an index of educational qualifications.

Latent traits of social class of origin, childhood intelligence and behavior disturbance were conceptualized as correlated predictors, whose effects were hypothesized to be partially mediated by educational qualifications. A structural equation model using Full Information Maximum Likelihood estimation, accounting overall for 48.3% of the total variance in social status attainment, confirmed that education had the strongest direct effect with a path weight of .32. Furthermore, education partially mediated the effects of social class of origin and childhood intelligence, and fully mediated the effects of behavior disturbance on status attainment. Social class of origin, childhood intelligence and behavior disturbance were strongly inter-correlated with values ranging from -.47 to .51. After controlling for these associations, educational and social status attainments were influenced to a considerably greater extent by childhood intelligence (path weights of .46 and .30, respectively) than by social class of origin (path weights of .23 and .20, respectively).

Predictors of Persistence in High-Intensity STEM Careers among Top STEM Graduate Students: A 10-year Longitudinal Study

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In their recent review of the literature, Ceci, Williams, and Barnett (2009) proposed a comprehensive model for organizing the various contributors to women's under-representation in academic science, technology, engineering, and math (STEM) fields. They concluded that, although there is enough evidence to support a causal role for most hypothesized predictors and pathways, including cognitive abilities, much of the evidence is inconsistent. Preferences and occupational interests emerge as the exceptions, however, with strong empirical support for their role in women's under-representation in academic STEM (e.g., Ferriman, Lubinski, & Benbow, 2009; Lubinski & Benbow, 2006).

Despite the empirical support for the primary role of preferences and occupational interests, to our knowledge, no studies have examined longitudinally the relative effects of sex, preferences, occupational interests, and cognitive abilities jointly on career status among top STEM graduate students (a select population with the requisite characteristics for commitment to and excellence in high-intensity STEM careers). The purpose of this study was to do precisely this. Participants were selected from top-15 U.S. math/science graduate programs (Male n = 368, Female n = 346). We examined the factors related to persistence in high-intensity STEM careers, including cognitive ability, vocational interests, sex, marital status, number of children, spouse characteristics, additional income, lifestyle preferences, graduate school and department, and graduate school mentoring relationships.

The single major limitation to the model presented in Ceci et al. (2009) involved the criterion variable: status in academic tenure-track STEM careers. While many statistics about women's participation in STEM reflect a focus on the academy, important contributions to STEM research can be made outside of academia. With this in mind, we broadened the criterion variable for our research to include high-intensity career paths outside of academic STEM that are comparable to tenure-track academic positions (based on expert ratings of position and compensation). This resulted in 139 males and 93 females pursuing high-intensity STEM careers. In examining the determinants that differentiated these high intensity STEM participants from their peers over a 10-year interval (from their first- or second year as graduate students to 10 years later), we found that, even for this highly select cohort, graduate school assessments of mathematical reasoning ability and educational-vocational interests were useful in reliably distinguishing them. This was true regardless of sex, and the psychological model we employed was more accurate in predicting the career trajectory of these participants than were their self-reports of their occupational goals during graduate school. One insight derived from this research was that participants who were not pursuing high intensity STEM careers were not less interested in STEM, but they tended to be more interested in other interest domains outside of STEM.

We also examined the career choices of those participants who did not remain in high-intensity STEM, with attention to their satisfaction and the quality of their contributions in their new career paths. Those participants who transitioned out of high-intensity STEM were very satisfied with their choices and were making worthwhile contributions in their new domains.

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Specialized or general? The differential prediction of general executive functioning skills and mathematics-specific cognitive processes on mathematics and reading psychometric outcomes.

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The present study examined the relationship of various primary abilities on assorted secondary abilities. Specifically, we were interested in the differential prediction of general executive functioning tasks and mathematics-specific processes on psychometric mathematics and reading performance measures. We hypothesized that executive functioning tasks would predict both mathematics and reading outcomes, but that primary math processes would only predict mathematics performance. Participants were drawn from the Western Reserve Reading and Math Project, an ongoing longitudinal twin project of 430 same-sex MZ and DZ twins from Ohio. The twins were approximately 12 yrs old at the time of testing. The analyses are based on tester-administered psychometric batteries of specific cognitive abilities, as well as measures of executive functioning (i.e. working memory), and process-based math cognition tasks (e.g., numerosity). Pearson correlations suggested that working memory measures were associated with psychometric math measures (r=.26-.46). Moreover, math cognition measures of numerosity, counting, estimation and simple arithmetic were associated with the psychometric math performance (r=.24-.70). None of the math cognition tasks were significantly correlated with psychometric reading performance. However, general working memory measures were correlated with reading (r=.29-.66). To further understand the relationship between the primary and secondary abilities, multiple regression models were then performed. These results suggested that working memory measures were predictors of psychometric mathematics performance, accounting for approximately 37-48% of the variance. Numerosity, estimation and simple arithmetic each also predicted psychometric math outcomes, accounting for 46 to 55% of the total variance. Working memory predicted reading outcomes, accounting for 58% of the variance. As suggested by the correlational analyses, no math cognition process-based task was a significant predictor of any reading outcome. These results would suggest that there exist basic cognitive processes which predict mathematics outcomes outside of reading, beyond the common predictive properties of general functioning processes. Data collection is ongoing, however we intend on decomposing these relationships into genetic and environmental effects in the final paper as the sample size will be then available. With this larger sample size, we will analyze the data set using structural equation modeling with latent factors of each of the discussed constructs. Using this measurement model, we examine a series of quantitative genetic models to determine the best to describe the underlying genetic and environmental structure of these data. We hypothesize that a common genetic influence will underlie performance on general executive functioning, mathematics and reading outcomes. Separate genetic effects will account for the covariance between mathematics-specific processes and math performance. In total, these analyses will allow for a better understanding of the etiology of the relationships in question, mainly the association of various primary abilities with secondary abilities. This will help in providing insight in determining the cognitive mechanisms underlying mathematics and reading achievement.

Fluid intelligence and math learning interaction: A longitudinal multilevel approach

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The association between fluid intelligence and interindividual differences in intraindividual growth on math achievement was investigated using multilevel growth curve modeling. The central theme of this paper is to show that individual differences in growth in math achievement are related to fluid intelligence. Hence, it tries to test that fluid intelligence is not only an important predictor of concurrent math achievement (entry level for the longitudinal measurements), which is also related to past learning, but also, a predictor of growth. The other purpose of this paper is to illustrate multilevel modeling using longitudinal data in the context of intelligence-learning research in psychology. Such methods of analysis are not commonly used in psychology, although they are better known in the educational literature, thus this paper illustrates the use of methodological approach of Education in the field of Psychology. A sample of 166 students (88 boys and 78 girls) ranging in age from 11 to 14 (M= 12.3, SD=.64) was tested. These individuals took four math achievement tests, vertically equated via Item Response Theory, at the beginning and end of the seventh and eighth grades. Cognitive abilities studied were Numerical Reasoning, Abstract Reasoning, Verbal Reasoning, Spatial Reasoning as measured by the Differential Reasoning Tests battery. The general results are in accordance with a common finding from the literature that individual differences in fluid intelligence are strongly related to math achievement when the measures are taken concurrently. It then shows that there are important interindividual differences in intraindividual growth patterns in math achievement throughout two-year period, with some subjects increasing their math scores at a faster rate than others. One substantial finding was that these individual differences in growth rate can be explained, at least in part, by fluid intelligence level. Individuals with higher fluid intelligence reveal a faster increase in math scores in the two years of the study than do individual with a lower fluid intelligence. Therefore the central finding is that fluid intelligence scores relate not only to initial math abilities, but also to the rate of learning, such that children with higher fluid intelligence scores demonstrated increased learning over time. These results agree with the hypothesis that fluid intelligence is an important factor in math learning. The interaction found between intelligence and math learning permits to discuss the impact of gf on learning and the impact of schooling on gc, as proposed in Cattell´s investment theory.

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DAY 2

Symposium 2
"Cognitive Ageing and Cognitive Epidemiology"

Organizer: *Lars Penke* (University of Edinburgh)

8.00-8.20: Symposium Introduction—The University of Edinburgh Centre for Cognitive Ageing and Cognitive Epidemiology: its structure, aims and examples of new studies (*Ian J. Deary*)
8.20-8.40: Task Performance Relies Differently on *g* Across Age Cohorts: Implications for *g* Theory (*Wendy Johnson, Robert H. Logie, & James R. Brockmole*)
8:40-9.00: Genome-wide association of processing speed measures (*Michelle Luciano, Gail Davies, Ian Deary, Narelle Hansell, Nicholas Martin, & Margaret Wright*)
9.00-9.20: The role of brain white matter integrity in intelligence and lifetime cognitive ageing (*Lars Penke, Susana Muñoz Maniega, Maria C. Valdes Hernandez, Mark E. Bastin, Alan J. Gow, Catherine Murray, Joanna M. Wardlaw, & Ian J. Deary*)
9.20-9.40: Reaction time and established risk factors for total and cardiovascular disease mortality: Comparison of effect estimates in the follow-up of a large, UK-wide, general-population based survey (*Beverly A. Roberts, Geoff Der, Ian J. Deary, G. & David Batty*)
9.40-10.00: Direct and indirect pathways connecting cognitive ability with cardiovascular disease risk: Do multiple health behaviours and socio-economic status mediate the relationship? (*Gareth Hagger-Johnson & Darren Shickle*)

10.00-10.20 (Break)

Paper Session
"Cognition"

Chairman: Earl B. Hunt

10.20-10.40: An Investigation of the Influence of Speed and Attention on Intelligence: Results Achieved by the Star-Counting- and Sign-Counting-Tasks (*Karl Schweizer*)
10.40-11.00: Longitudinal Study of the Effects of Working Memory on Behavior Problems (*Justin A. Low & Timothy Z. Keith*)
11.00-11.20: The dimensionality of Raven's Advanced Progressive Matrices and its relation to deductive and inductive ability (*George Spanoudes*)
11.20-11.40: Syllogism solving as a predictor of general intelligence (*Chizuru Shikishima, Shinji Yamagata, Kai Hiraishi, Koken Ozaki, & Juko Ando*)
11.40-12.00: Mathematical Technique of Response Time Data Analysis for Cognitive Tasks with Increasing Difficulty (*Yury Dodonov & Yulia Dodonova*)

12.00-13.30 (Lunch)

Paper Session 'MISC'
"Differentiation + Development + Flynn effect"

Chairman: Douglas K. Detterman

13.30-13.50: Modeling Differentiation of Cognitive Abilities within the Higher-Order Factor Model of Intelligence (*Dylan Molenaar & Conor V. Dolan*)
13.50-14.10: Global and Domain-Specific Changes in Cognition throughout Adulthood (*Elliot M. Tucker-Drob*)
14.10-14.30: The power of 1000 samples: A Flynn effect for crystallized intelligence arising from large-scale meta-analysis of cross-sectional, non-representative data sets (*Jakob Pietschnig, Martin Voracek, & Anton K. Formann*)
14.30-14.50: The Biological Correlates of the Flynn Effect in Estonia (*Olev Must & Aasa Must*)

Symposium 3
"Examining the Flynn Effect at Item Level"

Organizer: Alexander Beaujean

14.50-15.10: Studying the Flynn Effect in Estonia using Item-Level Latent Variable Modeling (*A. Alexander Beaujean, Yanyan Sheng, Olev Must, Jan te Nijenhuis, & Aasa Must*)
15.10-15.30: Further Examination of the NLSY PIAT-Math and PPVT-R Items that Exhibit the Flynn Effect (*Joseph Lee Rodgers, Siew Ang, A. Alexander Beaujean, Susan Cooper-Twamley*)
15.30-15.50: Using Item Response Theory to Investigate the Flynn Effect: Evidence from the Cognitive Abilities Test (*James L. Gambrell & A. Alexander Beaujean*)
15.50-16.10: Discussion (*Jelte Wicherts*)

16.10-16.30 (Break)

Symposium 4:
"Cognitive plasticity in healthy aging and cognitive impairment"

Organizer: Rocío Fernández-Ballesteros

16.30-16.45: Methods for assessing cognitive plasticity (*Mª Angeles Molina, Emilia Cabras, Rocío Schettini, Mª Dolores Zamarrón, Lluis Tárraga & Rocío Fernández-Ballesteros*)
16.45-17.00: Cognitive plasticity in healthy elders (*María Dolores Zamarrón, María Angeles Molina, Emilia Cabras, Rocío Schettini & Rocío Fernández-Ballesteros*)
17.00-17.15: Cognitive plasticity and cognitive impairment: preliminary results (*Emilia Cabras, María Angeles Molina, Loles Zamarrón, Lluis Tárraga, Rocío Schettini & Rocío Fernández-Ballesteros*)
17.15-17.30: Age and cognitive impairment in cognitive plasticity (*Rocio Fernández-Ballesteros, María Dolores Zamarrón, María Angeles Molina, Emilia Cabras, Luis Tárraga & Rocío Schettini*)

17.30-18.30 (Invited Speaker, David Bartholomew)

New Light on Thomson's Model of Intelligence

18.30-20.00 ISIR meeting

Symposium 2
"Cognitive Ageing and Cognitive Epidemiology"

Organizer/chair/correspondent: Lars Penke (lars.penke@ed.ac.uk)
Discussant (introduction): Ian J. Deary (Ian.Deary@ed.ac.uk)

Symposium Introduction—The University of Edinburgh Centre for Cognitive Ageing and Cognitive Epidemiology: its structure, aims and examples of new studies

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This symposium contains four examples of new studies from the The University of Edinburgh Centre for Cognitive Ageing and Cognitive Epidemiology. They have been chosen to represent work on: large-scale psychometric analyses of cognitive ageing; molecular genetic contributions to cognitive abilities using genome-wide analyses; brain imaging studies of cognitive ageing with the Lothian Birth Cohort of 1936; and studies in cognitive epidemiology using large-scale, population-representative samples. Before we hear these studies presented, this Introduction will describe the aims, structure, and membership of the Centre. Its aims are: (1) to elucidate the routes to the vulnerable ageing brain, and thus provide information to prevent or ameliorate cognitive disability and its negative consequences for health and wellbeing; (2) to determine the mechanisms by which lower cognitive ability through the lifecourse renders the body vulnerable to ill health and impaired wellbeing; and (3) to provide an outstanding environment for interdisciplinary research training in cognitive ageing and cognitive epidemiology. Its 30+ members include differential and cognitive psychologists, epidemiologists, geriatricians, neuroendocrinologists, neuroscientists, geneticists, statisticians, neuroradiologists, and medical physicists. Brief examples are presented from the Centre's research to show how it encourages and produces multidisciplinary studies of human intelligence.

Task Performance Relies Differently on *g* Across Age Cohorts: Implications for *g* Theory

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Within given samples, *g* factors derived from different test batteries appear to be effectively equivalent as long as the test batteries tap reasonably diverse abilities. This is important in showing that the general intelligence construct is independent of the particular specific abilities tested. For the construct to be truly general, however, it must also be independent of the specific individuals tested. This requires demonstration of measurement invariance across different sample groups, and large samples because of the low power of measurement invariance assessment techniques. Using an internet working and short-term memory test battery completed by over 95,000 people aged 18-90, we assessed the extent to which measurement of *g* was invariant across 14 age groups. Though factor loadings could be constrained equal, residual variances and intercepts could not. We discuss the implications of this finding for understanding general intelligence, working memory function, and cognitive changes with age.

Genome-wide association of processing speed measures

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Measures of information processing speed – psychometric and chronometric - were collected in an adolescent (15 - 22 years) and an old age (~ 70 years) cohort. Between 1393 and 1593 adolescents from up to 700 families (Brisbane Adolescent Study) and 1091 elderly (Lothian Birth Cohort 1936) were tested on the speed measures. Roughly 610 000 genetic markers (single nucleotide polymorphisms; SNPs) were typed using Illumina's 610 (Quad) array and were tested for their association with the speed measures. Population-wide significance was established if a SNP met the Bonferroni corrected p-value. Suggestive association was indicated for Inspection Time on chromosomes 9 and 16 in the adolescents and on chromosomes 6 and 4 in the elderly. Digit Symbol associations were with SNPs in known genes – *CTNND2* (adolescents), *NUDT12* (elderly) – one expressed in the dorsolateral prefrontal cortex and the other related to oxidative metabolism. Additional results will be discussed, as will the consistency of all results between young and old cohorts. Replication of these results will be possible in an independent Dutch cohort.

The role of brain white matter integrity in intelligence and lifetime cognitive ageing

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The brain's white matter provides the neuroanatomical substrate for functional integration between different brain areas, which has been implicated as fundamental for human intelligence differences [Jung RE, Haier RJ (2007) The Parieto-Frontal Integration Theory (P-FIT) of intelligence: converging neuroimaging evidence. Behav Brain Sci, 30:135-154.]. A pilot sample of 180 participants from the Lothian Birth Cohort 1936 study who had already been tested for IQ in 1947 at age 11 underwent extensive cognitive testing and whole-brain scanning at a mean age of 72, including structural and diffusion tensor MRI. Using tractography, water diffusion-based indices of white matter integrity in eight specific fibre tracts (tractography) were extracted. For seven of the eight tracts, the white matter integrity scores loaded highly on a general factor that explained about 45% of the variance and correlated significantly with a general factor of processing speed measures (simple and 4-choice reaction time, inspection time). The only tract that was not captured by the general integrity factor, the splenium of the corpus callosum, was also the only tract that connected posterior brain regions. White matter integrity in the splenium was associated with full-scale IQ and matrix reasoning, as was evolutionarily ancestral allele of the β2-adronergic receptor gene (ADRB2), which had already been reported to relate to intelligence [Bochdanovits Z, et al. (2009) A functional polymorphism under positive evolutionary selection in ADRB2 is associated with human intelligence with opposite effects in the young and the elderly. Behav Gen, 39:15-23.]. Splenium integrity partially mediated the effect of ADRB2 on intelligence, thus suggesting a gene-brain-intelligence link. Finally, since loss of white matter integrity in old age has been thought to relate to vascular problems, we used a novel multispectral image analysis method to detect and quantify iron deposits on structural MRI scans, which are biomarkers of microvascular disease. The percentage of iron deposits in brain tissue related significantly to intelligence at age 11, 70 and 72 years and also to cognitive decline between childhood and old age, explaining 4-9% of the variance. Overall, these results confirm the central role of white matter networks in intelligence and suggest potential biological pathways involved in stable intelligence differences and cognitive ageing.

Reaction time and established risk factors for total and cardiovascular disease mortality: Comparison of effect estimates in the follow-up of a large, UK-wide, general-population based survey

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Higher cognitive function is associated with faster choice reaction time (CRT), and both are associated with a reduced risk of mortality from all-causes and cardiovascular disease (CVD). However, comparison of the predictive capacity of CRT, an emerging risk factor, with that for established 'classic' risk factors, such as smoking, hypertension or obesity, is lacking. The purpose of this study was to compare the relative impact of CRT with a range of established risk factors for all-cause and CVD mortality. The UK Health and Lifestyle Survey (HALS) is a national sample survey of adults in England, Scotland, and Wales. In 1984/85 data on lifestyle factors, socioeconomic status, and health were collected for 9003 individuals. CRT data were available for 7414 individuals. With different predictor variables having differing coding structures, we used the relative index of inequality (RII) to explore the relation of a range of risk factors with mortality by computing the risk in disadvantaged (high risk; e.g., smokers) relative to advantaged (low risk; e.g., non-smokers) persons. During an average of 20 years of follow-up, there were 1289 deaths (568 ascribed to CVD). In age- and sex-adjusted models in which all-cause mortality was the outcome of interest, CRT mean (RII=2.57, 95% CI=1.98, 3.33) was the second most important predictor of death after smoking (RII=3.03, 95% CI=2.45, 3.75). For death from CVD, CRT mean (RII=2.31, 95% CI=1.55, 3.43) was again the second most important risk factor for death, behind systolic blood pressure (RII=4.37, 95% CI=3.03, 6.29). These analyses suggest that CRT, a moderately high correlate of intelligence, is an important risk factor for death from all-causes and CVD.

Direct and indirect pathways connecting cognitive ability with cardiovascular disease risk: Do multiple health behaviours and socio-economic status mediate the relationship?

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Lower levels of general cognitive ability (*g*) may be associated with increased cardiovascular disease (CVD) risk. Modelling both direct and indirect pathways could help explain this association. Multiple health behaviours and socio-economic status (SES) are candidate mechanisms which might connect *g* with CVD outcomes. However, they are rarely modelled explicitly as mediating variables. This partly reflects the tendency to adjust or control for health behaviours or SES, but partly reflects the lack of available datasets which contain all of the relevant variables. The Health and Lifestyle Survey 1984 (HALS) is one exception. Previously, researchers have used the HALS data to demonstrate the importance of modelling cognitive ability (Shipley, Der, Taylor & Deary, 2008), multiple health behaviours (Boniface & Tefft, 1997), socio-economic status (Ecoba & Davey Smith, 1999) and indirect pathways to health outcomes (Ploubidis & Grundy, 2009). The aim of our analysis was to combine these approaches, testing both direct and indirect pathways to CVD risk, via multiple health behaviours and SES. In a latent variable model, CVD risk (defined by waist-hip ratio, systolic and diastolic blood pressure) was regressed on cognitive ability (defined by reaction time, choice reaction time, reaction time errors, incidental verbal declarative memory, visual-spatial reasoning and crystallized health knowledge). Two mediating latent variables connected *g* with CVD risk: multiple health behaviours (defined by smoking, physical inactivity and weekly saturated fat intake) and SES (defined by educational attainment, occupational social class and income). Only the indirect path via SES was statistically significant. Furthermore, this was specific to males in the 40 to 59-year age group. One standard deviation increase in *g* was associated with a .14 standard deviation decrease in CVD risk that was mediated by SES. Therefore, SES may connect *g* with CVD risk in males, but not systematically across the entire age range. Several different explanations for the specificity of the indirect effect will be considered, and alternative modelling strategies will be discussed.

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Paper Session
"Cognition"

An Investigation of the Influence of Speed and Attention on Intelligence: Results Achieved by the Star-Counting- and Sign-Counting-Tasks

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According to the cognitive-basis approach of intelligence attention and speed are two sources of individual differences in intelligence. Since attention and speed are usually represented by similar measures, it is important to clarify the relationship of these concepts as predictors of intelligence. In a sample of 123 participants the Star-Counting-Task (StCT) and the Sign-Counting-Task (SiCT) were applied for the measurement of attention and speed. StCT requires the counting of stars included in a quadratic array of simple figures. SiCT demands the counting of signs presented sequentially somewhere in the frame of a square. This task includes two treatment levels since in one level only "plus" signs appear which needs to be counted, whereas in the other level additionally "minus" signs become visible, which require the subtraction of one from the result. In each task the assessment of performance included accuracy as measure of attention and reaction time as measures of speed. Intelligence was measured by means of APM and BIS. For investigating the data three models were constructed. The first model was characterized by attention and speed as equivalent predictors. In the second model attention was the basic predictor and speed the higher-ranking predictor. The final model included speed as basic predictor and attention the higher-ranking predictor. The results revealed the third model as most appropriate model. Each one, attention and speed, contributed to the prediction of intelligence.

Longitudinal Study of the Effects of Working Memory on Behavior Problems

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Several research studies have examined the link between working memory ability and behavior problems in youth. Research suggests that children with working memory deficits demonstrate lower levels of attention and higher levels of hyperactivity, physical aggression, and other behavior problems. However, no research has examined the effect of the development of working memory skills on behavior problems. Accordingly, this study examined the developmental impact of working memory on behavior problems and evaluated several questions: Do changes in working memory translate into changes in behavior problems? Alternatively, do children with initial deficits in working memory develop behavioral patterns that continue in their youth despite later development in working memory skills?

This study used latent growth curve models, a form of structural equation modeling used to model developmental trajectories. Digit Span – Backwards was used as a measure of working memory and the Behavior Problems Index was used as a measure of behavior problems. The Behavior Problems Index contains measures of Peer Conflict, Anxiety/Depression, Headstrongness, Hyperactivity, Antisocial Behavior, and Dependence. Several background variables were taken into consideration. The Peabody Picture Vocabulary Test – Revised was used to control for the effects of general intelligence on working memory and behavior problems. Sex of the participants was controlled as boys and girls show differing levels of behavior problems. Additionally, short-term memory was considered to ensure that the effect of working memory was not due to general memory abilities. Socioeconomic status was used as a background variable as children of different backgrounds are likely to display different behavior patterns.

On average, children showed increases in internalizing behaviors from the ages of 7 to 14; however, children who initially demonstrate high working memory ability showed smaller increases in internalizing behaviors than did children with average levels of working memory. Likewise, children who initially demonstrate low working memory ability show larger increases in internalizing behaviors than the average child. Many of the background variables included in the model had statistically significant effects on the initial levels and developmental trajectories of internalizing, externalizing, and Inattentive/Hyperactive behavior problems. Specifically, general cognitive ability affected the developmental trajectories of internalizing, externalizing, and Inattentive/Hyperactive behaviors. Socioeconomic Status also affected the developmental trajectories of internalizing and externalizing behaviors. Contrary to expectations, the developmental trajectories of working memory did not affect the developmental trajectories of behavior problems. Thus, developmental increases in working memory do not seem to affect the course of behavior problems in childhood, while initial levels of working memory and general cognitive ability do.

The dimensionality of Raven's Advanced Progressive Matrices and its relation to deductive and inductive ability

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Although the dimensionality of the Raven´s Advanced Progressive Matrices test (APM; Raven, 1962) has studied extensively, the data so far collected are inconclusive as they supported different factor structures. The proposed taxonomies of the test vary in the number and the nature of the extracted factors (Vigneau & Bors, 2008). Some studies are tried to define the factor structure of the test using factor analyses (exploratory or confirmatory), others applied cognitive methodologies in order to induce the rules required for the solution of the test items and others, more recently, utilized the Rasch model. Few attempts have been made to study the APM solution process in relation to deductive and inductive reasoning tasks.

The present paper is an attempt to investigate the factor structure of the APM and its discriminant validity with respect to the deductive ability as it is measured through categorical, linear and conditional arguments tasks, and inductive ability as it is assessed by using inductive arguments. The results of a confirmatory factor analysis suggested that a three factor solution seems to be the best representation of the APM´s structure. These three factors were moderately correlated with performance on deductive tasks but not with inductive tasks. The importance of our findings is discussed in relation to the models concerning the factor structure of the Raven´s APM.

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Syllogism solving as a predictor of general intelligence

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Syllogisms are a form of logical deductive argument relating three terms that consist of two premises and a conclusion. In the fields of traditional logic and philosophy, the deductive reasoning ability expressed in syllogisms has been inferred as a symbol of human intelligence since first described in 350 B.C.E. by Aristotle in Prior Analytics (Bochenski, 1970).

We earlier reported that logical deductive reasoning ability—as measured by syllogism solving—jointly constructed human general intelligence (*g*), with verbal and spatial abilities as measured by intelligence test. We also described that *g* was identified at its genetic and environmental factor levels (Shikishima, et al, 2009). In that study, 100 syllogism problems and a full-scale intelligence test were administered in a group test design to 220 pairs of Japanese young adult twins (448 individuals) (ages 17-36).

The present study examines the validity of a greatly shortened version of a syllogism-solving test as a simple predictor of *g* using a mail survey design. Five problems of syllogisms were included in a questionnaire as part of a mail survey conducted by the Keio Twin Research Center (KoTReC). Data were collected from 487 pairs of twins (1021 individuals) who were Japanese junior high or high school students (ages 13-18), and from 536 mothers and 431 fathers.

The higher intraclass correlation for identical twins (r =.38) than fraternal twins (r =.30) demonstrated the genetic contributions to logical deductive reasoning ability as measured by syllogisms. Shared environmental effects were identified, but the component might result in part from assortative mating related to the ability represented as a positive correlation between mothers' and fathers' respective performances (r =.25). Genetic overlap, as indicated by substantial genetic correlations with performance on syllogism solving, was observed for English and mathematics achievement, and democratic social attitudes. The validity of the five problems of syllogisms as efficient markers of *g*—a *vehicle* of *g*—is discussed.

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Mathematical Technique of Response Time Data Analysis for Cognitive Tasks with Increasing Difficulty

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The purpose of this paper is to present a mathematical technique that can be used for response time data analysis in cognitive tasks with increasing difficulty.

Response time registration is quite often used for cognitive tasks as it provides important information about underlying cognitive processes. At the same time only two measures of response time are mostly used in modern studies namely average response time and standard deviation or some other measure of individual variability. However these measures are appropriate only for certain experimental conditions when all the tasks in the trial are nearly equal in their difficulty for individuals. In our studies we are interested in another category of elementary cognitive tasks. We create tasks very similar in their design, but different in their difficulty for the participants. We are interested not only in individual task performance but mostly in individual sensitivity to the increase of task complexity.

Mathematical technique described in the present study can be used for complex analysis of response time data of such tasks. Average response times are counted separately for each difficulty level. These average times are approximated; individual parameters of the time function are estimated for any given individual. Optimal function for response time approximation is discussed. Using individual approximation parameters individual index expressing the area under the approximation curve is calculated using integral. Other indexes of approximation are also used in analysis as they reflect different aspects of cognitive processing.

Response time data collected from visual stimuli recognition tasks are presented as an example of such analysis (235 participants). Individual integral index shows higher correlations with IQ than simple average response time. Other indexes give us at the same time a measure of simple processing speed and so on.

Universality of the approximation function for this type of the tasks is discussed. This method is compared with other ways of response time data analysis and approximation (Hick's law and Shepard's mental rotation task are discussed as the examples).

Paper Session 'MISC'
"Differentiation + Development + "Flynn effect"

Modeling Differentiation of Cognitive Abilities within the Higher-Order Factor Model of Intelligence

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The general differentiation hypothesis states that the strength of the correlations among a set of IQ subtests varies across a given background variable. Instances of the general differentiation hypothesis that have been considered in the literature include age differentiation, ability differentiation, and personality differentiation. Traditionally, the differentiation effect is attributed to the varying role of g in the subtest scores of an IQ test across the background variable. In this paper we argue that this is only one possibility for a differentiation effect to arise. We discuss additional ways in which differentiation can emerge in the higher-order factor model of intelligence, and demonstrate that these manifestations of differentiation can be tested using moderated factor analysis. Using this method, we study the degree in which the various conceptualizations of differentiation can be distinguished, and investigate the age and ability differentiation hypotheses in a real data set.

Global and Domain-Specific Changes in Cognition throughout Adulthood

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Normative adult age-related decrements are well documented for multiple domains of cognitive functioning. However, it is currently unclear whether these decrements each reflect a distinct and independent developmental phenomenon or, in part, a more global phenomenon. This possibility was directly examined using multivariate longitudinal cognitive ability data. A number of alternative factor analytic models were superimposed over longitudinal growth curve models of twelve different variables representative of four core cognitive ability domains (Fluid Reasoning, Spatial Visualization, Episodic Memory, and Processing Speed). Results supported a hierarchical structure of longitudinal changes, with approximately 50% of the change occurring in each cognitive domain attributable to global (domain-general) processes. Although it is generally assumed that systematic and pervasive sources of maturational decline only emerge in later adulthood, this same pattern held for younger (ages 18-50 years) as well as older (ages 51-97 years) adults.

The power of 1000 samples: A Flynn effect for crystallized intelligence arising from large-scale meta-analysis of cross-sectional, non-representative data sets

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Keywords: Flynn effect, crystallized intelligence, meta-analysis

The accumulated empirical evidence for long-term gains on standardized intelligence test scores in the general population, known as the Flynn effect (Flynn, 1984, 2009; Wicherts et al., 2004; Colom et al., 2005), for the most part is based on: (1) large and representative (population-based) samples; (2) healthy male subjects (e.g., from conscript mass-testing); (3) different measures of fluid intelligence; (4) data from the Anglo-American sphere; and (5) study periods prior to the 1970s. In contrast, here we provide first-time meta-analytic evidence for the Flynn effect based on: (1) small and non-representative samples; (2) samples of normals and patients of both sexes; (3) a single measure of crystallized intelligence sensu Cattell (the German-language *Multiple-Choice Vocabulary Test*, MWT; Lehrl et al., 1995); (4) data from the German-speaking countries of Central Europe; and (5) a more recent study period (subsequent to the 1970s). As for the central finding, sample size-weighted mean MWT IQ figures from about 1000 retrievable samples (collected between 1973 and 2009; total N = 39,000+) correlated significantly positive (r = +.37, p < .001) with study year. This effect generalized across sample type (normals vs. patients), publication status (published vs. unpublished data), and publication language (English vs. German). The estimated IQ gain per decade (Jensen's Delta IQ) amounted to 2.2 IQ points. This novel finding contains several points of interest: (1) in contrast to the majority of findings from Anglo-American countries, in German-speaking countries the Flynn effect is also observable for the crystallized component of intelligence (Voracek, 2006); (2) in contrast to recent evidence from Scandinavia for an end or even reversal of the Flynn effect (Flynn, 2009), IQ gains apparently are still ongoing in German-speaking countries; and (3), intriguingly so, the Flynn effect is even ascertainable through meta-analytic aggregation of a great many samples, all of them small and non-representative, thereby demonstrating the pervasiveness and robustness of this still poorly understood phenomenon.

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The Biological Correlates of the Flynn Effect in Estonia

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Positive FE is revealed in different Estonian IQ datasets during the XXth. century. It comes side by side with the rise of height of Estonians. During the XXth. century there were several changes in nutrition (a shift towards using animal protein in 1930s, the practice of eating fat-rich food in the 1980s and the trend towards more balanced diet in the beginning of the XXIst. century).

The conclusion of the FE in Estonia, as described in literature: the meaning of IQ tests is changed in time. This conclusion is too simplified to satisfy research goals in this area. All the available data and interpretation possibilities are not utilised.

There are 3 kinds of data available regarding FE and its correlates in Estonia:

A. IQ and Ability Data Concerning Estonians.
1928: Binet- Simon Bobertag Scale. Adapted by H. Valma into Estonian in 1928.
1934/19362 National Intelligence Tests. Adapted by J. Tork. Results are published, IQ and FE data about schoolchildren are available..
1934/1938 several ability tests were adapted into Estonian by the Vocational Guidace Bureau in Tallinn. The majority of tests are non-verbal and time-dependent. They were psychometric tests of attention, memory , spatial reasoning, motor skills. Reimann (1939) presents a summary of the data on 1016 Estonian adults.
1969: Amthauer der Intelligenz-Structur-Test (IST) was adapted into Estonian by E. Koemets and H. Liimets (Koemets & Liimets, 1969; Toim, 1987). There is a student paper (K. Traks, 2004) about FE (1971/72 -2004) in Estonia on the bases of IST.
1972 the General Aptitude Test Battery (GATB) was adapted into Estonian by J.Ennulo, A.Kivistik, E.Kraning, H.Põldma and S.Sõerd. There is no analysis of FE on the bases of this test.
1972: The first Estonian data collected with Raven Standard Progressive Matrices(SPM) The mean SPM score of 13-14 year old schoolchildren was 43,17 (Toim, 1974). The FE on bases of this data is analyzed (Meskanen, 2002).
2001: H. Pullmann and J. Allik standardized the Ravens Standard Progressive Matrices in Estonia on the sample of 1,835 7-11olds. The mean IQ of the Estonian sample was estimated at 98 in relation to a British IQ of 100.

B. Anthropological Data. There are a lot of anthropological studies and data about Estonians from the beginning of 19th century. Between 1811 – 2003 the mean height of 17-year-old Estonian boys increased by 18,4 cm (0, 97 per decade) (Lintsi & Kaarma, 2006).

C. Nutritional Studies. The history of food science in Estonia dates back centuries. The surveys of population food habits started in 1920s. From 1925 and from 1937/38 there are official budget survey data (Reimann, 1926; Reimann, 1939). Nutrition studies started again in 1960s (Vagane, 1965). From 1980s there are several dietarial surveys (Saava, 2001; Solodkaja, 2001; Pitsi, 2006).

Symposium 3
"Examining the Flynn Effect at Item Level"

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The majority of the data on the Flynn Effect (FE) comes from amalgamated test scores (e.g., full scale IQ). Such investigations often rely on either full scale IQ (or equivalent) scores from large research samples in the United States or certain European countries. While the results from such studies have found a wide range of gain magnitudes (and sometimes even a decrease in scores), the average is approximately 3 IQ points per decade, depending of the instrument and country of origins of the examinees.

While using amalgamated scores is sufficient to show an increase in IQ, such scores are concurrently problematic as they does not allow for an understanding of why such IQ gains are extant. For example, a rise in IQ scores could be due to genuine rise in cognitive ability, a change in item properties (i.e., discrimination, difficulty), or perhaps both occurring simultaneously. To answer such questions, investigations will need to move beyond analyzing full scale type scores and, instead, move to using more refined data, such as those at the item level. To that end, this symposium will have three presentations that examine the FE at the item level.

1. Beaujean, Sheng, Must, te Nijenhuis, Must will investigate the FE in three cohorts (1933/36, 1997/98, 2006) of Estonian students using items from the Estonian National Intelligence Test.

2. Rodgers, Ang, Beaujean, Cooper-Twamley, and Moye will extend the work of Rodgers and Ang (2008) and investigate the commonalities of the items shown to exhibit invariance over time in the National Longitudinal Study of Youth, using the Math test from the Peabody Individual Achievement Test as well as Peabody Picture Vocabulary Test-Revised.

3. Gambrell and Beaujean will examine the FE in items across the Cognitive Abilities Test from 1984 to 2000.

Studying the Flynn Effect in Estonia using Item-Level Latent Variable Modeling

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The Flynn Effect (FE) has been a source of interest for intelligence researchers for almost three decades. During that time, much research has shown that cognitive ability has generally increased over much of the 20th century. However, most of these studies utilized classical test theory (CTT) -based measurement, which might not be adequate when investigating the FE. Not only does CTT not allow for direct assessment of invariance across cohorts, but it cannot tease apart if the change in group means is due to a change in the people taking the tests, a change in the instrument's properties, or perhaps a change in both. Latent variable modeling of cognitive ability measures extends CTT by allowing the researcher to transcend the issues inherent in CTT. More specifically, it allows for a specific assessment of whether there is a change in the underlying trait being measured, the items measuring the trait, or if both are occurring concurrently.

The current project will examine the FE in Estonia, using three cohorts (1933/36, 1997/98, 2006) of Estonian students (N = 2173). Each of these respondents took the Estonian version of the National Intelligence Test, which is comprised of 10 subtests measuring verbal (sentence completion, synonyms–antonyms, symbol–number correspondence, information, vocabulary, analogies) and nonverbal (arithmetic, concept comprehension, computation, comparisons) reasoning skills. The results from the current study will be put into context of the results of Must, te Nijenhuis, Must, and van Vianen (2009), who found a FE in most of the subtests when examining the aggregated scores.

References

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Further Examination of the NLSY PIAT-Math and PPVT-R Items that Exhibit the Flynn Effect

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The corpus of Flynn Effect (FE) research has examined differences in aggregated IQ and IQ-equivalent scores over time, paying little attention to the items that comprise these scores. In doing so, they assume that all the items act very similarly, which may not be the case. Consequently, by not using item-level data, such studies do not analyze all the information available from a test administration.

In the current paper we evaluate the Flynn Effect at the item level in PIAT-Math and PPVT-R from the National Longitudinal Study of Youth. Extending the work previously done by Rodgers and Ang (2008), this study compares the PIAT-Math items that Rodgers and Ang found to exhibit non-invariance over time using item-level unstandardized regression slopes with the PIAT-Math items Beaujean and Osterlind (2008) found to exhibit non-invariance over time using item response theory. Second, again following Rodgers and Ang, this study examines the item content of the PPVT-R items that Beaujean and Osterlind found to exhibit non-invariance over time. Preliminary analysis shows that many of the PPVT-R items that exhibited non-invariance were in the interpersonal domain, with a less strong relationship being found with items in the home (e.g., furniture, appliances) and environment (foliage, terrain) domains.

References

Beaujean, A. A. & Osterlind, S. (2008). Using item response theory to assess the flynn effect. *Intelligence, 36*, 455-463

Rodgers, J. L. & Ang, S. (2008). Putting the flynn effect under the microscope: Item-level patterns in the NLSY PIAT-Math scores. In J. te Nijenhuis (Chair), *Recent advances in research on the flynn effect*. Symposium presented at the annual conference of the International Society for Intelligence Research, Atlanta, GA.

Using Item Response Theory to Investigate the Flynn Effect: Evidence from the Cognitive Abilities Test

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The majority of what we currently know about the Flynn Effect (FE) comes from data using amalgamated test scores (e.g., full scale IQ). Such investigations are sufficient to show the existence of the FE, but do not allow for an understanding of why such IQ gains are extant. For example, the rise in IQ scores could be due to genuine rise in cognitive ability, a change in item properties (i.e., discrimination, difficulty), or perhaps both occurring simultaneously. To test such hypotheses, FE investigations need to move beyond analyzing full scale type scores and start using more refined data, such as item-level scores.

The current study examines the FE by investigating item invariance in Forms 4, 5, and 6 of the Cognitive Abilities Test (CogAT). The CogAT is one of the few intelligence tests that has repeatedly collected large (> 100,000) representative samples in its standardizations. Each CogAT battery contains 3 subtests in each of the Verbal, Quantitative, and Nonverbal domains. This study will examine the FE in all three domains using standardization samples from 1984-2000, which is made up of responses from schoolchildren ages 8-18 from a wide variety of backgrounds found in the United States. Analyses will focus on white examinees to minimize the influence of demographic factors.

Using Item Response Theory analyses, this study will investigate the following questions:

1. Are the items on the CogAT invariant across time, or is there a change in difficulty,
   discrimination, or both?
2. Controlling for any possibly-invariant items across time, is there a rise in latent ability from
   1984 to 2000 in any of the three CogAt domains?
3. If there is a rise, is it uniform, or are there substantial differences across the domains, across subtests, and/or across age ranges?

Symposium 4:
"Cognitive plasticity in healthy aging and cognitive impairment"

Organizer: Rocío Fernández-Ballesteros

Universidad Autónoma de Madrid (UAM)

Cognitive plasticity is a relatively recent construct which has been assessed through learning potential tests (so called "dynamic assessment" tests or, "testing-the-limits") through test-training-postest designs but using standard cognitive tasks (e.g. Raven's Matrixes, Khos´ Blocks, etc.). Also, is relatively recent the utilization of this construct in the assessment of cognitive impairment and healthy older persons. The present Symposium is trying to introduce a set of studies developed by the Autonomous University of Madrid research group "Assessment and Aging" (EVEN). First of all, the concept of cognitive plasticity will be reviewed as well as the methods of assessment will be introduced by Molina et al.; secondly, cognitive plasticity data about healthy individuals older than 55 (from 55 through 100 years old) will be presented by Zamarrón et al.; third, comparisons between mild cognitive impaired individuals and Alzheimer's disease patients will be introduced by Cabras et al.; fourth, differential influence of age and cognitive impairment in cognitive plasticity will be presented and discussed by Fernández-Ballesteros et al..

Methods for assessing cognitive plasticity

Mª Angeles Molina, Emilia Cabras, Rocío Schettini, Mª Dolores Zamarrón, Lluis Tárraga & Rocío Fernández-Ballesteros

Universidad Autónoma de Madrid and ACE (Barcelona)

After examine several definitions of cognitive plasticity and related terms, review some instruments used in the assessment and operationalization of cognitive plasticity in healthy older people and those with cognitive impairment. Subsequently the Assessment Battery of Learning Potential for Dementia (BEPAD) developed by the group of UAM EVEN is introduced. The BEPAD consists of three tasks assessing cognitive functions of high involvement in cognitive decline in dementia and Alzheimer's Disease: Dots Location (visual memory), List of words (audio-verbal memory), and Test verbal fluency. The three tasks are in accordance with experimental paradigm test-training-retest. After the BEPAD administration to normal elderly, people with MCI and those with Alzheimer's disease, several data about reliability and diagnostic validity are going to be introduced.

Cognitive plasticity in healthy elders

María Dolores Zamarrón, María Angeles Molina, Emilia Cabras, Rocío Schettini & Rocío Fernández-Ballesteros

Universidad Autónoma de Madrid

Cognitive plasticity is a new constructs predicting cognitive modifiability and cognitive reserve in old age. The purpose of this study is to test healthy elders show cognitive impairment assessed through a Leaning Potential Verbal test and which is its internal structure. Participants from the base line of the Longitudinal Study of Active Aging (ELEA; N=458; age range= 55-75), from the base line of the Longitudinal Study 90+ (90+; N=189) were tested through several cognitive tests (Digit backward and Digit Symbol) and through Leaning Potential Verbal tests (VALT-PA) from the BEPAD. Results were discussed, first of all regarding internal consistency of VALT-PA trials and its internal structure; secondly socio-economic (income and schooling) influence in cognitive plasticity are examined and, finally, individual differences due to age will be analyzed.

Cognitive plasticity and cognitive impairment: preliminary results

Emilia Cabras, María Angeles Molina, Loles Zamarrón, Lluis Tárraga, Rocío Schettini & Rocío Fernández-Ballesteros

Universidad Autónoma de Madrid, ACE

The general objective of this study was to test in what extent Mild Cognitive Impairement individuals and AD patients show cognitive plasticity. Participants in this study were 156 subjects (85 women, 71 men, mean age: 75,9), divided in three groups: 41 healthy older adults, 55 diagnosed with MCI (Mild Cognitive Impairment) according to Petersen's criteria, and 60 diagnosed as mild AD (Alzheimer's Disease) according to NINCDS-ADRDA criteria. The BEPAD (Batería de Evaluación del Potencial de Aprendizaje en el Deterioro) is a battery of learning potential tests, two subtests from this battery were administered: AVPA (a verbal learning task) and TP/PA (a visual memory task). We also used mental examination for screening (MMSE). As expected, in the baseline healthy older adults significantly had higher performance than MCI and AD in both tasks. MCI do not significantly differs than AD in both tasks. After training, the three groups significantly improve their performances in comparison with baseline in both tasks. Although healthy older adults show higher cognitive plasticity than cognitively impaired individuals, it can be reasonably concluded that MCI individuals and AD patients also show cognitive plasticity or, in other words, their cognitive performance can be in some extent modifiable through cognitive training.

Age and cognitive impairment in cognitive plasticity

Rocio Fernández-Ballesteros, María Dolores Zamarrón, María Angeles Molina, Emilia Cabras, Luis Tárraga & Rocío Schettini

Universidad Autónoma de Madrid

Two main factors are influencing cognitive plasticity on the elderly: age and cognitive impairment. The main objective of this study is to examine in what extent age and cognitive impairment are explaining cognitive plasticity. Participants from the base line of the Longitudinal Study of Active Aging (ELEA; N=458; age range= 55-75), from the base line of the Longitudinal Study 90+ (90+; N=189) and from the base line of the Longitudinal Study of Cognitive Plasticity and Cognitive Impairment (Healthy=100; MCI individuals=100 and Alzheimer´s disease patients) were examined through one of the BEPAD Test, the Learning Potential Verbal Test. Although results show differences both due to age and due to cognitive impairment, learning scores are more sensitive and with more discriminant power than pre-test (base line) scores. Results are discussed from the point of view of the several theories on the field.

DAY 3

Symposium 5
"Group differences"

Organizer: Jan te Nijenhuis

8.00-8.20: *g* Loadings and Their True Score Correlations with Heritability Coefficients, Giftedness, and Mental Retardation: Three Psychometric Meta-Analyses (*Rosina M. van Bloois, Lise-Lotte Geutjes, Jan te Nijenhuis, & Irene E. de Pater*)
8.20-8.40: Evaluation of the Relation Between Heritability (h^2) and *g*-loadings in Psychometric Intelligence Tests (*Kees-Jan Kan, Sanne Haring, Conor Dolan, & Han van der Maas*)
8.40-9.00: The Rise and Fall of the Flynn Effect as a Reason to Expect a Narrowing of the Black-White IQ Gap (*J. Philippe Rushton, and Arthur R. Jensen*)
9.00-9.20: Developmental Origins of Group Differences (*Gerhard Meisenberg*)
9.20-9.40: The Chosen People: Jewish Intelligence and Achievements (*Richard Lynn*)
9.40-10.00: The Impact of Smart Fractions, Cognitive Ability of Politicians and Average Competence of Peoples on Social Development (*Heiner Rindermann, Michael Sailer, & James Thompson*)
10.00-10.20: Discussion (*Charles Murray*)

10.20-10.40 (Break)

Paper Session
"Group Differences"

Chairman: Raegan Murphy

10.40-11.00: Use Slopes to Track the "Fundamental Cause" of Group Disparities in Health (*Linda S. Gottfredson*)
11.00-11.20: Stereotype threat and the cognitive test performance of African Americans (*Jelte M. Wicherts & Cor de Haan*)
11.20-11.40: The bilingual testing of intelligence in bilinguals: Why it should be done bilingually (*Serge Lacroix*)
11.40-12.00: Gender effect on reasoning tasks performance: Impact of items contents on cognitive performance (*Gina C. Lemos, Leandro S. Almeida, & M. Adelina Guisande*)

12.00-13.30 (Lunch)

13.30-13.50: A preliminary analysis of the relationship between haplogroup frequency and IQ Towards an evolutionary ecology of general intelligence (*Michael A. Woodley & James P. Stratford*)
13.50-14.10: The cross-cultural comparison of self-assessment of intelligence (*Ekaterina Valueva & Sofya Belova*)
14.10-14.30: Sex Differences in Latent Means and Variances of Cognitive Abilities: Evidence from the CogAT (*Timothy Z. Keith, Matthew R. Reynolds, & Joni M. Lakin*)

Paper Session
"Methods"

Chairman: Conor V. Dolan

14.30-14.50: Self Awareness, Cultural Awareness, Consistency and the Ecology of Abilities in College Students (*Joseph Psotka, Peter Legree, & Brandis L. Ruise*)
14.50-15.10: The issue of power in the identification of "g" with lower-order factors (*Dora Matzke, Conor V. Dolan, & Dylan Molenaar*)
15.10-15.30: Viability of two strategies of IQ estimation in a Brazilian sample: A study with Bland-Altman analyses (*Flávia Wagner, Josiane Pawlowski, Denise Balem Yates, Susy Camey, & Clarissa Marceli Trentini*)
15.30-15.50: Self-Estimated Intelligence Revisited (*Kari Celeste Ross & Aurelio José Figueredo*)
15.50-16.10: Computer-based assessment of emotional intelligence (*Fabiano Koich Miguel & Ricardo Primi*)
16.10-16.30: Processing discrepancy between probe and target stimuli: Further refinement of a near match-to-sample task (*Meredith C. Frey*)

Symposium 5
"Group differences"

Organized by Jan te Nijenhuis

Group differences in IQ test scores were, are, and most likely will remain one of the most intriguing and controversial findings in the social sciences research literature. This symposium includes some of the latest empirical findings, with studies from the Netherlands, Canada, the U.S., Great-Britain, Dominica, and Austria.

Rosina van Bloois, Lise-Lotte Geutjes, Jan te Nijenhuis, Irene de Pater and Birthe Jongeneel-Grimen focus on three hypotheses in the nomological net of *g* loadings. They hypothesized that *g* loadings of subtests of a test battery are strongly linked to 1) the heritability coefficients of these same subtests, 2) scores on subtests of mentally retarded, and 3) scores on subtests of gifted. Using psychometric meta-analyses on huge samples, all hypotheses are strongly confirmed.

Kees-Jan Kan, Sanne Haring, Conor Dolan, and Han van der Maas review the relevant literature on the Jensen-effect for heritability and conclude that although the evidence is rather limited, it seems to exist. However, the most cultural biased subtests show the highest heritabilities as well as the highest *g*-loadings, which is a problematic finding for explanations in terms of a biological, genetic *g*.

Phil Rushton and Arthur Jensen criticize the recent book Intelligence and How to Get It*, by Richard Nisbett (2009). Nisbett argues that the finding that Black-White differences are more pronounced on the more* g*-loaded and genetically influenced tests is a "red herring" in the race-IQ debate because these variables correlate just as high with the secular gains, implying the "absurd" conclusion that the secular gains are also heritable. After a review of the empirical literature it is concluded that the mostly heritable cause of the one is not the mostly environmental cause of the other.*

Gerhard Meisenberg uses data from the NLSY79 in the United States and shows there is an essentially linear rise of *g* and of scores on the ASVAB subtests. This rise is greater for males than females, and greater for Whites than Blacks.

Richard Lynn reviews studies of the intelligence of Ashkenazi Jews in the United States, Canada and Britain showing that their average IQ is approximately 110. The intelligence of the Jews raises several interesting questions including (1) how can the high IQ of the Ashkenazi be explained; (2) why do the Oriental Jews have a much lower IQ than the Ashkenazi; (3) why is high IQ of Ashkenazi Jews not mentioned in textbooks on intelligence?

Heiner Rindermann, Michael Sailer, and James Thompson will present on smart fraction theory which supposes that gifted and talented persons are especially relevant for societal development. Using datasets on 90 countries they calculated an ability sum value for the upper level group and compared its influence with the mean ability and the 5th percentile ability on wealth, patent rates, Nobel Prizes, numbers of scientists, political variables, HIV, AIDS and homicide. The data confirmed the theory.

Charles Murray will serve as a discussant.

g Loadings and Their True Score Correlations with Heritability Coefficients, Giftedness, and Mental Retardation: Three Psychometric Meta-Analyses

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In the area of cognitive ability it is generally agreed on that performance on all cognitive tasks is not independent but rather is always positively associated, the well-known positive manifold. When factor analyzed, these positive intercorrelations yield clusters of higher-order cognitive capacities. In hierarchical models of cognitive ability the top level of this hierarchy is occupied by the general factor of mental ability, Spearman's *g*. It is usually defined as the first factor or the first component derived by methods such as principal factor analysis or principal component analysis. The correlations of the subtests with the general factor are known as the *g* loadings of these subtests.

In this presentation we focus on three hypotheses in the nomological net of *g* loadings. First, several authors, including Jensen (1987) and Spitz (1989), have hypothesized that *g* loadings of subtests of a test battery are strongly linked to the heritability coefficients of these same subtests. Second, Spitz has hypothesized that scores on subtests of mentally retarded correlate strongly with *g* loadings of these subtests. Third, we hypothesize that scores on subtests of gifted also correlate strongly with *g* loadings of these subtests.

Psychometric meta-analysis (Hunter & Schmidt, 2004) estimates what the results of studies would have been if all studies had been conducted without methodological limitations or flaws. The results of perfectly conducted studies would allow a clearer view of underlying construct-level relationships (Schmidt & Hunter, 1999). We carried out three psychometric meta-analyses with the goal to provide reliable estimates of the true correlation between the magnitude of *g* loadings and (1) heritability coefficients, (2) score differences between a mentally retarded group and an average group, and (3) score differences between a gifted group and an average group.

Psychometric meta-analytical techniques were applied using the software package developed by Schmidt and Le (2004). Psychometric meta-analysis is based on the principle that there are artifacts in every dataset and that most of these artifacts can be corrected. In the present meta-analyses we corrected for five artifacts identified by Hunter and Schmidt that alter the value of outcome measures: (1) sampling error, (2) reliability of the vector of *g* loadings, (3) reliability of the vector of a specific variable of theoretical interest, (4) restriction of range of *g* loadings, and (5) deviation from perfect construct validity.

First, the psychometric meta-analysis on the correlation between *g* loadings and heritability coefficients is based on eight studies, with participants numbering a total of 3,024 (1,512 twin pairs). This resulted in a value of +1.01 for the estimated true correlation between *g* loadings and heritability coefficients. Second, the psychometric meta-analysis on the correlation between *g* loadings and mental retardation is based on data derived from 24 studies with a total sample size of 3,057 participants. This resulted in a value of +.74 for the estimated true correlation between *g* loadings and mental retardation. Third, the psychometric meta-analysis on the correlation between *g* loadings and the score differences between gifted groups and average groups is based on twenty-two studies, with participants numbering a total of 5,129. This resulted in a value of +1.01 for the estimated true correlation between *g* loadings and giftedness. So, all three hypotheses are strongly supported.

Evaluation of the Relation Between Heritability (h^2) and *g*-loadings in Psychometric Intelligence Tests

Kees-Jan Kan[1], Sanne Haring[1], Conor Dolan[1], & Han van der Maas[1]
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In psychometric intelligence testing, the method of correlated vectors has been used to investigate relationship between the general factor of intelligence (*g*) and heritability of IQ subtest scores. The crux of this method is the correlation between the subtests' *g*-factor loadings (obtained in a factor analyses) and the subtests' heritability coefficients (h^2; obtained for instance in a twin study). As an empirical finding, it is often considered that this correlation (termed the Jensen-effect for heritability) is a significant and well-established fact, which is taken to suggest a high influence of the genetic component of *g*. The Jensen-effect for heritability is considered to be evidence for a real biological, genetic *g*, as opposed to a mere statistical factor. Indeed, without making additional assumptions the effect is problematic for alternative explanations (sampling theory, the Dickens & Flynn model of intelligence, and the mutualism model of intelligence), which do not include a general factor as an underlying quantitative variable, but which explain the positive manifold. In this presentation, we review the relevant literature and conclude that although the evidence is rather limited, the Jensen-effect for heritability seems to exist. However, subtests that measure crystallized abilities (the most cultural biased subtests) show the highest heritabilities (as well as the highest *g*-loadings), which is a problematic finding for explanations in terms of a biological, genetic *g*. We end with a discussion concerning the consequences and implications for intelligence research.

The Rise and Fall of the Flynn Effect as a Reason to Expect a Narrowing of the Black-White IQ Gap

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In *Intelligence and How to Get It*, Richard Nisbett (2009) argues that the finding that Black-White differences are more pronounced on the more *g*-loaded and genetically influenced tests is a "red herring" in the race-IQ debate because these variables correlate just as high with the secular gains, implying the "absurd" conclusion that the secular gains are also heritable. We clarify the apparent paradox by reviewing our published results showing that while *g* and inbreeding depression scores correlate *significantly positively* with Black-White differences .61 and .48 ($P < .001$), respectively, they correlate *significantly negatively* (or not at all) with several sets of secular gains (mean $r = -.33$; $P < .00001$) and .13 (*ns*), respectively. A recent meta-analysis of 17 studies ($N = 12,732$) has almost exactly corroborated our earlier result, finding a rho between *g* and the secular gains of -.33 ($P < .001$). We conclude that predictions about the Black-White IQ gap narrowing as a result of the secular rise are acts of faith. The (mostly heritable) cause of the one is not the (mostly environmental) cause of the other.

Developmental Origins of Group Differences

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Group differences depend on the age at which the cognitive test is administered. Using data from the NLSY79 in the United States, this study analyzes scores on the Armed Services Vocational Aptitude Battery (ASVAB) between the ages of 15 and 23 years. In this age range there is an essentially linear rise of *g* and of scores on the ASVAB subtests. This rise is greater for males than females, and greater for Whites than Blacks. *g* scores for Whites show a male advantage of 1.8 points at age 15 and 6.5 points at age 23. For Blacks, females have a .2 point advantage at age 15, and males have a 2.1 point advantage at age 23. Between the ages of 15 and 23, the black-white gap rises from 11.0 points to 14.9 points for females and from 13.0 points to 19.3 points for males. Possible causes of these age trends are investigated.

The Chosen People: Jewish Intelligence and Achievements

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Studies of the intelligence of Ashkenazi Jews in the United States, Canada and Britain show that their average IQ is approximately 110. Jews have high achievements in all fields (except the military and sport) including science, literature, music, the professions, and chess. The high achievements of Jews is attributable, at least in part, to their high IQ.

The intelligence of Ashkenazi Jews in Israel is estimated at 106. The intelligence of Oriental Jews in Israel is estimated at 91. There are considerable differences in the educational, socio-economic and intellectual achievements of the two groups consistent with the differences in their IQs.

The intelligence of the Jews raises several interesting questions including (1) how can the high IQ of the Ashkenazi be explained; (2) why do the Oriental Jews have a much lower IQ than the Ashkenazi; (3) why is high IQ of Ashkenazi Jews not mentioned in textbooks on intelligence such as those by Brody (1992), Mackintosh (1998) and Sternberg (2000)?

References

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Mackintosh, N.J. (1998). *IQ and Human Intelligence*. Oxford, UK: Oxford University Press.

Sternberg, R.J. (Ed) (2000). *Handbook of Intelligence*. Cambridge, UK: Cambridge University Press.

The Impact of Smart Fractions, Cognitive Ability of Politicians and Average Competence of Peoples on Social Development

Heiner Rindermann[1], Michael Sailer[2], and James Thompson[3]
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Smart fraction theory supposes that gifted and talented persons are especially relevant for societal development. Using results for the 95th percentile from TIMSS 1995-2007, PISA 2000-2006 and PIRLS 2001-2006 we calculated an ability sum value (*N*=90 countries) for the upper level group (equivalent to a within country IQ-threshold of 125 or a student assessment score of 667) and compared its influence with the mean ability and the 5th percentile ability on wealth (GDP), patent rates, Nobel Prizes, numbers of scientists, political variables (government effectiveness, democracy, rule of law, political liberty), HIV, AIDS and homicide. Additionally, using information on school and professional education, we estimated the cognitive competence of political leaders in *N*=90 countries. Results of correlations, regression and path analyses generally show a larger impact of the smart fractions' ability on positively valued outcomes than of the mean result or the 5th percentile fraction. The influence of the 5th percentile fraction on HIV, AIDS and homicide, however, was stronger. The intelligence of politicians was less important, a longitudinal cross-lagged analysis could show a positive influence on the cognitive development of nations.

Additional analyses using different statistical methods and country samples confirm the results.

Reference

Rindermann, H., Sailer, M. & Thompson, J. (2009). The impact of smart fractions, cognitive ability of politicians and average competence of peoples on social development. *Talent Development and Excellence, 1*(1), 3-25.

Paper Session
"Group Differences"

Use Slopes to Track the "Fundamental Cause" of Group Disparities in Health

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Health scientists have long puzzled over why virtually all aspects of health are worse at lower levels of social class regardless of time, place, disease, and access to health care. The health-class relation is not just pervasive, but positive and monotonic. These scientists therefore seek a "fundamental cause" that is general enough to influence such a wide array of health outcomes across so many social contexts. A currently popular hypothesis is that individuals who perceive themselves as lower in social status (self-rated "subjective social status") experience more physiological stress. In 2004, Gottfredson proposed an alternative: that the ubiquitous health-class gradients are really health-intelligence (*g*) gradients. Attempts to test this hypothesis about health disparities across a nation's subgroups almost always misconstrue the concept of fundamental cause and how to analyze it statistically.

I therefore attempt to clarify (a) why commonly used study designs do *not* provide relevant tests of the hypothesis, and (b) what sorts of analyses *would* be relevant. Among the irrelevant designs are individual-level analyses that estimate how well intelligence level predicts a particular health outcome and whether that relation (e.g., a regression slope) can be washed away (driven to zero) by controlling for socioeconomic status and other predictors. However, the fundamental cause hypothesis tackles a different question. Namely, why are virtually *all* class-health gradients (slopes) positive and monotonic? This requires analyses of slopes. Such analyses can probe more specific, theoretically-driven predictions: For instance, do causes of death with steeper gradients (e.g., diabetes vs. neoplasms) involve self-care tasks with higher cognitive load? I provide sample analyses using various morbidity and mortality gradients from several large cohort studies. I also illustrate how slope analyses can incorporate the classic triad of influences in epidemiology: exposure (e.g., to information), host susceptibility (e.g., probability of uptake), and vector burden (e.g., task cognitive load).

Gottfredson, L. S. (2004). Intelligence: Is it the epidemiologists' elusive 'fundamental cause' of social class inequalities in health? *Journal of Personality and Social Psychology, 86,* 174-199.

Stereotype threat and the cognitive test performance of African Americans

Jelte M. Wicherts & Cor de Haan

University of Amsterdam

Numerous laboratory experiments have been conducted to show that African Americans' cognitive test performance suffers under stereotype threat, i.e., the fear of confirming negative stereotypes concerning one's group. A meta-analysis of 55 published and unpublished studies of this effect shows clear signs of publication bias. The effect varies widely across studies, and is generally small. Although elite university undergraduates may underperform on cognitive tests due to stereotype threat, this effect does not generalize to non-adapted standardized tests, high-stakes settings, and less academically gifted test-takers. Stereotype threat cannot explain the difference in mean cognitive test performance between African Americans and European Americans.

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The bilingual testing of intelligence in bilinguals: Why it should be done bilingually

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The assessment of cognitive abilities of bilingual individuals coming from two linguistic and cultural backgrounds represent one of the greatest challenges for psychologists. Questions around language of testing or bilingual versus monolingual testing are raised when a bilingual individual is referred for an assessment. The hypothesis that guided the study presented was that bilinguals should be assessed bilingually. Results show that there is a significant impact on test results when a bilingual procedure allowing both languages to be used is applied to measure intelligence. The impact of using two languages either to respond or to receive test items is significant, even when accounting for language dominance.

By testing bilingual individuals bilingually, a broader understanding of the mechanism behind the expression of intelligence is obtained. While the role played by language seems undisputable in how cognitive abilities are measured, the actual use of the linguistic channel remains unclear. Is bilingualism actually playing a role in the development of intelligence? Is it only one specific skill that has very little impact on other more general skills?

This presentation will provide the opportunity to discuss these questions, see how researchers in the field of intelligence as well as test developers and publishers, should view the impact of bilingualism as a factor needing closer attention in a time when most individuals on the planet are now considered bilingual if not multilingual.

Gender effect on reasoning tasks performance: Impact of items contents on cognitive performance

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This paper presents evidence for gender differences in cognitive abilities from the representative Portuguese standardization sample of Reasoning Tests Battery (RTB; Almeida, 2003; Almeida & Lemos, 2007). In order to see whether gender differences in reasoning tests scores is related to age and growth process or due to tasks content, 1795 males and 1894 females (n= 3689), from junior and senior public high schools (from 7th to 12th grades), performed tests of abstract, numerical, verbal, mechanical and spatial reasoning. We analysed the scores obtained by male and female students in RTB and the effects of gender and school grade (a matching variable for age) on battery tests scores as well as its contrasts. In general, male students tend to reach a better average cognitive performance than female ones. Regarding a specific analysis, this male advantage refers particularly to some abilities, namely numerical and mechanical in high school level (12/14 years old) and, additionally, verbal and spatial ones in senior school level (15/18 years old). Moreover, within each school grade level there is a progressive growth of average cognitive performance as one goes through higher school grades. In addition, the magnitude of this growth tends to be greater in high school grades (namely in verbal, mechanical and spatial reasoning tests) and the discrepancies in reasoning scores tend to decrease considerably along senior school grades, where some mean scores stabilise on both male and female groups or even show a small decrease. Spatial ability mediated the relationship between school grade and gender in high school grades, in a way that in 9th grade mean advantage is observed in female group, contradicting the general tendency. Also in high school level, there was a main effect of gender on numerical and mechanical reasoning tests and a main effect associated to school grade in abstract, numerical, verbal and mechanical reasoning tests. No significant interaction effect was found for both gender and school grade in senior school level but a meaningful effect could be pointed out considering them separately: gender main effect refers to numerical, verbal, mechanical and spatial reasoning tests, where males tend to have a better score and school grade main effect refers to numerical, verbal and mechanical reasoning tests. Results are discussed regarding research on gender differences and intelligence in general, and gender differences in specific tasks contents more particularly.

A preliminary analysis of the relationship between haplogroup frequency and IQ: Towards an evolutionary ecology of general intelligence

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Haplogroups represent groups of similar haplotypes linked through common ancestry via a single nucleotide polymorphism. Haplogroups can either be inherited paternally through the Y chromosome or maternally through mitochondrial DNA, making them unambiguous measures of ancestry (as neither Y DNA nor mtDNA recombines). Haplogroups are selection neutral and enter populations via genetic drift. Cross-cultural variation in the frequencies of haplogroups is a function of historical genetic bottlenecks and founder events associated with the environment in which they arose. Research into the relationship between cross-national measures of haplogroup frequency and IQ may be especially informative as strong associations may indicate evolutionary relationships between the ancestral environments of haplogroups and IQ. To investigate this a data set of 12 Y DNA haplogroups was assembled for 39 countries using data obtained from a cross-national statistical summary of a number of haplogroup frequency studies. Of the 12 haplogroups studied, only six yielded statistically significant correlations with IQ: I1 (.491), R1b (.476), J2 (-.350), J1 (-.794), E1b1 (-.636) and T(+L) (-.660). Linear multiple regression was used to determine the impacts of these haplogroups as predictors of national differences in IQ along with three other environmental independent variables; human development index, nutrition (as measured by gross food consumption in Kcal per capita per day) and median latitude (a geographic control). Eight models were generated in total testing the effects of adding all variables simultaneously, excluding all haplogroups and adding each one individually. It was found that the addition of haplogroups improved the fit of the models (increased R) in all cases, relative to the model in which only the environmental independent variables were regressed. The relationship between haplogroup frequencies and IQ reveals interesting aspects of the evolutionary ecology of general intelligence. Haplogroup I1 for example was found to be both a strong positive correlate and predictor of IQ. This haplogroup, which arose 5,000 years ago in Scandinavia, just prior to the Bronze Age, is associated with the Corded Ware culture responsible for the introduction of metals into Northern Europe. The accomplishments of this culture are likely therefore to have been associated with a positive selection for general intelligence. Haplogroup J1 on the other hand is strongly negatively correlated with and predictive of IQ and is associated with populations, which emerged 10,000 years ago in the Arabian Peninsula. Historically the peninsula was far more fertile than today, so these populations would not have been subjected to the environmental hardships believed necessary for the development of higher levels of general intelligence. In conclusion, more research is needed in order to expand the list of countries for which haplogroup frequency data are available, as this will permit a better picture of the full evolutionary ecology of general intelligence to emerge.

The cross-cultural comparison of self-assessment of intelligence

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This collaborative Russian-German study was aimed at the examination of cultural specificity of self-assessment of intelligence. We suggested that three culture-specific characteristics of intelligent actions described in questionnaire items could influence psychometric properties of intelligence questionnaire. They are (1) frequency of practice, (2) value as a motivational appeal, (3) prototypicality with respect to the construct of intelligence. These dimensions constitute the theoretical model of relevance of self-assessment measure of intelligence to culture. The empirical study consisted of three stages. On the first stage intelligence questionnaire has been developed on the basis of Act Frequency Approach (Buss, Craik, 1983). On the second stage the German and Russian participants (N(Germany)=371, mean age 16.14; N(Russia)=188, mean age 15.95) estimated cultural specificity of questionnaire's items, i. e. their frequency, value and prototypicality. On the third stage traditional IQ tests were applied in order to reveal questionnaire's psychometric properties and to test the main hypotheses about the mediation of psychometric properties of intelligence questionnaire by 3 dimensions of cultural specificity of its items (N(Germany)=504, mean age 15.95; N(Russia)=460, mean age 15.87). Russian and German self-estimates of intelligence obtained from the items which had similar specificity estimates in two cultures intercorrelated significantly higher than those obtained from the remote items. This proves that items' relevance to a culture mediates self-assessment of intelligence. Furthermore, the external validity of the questionnaire was positively related to prototypicality, and negatively related to value. The level of self-estimates of intelligence was predicted by value and frequency. These two findings were revealed in both samples. To improve questionnaire external validity, the procedures of correction of scores which take items' relevance to a culture into account were developed.

Sex Differences in Latent Means and Variances of Cognitive Abilities: Evidence from the CogAT

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The existence, nature, and meaning of sex differences in cognitive abilities have been debated from the beginning of the empirical study of intelligence. Recent developments include the use of latent variable methods and the increased use of well-developed, theoretically-derived test instruments. This research has shown consistencies with previous findings, such as a male advantage on visual-spatial factors and a female advantage on processing speed factors. Other findings have not been consistent, including whether differences exist in latent a *g* factor, and, if so, whether such differences favor males or females. The existence and nature of differences in variability in cognitive abilities have been studied less frequently than have mean differences. One reason is that considerably larger samples are needed to study differences in variability than are needed to study differences in means. Nevertheless, the evidence that does exist, based on measured variables, suggests that males are often more variable in cognitive abilities than are females, and may overpopulate the tails of the distributions. Here, we use multiple-group mean and covariance models to investigate differences in latent means and variances of the cognitive abilities underlying the Cognitive Abilities Test (CogAT), Form 6. The CogAT is a group administered test designed to assess verbal, quantitative, and nonverbal reasoning in children grades K to 12. The large sample size (approaching 100,000) of the standardization sample of the CogAT and the test's focus on components of general (fluid) reasoning make these data an excellent choice for studying differences in variability across the sexes. Previous research with these data has indeed shown the existence of small mean differences and greater male variability, but that research focused on measured variables, and did not test for differences in general intelligence. In this study a bi-factor hierarchical model was used to test for possible differences in verbal reasoning, quantitative reasoning, and nonverbal reasoning, concurrently with *g*. Preliminary analyses suggest small mean differences on all factors, with the differences in broad reasoning abilities generally favoring males, but differences in *g* often favoring females. Males showed larger variances for all latent variables, including *g*, across most levels of the test. Additional analyses will focus on the shape of the distributions of these latent variables.

Paper Session
"Methods"

Self Awareness, Cultural Awareness, Consistency and the Ecology of Abilities in College Students

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Since last year, we have acquired ten years of data by hundreds of thousands of students collected by the Higher Education Research Institute (HERI). We are beginning to analyze the survey results according to the Intelligent Self Awareness (ISA) procedures we described last year. In addition we are starting a new direction with these data, using self - rated variables that correlated with achievement scores to create Ecology of Ability Variables (EcoVars). Factor scores of these EcoVars correlated strongly (.45 < r <.65) with achievement scores and with ISA scores created from 15 questions dealing with political views. Self awareness has long been considered an essential component of intelligence (c.f. Binet 1905). Cognitive consistency has been valued but not as consistently. We have combined these two attributes and developed a technique for the measurement of individual relationships among human knowledge, skills, attitudes, and values by three-dimensional Consensus Based Assessment (CBA). Given its resolution and sensitivity, this CBA technique is a powerful tool for the ISA analysis and detection of relationships among ecological activities and opinions with knowledge, self awareness, and cognitive ability. To create the self - awareness factors, respondents are separated according to two subordinate attributes, measured by specific questions and factor scores in the first two dimensions, and according to a superordinate, but semantically related, attribute in the third dimension, measured by a self appraisal of a general question about the abscisssa. If these two subordinates and superordinates are related, it is possible to obtain a perspective on the stepped variation of higher order relationships among the two subordinates as the superordinate attribute varies. This technique works effectively in the HERI data for political views and self ratings of political orientation across all ten years of data. This presentation will offer a speculative but principled theoretical argument that CBA especially with the use of EcoVars extends the range of applicable cognitive ability measures to go beyond general knowledge tests to surveys of opinions and personal values.

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The issue of power in the identification of “g" with lower-order factors

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In higher order factor models, general intelligence (g) is often found to correlate perfectly with lower-order common factors, suggesting that g and some well-defined cognitive ability, such as working memory, may be identical. However, the results of studies that addressed the equivalence of g and lower-order factors are inconsistent. We suggest that this inconsistency may partly be attributable to the lack of statistical power to detect the distinctiveness of the two factors. The present study therefore investigated the power to reject the hypothesis that g and a lower-order factor are perfectly correlated using artificial datasets, based on realistic parameter values and on the results of selected publications. The results of the power analyses indicated that power was substantially influenced by the effect size and the number and the reliability of the indicators. The examination of published studies revealed that most case studies that reported a perfect correlation between g and a lower-order factor were underpowered, with power coefficients rarely exceeding 0.30. We conclude the paper by emphasizing the importance of considering power in the context of identifying g with lower-order factors.

Viability of two strategies of IQ estimation in a Brazilian sample: A study with Bland-Altman analyses

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The aim of this study was to evaluate through the Bland-Altman analysis the viability of estimating the Intelligence Quotient (IQ) in adults based on two strategies that use Vocabulary and Block Design subtests of WAIS-III. In Brazil, there are not any tables available for Estimated IQ conversion and the translation and adaptation of the WASI (The Psychological Corporation, 1999) is still in process. The fourth edition of the WAIS is not available either in Brazil. The strategies proposed in this study are used in Brazil to estimate IQ in many different situations, like hospital admissions and screening, since there are not other available short forms strategies. Therefore it's necessary to confirm the reliability of these strategies as there are not studies about their validity. The first strategy includes the sum of two subtests scaled scores and the transformation of this result in IQ using tables suggested by Jeyakumar, Warriner, Raval, and Ahmad (2004) for the north-american population. In the second strategy, the mean of the sum of Vocabulary and Block Design scaled scores is transformed into IQ score through the correspondent scaled-IQ table of the WAIS-III Manual, Brazilian version (Nascimento, 2005). Seventy-seven men and women participated of the study, mean age 39.1 (sd = 13.4). They completed the Wechsler Adult Scale of Intelligence (Third Brazilian version) and a sociodemographic questionnaire to exclude participants with any neurological or psychiatric impairment. Data analyses included Pearson correlation and *t* test for independent variables. To improve the analyses, a statistic method proposed by Bland and Altman (1986) was used to evaluate the agreement between IQ estimates and the IQ full-scale. The findings suggest that IQ estimates derived from both strategies demonstrate agreement with the IQ derived from the full battery only in some of the cases of the sample. Considering these findings, caution is suggested when using these short forms to estimate adults IQ and further studies are strongly recommended, especially about the development of appropriate tables for Brazilian short forms.

Keywords: test forms; Wechsler Adult Intelligence Scale; subtests; intelligence quotient

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Self-Estimated Intelligence Revisited

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Certain evolutionary psychological theories, such as Geoffrey Miller's Fitness Indicator Theory (FIT), predict that individuals will utilize observable signs of general intelligence as a valid cue to assess mate value. Intelligence is reported in cross-cultural studies to be found valuable by both men and women in a potential mate, and assortative mating on the basis of intelligence has also been documented in many societies. However, much recent work on the estimation one's own intelligence has found most people to be extremely poor judges of their own mental ability. This strongly suggests, although it does not necessarily imply, that people will also be poor judges of other's intelligence.

It is therefore a logical question to wonder how assortative mating occurs on the basis of intelligence if intelligence is not being accurately assessed. It is hypothesized here that observed estimation inabilities result from methodological problems within intelligence estimation. These methodological problems might stem primarily from asking for estimates of intelligence the wrong way, i.e., in ways that people might not be able to respond with much accuracy. For example, it is possible that too much emphasis is placed on purportedly different types of intelligence, which people might not be able to discriminate. Similarly, IQ scores are sometimes used as the scale of measurement, which is a metric that people might not be familiar with and might therefore not able to estimate. Frames of reference for social comparisons of mental ability are often not specified, or might be either unrealistic or unrepresentative.

The theoretical problems we address include how humans reliably mate assortatively on the basis of general intelligence if they are not able to accurately assess intelligence and whether or not the inability to assess one's own intelligence necessarily implies an inability to assess the intelligence of others. Most importantly, we address the issue of whether or not the problems in the estimation of intelligence truly represent perceptual deficits or instead indicate methodological failings on the part of intelligence research. To address these issues, a novel methodology for intelligence estimation was created.

In the Cognitive Abilities Questionnaire (CAQ) we have developed, respondents are asked to compare themselves to various groups of individuals in their lives or communities. It is hypothesized that intelligence estimations made by this method will correlate significantly to objective measures of general intelligence, such as the Shipley Institute of Living Scale. As an alternative hypothesis, we also correlated self-estimated intelligence (SEI) with self-reported Emotional Intelligence using the TEIQue, in case the respondents might be estimating something other than conventional academic intelligence. Furthermore, consistent with the work of Gerd Gigerenzer, a frequentist representation of intelligence rankings was applied to establish a metric that people might find more intuitively easy to use. These results could have potential implications for the field of intelligence testing as well as for our understanding of the evolutionary underpinnings of human intelligence.

Computer-based assessment of emotional intelligence

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The concept of emotional intelligence relates to the way a person receives emotional information, both from the environment and from her own self, processes it and responds adaptively. The construct is divided into four branches, namely: emotional perception, facilitation of thought, emotional understanding and emotional management. Over time, several instruments were developed to assess this construct and its branches. However, there is some controversy regarding the most appropriate way to identify the correct answer to a test with items related to emotions. The assessment instruments usually are divided into self-report and performance measures. Research shows that self-report tests usually measure personality traits. In the case of performance tests, represented by the most popular test, the MSCEIT, it is customary to score by consensus, but it is also questioned if this score can be considered representative of a cognitive ability or if it represents the subject's level of adherence to the group. A way to avoid this problem would be to build a test with items based on a logical criteria for the correct answer that do not allow for more than one correct answer. Accordingly, we intend to present the process of developing a computerized test of emotional perception through facial expressions. The instrument consists of video snippets with emotional expressions of people. The instrument is proposed to assess the ability to properly recognize the expression of eight basic emotions, both authentic and fake expressions. This paper analyzes the stages of construction of the instrument items, which consisted of filming 22 people who watched photos and film clips. Excerpts that ranged from 3 to 8 seconds were taken from the shootings, and a few criteria were applied to identify what the correct answers would be, in order to avoid consensus scoring, such as congruence with stimuli and proper muscular reaction. The test was applied to 310 students, and validity studies have reproduced most of what is found in the emotional intelligence literature, ie, moderate correlation with other intelligence tests and low correlations with personality traits. But a full information item factor analysis showed a three-factor solution for emotional perception instead of a unidimensional solution. These results are discussed with respect to the measurement of emotional intelligence.

Keywords: emotional intelligence; emotional perception; psychological assessment

This paper is based on the first author's doctoral dissertation, that's taking place at University of São Francisco (Brazil), and it is financed by the São Paulo Research Support Foundation (Fapesp).

Processing discrepancy between probe and target stimuli: Further refinement of a near match-to-sample task

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Abstract

Previous research presented at this conference has pointed to a discrepant match-to-sample task as a way of uncovering different central processes of intelligence required for task completion (Frey, 2007). Differential *g*-loadings indicated that both the type of discrepancy and the degree of discrepancy may be accessing different central processes, as the input and output processes were unchanged across tasks. Regrettably, it was unknown whether some rule acquisition phase might have been at work, as task presentation was not counterbalanced. Furthermore, it was not known if subjects were, in cases of discrepant probe and target, operating on the probe, on the target, or on some combination of the two in order to determine which stimulus was closest to the probe. The current study rectifies these shortcomings by providing a partially counterbalanced presentation of five matrix based match-to-sample tasks: Standard (target is an exact match to probe), Plus 1 (target has 1 more square than probe), Minus 1 (target has 1 fewer square than probe), Plus 2 (target has 2 more squares), and Minus 2 (target has 2 fewer squares). *g*-loadings of the tasks were determined by correlations with Raven's Advanced Progressive Matrices (Raven, 1962), and the predictive validity of the tasks was investigated in a college sample using grade point averages. Additionally, subjects were presented with a brief questionnaire to uncover how they selected the proper match in discrepant trials. Implications for the system theory (Detterman, 1987) are discussed.

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[11] Temperament and the relationship bewteen fluid and crystallized intelligence (**Maciej Stolarski, Marcin Zajenkowski, Maria Ledzińska**)
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[17] The Intelligence Nature (**Tatiana de Amorim Badaró**)
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[28] Intelligence and temporal variability – unique and common sources of variance among finger tapping and reaction time measures (**Guy Madison and Fredrik Ullén**)
[29] The relation between temporal variability and intelligence is not due to differences in top-down control - further evidence using manipulations of motivation during tapping (**Fredrik Ullén and Guy Madison**)
[30] Parents' education, less their money, nurtures the intelligence of their children (**Christina Perissutti & Heiner Rindermann**)

Poster Session

[01]
Using Personality and Intelligence to Predict Different Measures of Academic Achievement in a Young Adult Sample

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The two major fields in the study of individual differences are cognitive ability and personality (Eysenck & Eysenck, 1985). However, instead of being separate entities, much research has shown that the two areas tend to work together to produce a panoply of different life outcomes, from personal/social adjustment, to health outcomes, to academic outcomes. This study extends this previous research by examining how cognitive ability and personality work together to predict various academic achievement outcomes.

Current Study

One hundred ninety-seven students from a Midwestern university in the United States of America were each given a battery of tests measuring: (a) cognitive ability (Reynolds Intellectual Assessment Scales, the Revised Shipley Institute of Living Scale, and Compressive Test of Nonverbal intelligence-Second Edition); (b) personality (International Personality Item Pool Representation of the NEO PI-R); and (c) academic Achievement (SAT and Wide Range Achievement Test-Third Edition).

Using path modeling, preliminary results indicate that general cognitive ability (g) is the strongest predictor of all areas of achievement. After controlling for g, openness to experience (openness) still predicted (latent) reading achievement and (manifest) spelling knowledge. For (latent) math achievement, however, conscientiousness had the strongest predictive relationship. When g, conscientiousness and openness were put in a model to predict math achievement, conscientiousness had a strong positive relationship to math, but openness had a negative predictive relationship.

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[02]
Do schizophrenic and various categories of depressive patients share similar risks for diminished young and old IQ?

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A recent large-scale genome-wide study suggested that schizophrenia and bipolar disorders share about one third of the genetic risk due to genes on chromosome 6, but the risk does not generalize to non-psychiatric disorders (Purcell et al., 2009). The present study examined whether this genetic risk on chromosome 6 disposes for diminished young and old IQ not only in schizophrenia and bipolar diseases, but also in other diagnostic categories of depression. The reason for this suspicion is that the specific area - 6p22.1 - also harbors genes for how and when genes are switched on and off during development, a molecular mechanism that may involve general and/or specific aspects of brain development, and thus may affect the development of general intelligence.

The Vietnam Era Study (VES, 1985) provided large-scale archival cross-sectional and longitudinal male IQ data for 46 schizophrenics, 69 bipolar, 50 atypical bipolar, 69 manic, 459 major, 101 single and 290 recurrent depressive patients, and for 4.300+ normal controls. IQ was the first principal factor extracted from a unique battery of 19 highly heterogeneous tests, and psychiatric diagnoses were established by DSM-III. We found that young and old IQ were equally compromised in schizophrenia and bipolar disorder, and variously affected in other categories of depression, except when co-morbid with schizophrenia or hypomania.

The results suggest that schizophrenia, bipolar disorder and certain co-morbid varieties of depression share a developmental brain vulnerability that affects pre- as well as post-morbid intelligence but does not generalize to other diagnostic categories of depression. The study provides new genetic and molecular perspectives on brain-intelligence development.

[03]
Predicting Academic Achievement With Test-Specific Variances: Not Much More Than *g*

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Purpose: The specificity doctrine holds that test-specific skills and knowledge predict important life outcomes better than general intelligence or *g* (i.e., variance common to diverse mental tests; Jensen, 1998, pp. 107-114). The specificity doctrine has been tested by Ree and Earles in work-related contexts (1991, 1992, 1994), and has been found deficient. Compared to *g*, test-specific knowledge and skills are poor predictors of work performance, aviator performance, and training performance. The current study examined the specificity doctrine with respect to school achievement in math and verbal domains, as measured by SAT and ACT subtests. Such tests have been characterized as tests of academic achievement, not IQ tests (e.g., ACT, 2009, "The ACT is not an aptitude or IQ test […] the questions on the ACT are directly related to what students have learned in high school courses in English, mathematics, and science."). Based on the specificity doctrine, the **hypothesis** was that test-specific variances from math and verbal tests, obtained after removing *g*, would predict academic achievement (based on SAT and ACT subtests) better than *g*.

Analyses: Subjects and test scores were obtained from the 1997 National Longitudinal Survey of Youth (N = 8984). Structural equation modeling (SEM) was used to estimate latent constructs and to test the hypothesis. *g* was estimated using the 12 tests of the Armed Services Vocational Aptitude Battery (ASVAB). Math-specific variances, obtained after removing *g*, were estimated using ASVAB tests of arithmetic reasoning (AR) and math knowledge (MK). Verbal-specific variances, obtained after removing *g*, were estimated using ASVAB tests of word knowledge (WK) and paragraph comprehension (PC). Math achievement was estimated using math tests from the SAT (math reasoning and subject test) and ACT (math). Verbal achievement was estimated using verbal tests from the SAT (verbal reasoning) and ACT (English and reading). SEM estimated standardized path coefficients (in parentheses below) from *g* to each achievement factor; and from specific math- and verbal-variances (on the ASVAB tests) to each achievement factor.

Results: Contrary to the specificity doctrine, *g* was a far better predictor of academic achievement than test-specific variances. *g* predicted math achievement (.84) far better than the math-specific variances (.20 and .01 for AR and MK, respectively). *g* also predicted verbal achievement (.81) far better than the verbal-specific variances (.02 and .17 for WK and PC, respectively). Other analyses, structurally parallel to the preceding analyses, estimated math and verbal achievement using the ASVAB math and verbal tests, which were predicted by test-specific variances from SAT and ACT math and verbal subtests (now loading on *g*, along with all ASVAB tests except the math and verbal ones). The results were replicated: *g* predicted math and verbal achievement,

estimated using the ASVAB math and verbal tests (.84 and .81, for *g*→math and verbal achievement, respectively), far better than any test-specific variance from the SAT and ACT subtests (*M* = .03, range = -.15 to .20).

Discussion: The results contradict the specificity doctrine: Test-specific variances were far weaker predictors of academic achievement than *g*. The results are consistent with research on the predictive validity of test-specific skills in work-related contexts. That research, along with the research presented here, suggests that when *g* is removed from tests of specific skills, the tests weakly predict the outcome for which they were designed, especially compared to *g*, which predicts the outcomes far better. This suggests that the predictive validity of work- and school-specific tests is attributable to "not much more than *g*."

[04]
Mental Image Manipulation and Math: An Investigation into the Influence of Visualization and Mental Rotation on Math Performance

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The focus of the current study was to expand on previous research suggesting a link between the visualization component of spatial ability and math performance. Four measures of visualization from the ETS Kit of Factor Referenced Tests were chosen to measure visualization ability. A mental rotation component, not researched in the current context in previous studies, was also included. The measures of visualization and mental rotation were compared to tests of math ability and achievement as measured by the SAT-M, and the Woodcock-Johnson III Test 5 (Calculation), Test 6 (Fluency), and Quantitative Concepts sections. Statistically significant correlations between the math measures and visualization and mental rotation were discovered for most of the math measures. Multiple regression analyses were conducted to control for the effects of general intelligence (g). From these data it was determined that visualization/mental rotation components differentially influenced math achievement independent of g.

[05]
Perceptual Speed and Intelligence: A New Approach using Visual Detection and Identification Threshold Measures

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The aim of this research endeavor was to create a new approach to mental speed testing that employs experimental threshold method for assessing speeded detection and identification. Previously used methods for assessing inspection time commonly use a discrimination design in which the participant is presented successive stimuli an with an inter-stimulus interval between the target and comparison. Since recent research suggests that having even a very small time gap between the target and comparison stimuli in a discrimination design may be convoluting the measure to include contributions of processes related to working memory capacity, this study used a newly created speed measure that eliminates the comparative decision. Instead of a speeded discrimination judgment, a speeded detection and identification task were used. Additionally, the task was designed to permit the observations of performance changes within and between individuals as the stimulus presentation time decreases.

The perceptual speed task consisted of a forward mask of 80ms, a backward mask following the target stimulus for 300 ms, and the target stimulus presentation duration was varied (80, 50, 30, 20, and 10 ms). For each trial participants were instructed to decide whether or not a letter was present between the masks ("#"), and then decide what the letter would be if present. Participants also completed the Raven's Progressive Matrices test in order to assess potential relationships between the perceptual tasks (detection and identification) and intelligence.

Results indicated that for both the perceptual speed measures that performance significantly dropped as duration of the stimulus decreased, with identification being affected more dramatically by the decrease in presentation time than detection. Participants were significantly more accurate with detection over identification. These results are discussed in terms of the associated mental processes. Both detection and identification accuracy was correlated with age and the Raven's test, supporting the notion that such a threshold design has utility in individual differences research. Using a wide ranging threshold measure allows for a comprehensive measure that would not exclude participants with low ability, but instead permit a means of observing where difficulty occurs. Results provide evidence that aside from traditional speed measures using discrimination judgments, inspection time for detection and identification are also correlated with intelligence.

[06]
Capacity and control: Two aspects of working memory independently accounting for general fluid intelligence

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Large body of evidence shows that general fluid intelligence (Gf) is closely connected with working memory (WM). Such findings suggest that WM processes could be interpreted as a cognitive substrate of Gf. It is not clear, however, which aspects or functions of WM are responsible for the WM/Gf relationship. Some authors emphasize the storage aspects of WM, others prefer to give special importance to the control aspects of WM. In our studies, we used a modified n-back procedure in order to capture two aspects of WM: the one pertaining rather to its capacity and another one referring to controlling functions. Participants were exposed to a long string of two-digit numbers appearing one by one. Their task was to decide whether a particular number was already presented one, two, or three elements ago. The number of properly recognized elements served as an indication of WM capacity, whereas the number of false recognitions served as an indication of WM's (in)ability to control its functions. Moreover, we manipulated with tasks parameters in order to make it more or less demanding for both capacity and control aspects of WM. Two studies showed that the more demanding task's conditions, the higher the correlation coefficients between WM and Gf. It also appeared that both capacity and control aspects of WM accounted for Gf independently (i.e., in the additive way) together accounting for about 91% of its variance.

[07]

Empirical classification of word algebra problems

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A good deal of theoretical and experimental discussions have focused on ways to classify numerous problems using in psychological research, assessment of intelligence, and educational practices (e.g., Metcalfe, Wiebe, 1987; Weisberg, 1995; Newell, Simon, 1972; Spiridonov, 2003, 2004). A serious challenge in this field is not only to identify real sorts of problems, but to also explain how they can be solved by a limited set of intellectual mechanisms involved in finding solutions. It is especially difficult to separate different problems in the whole area of knowledge (for example to sort out word algebra problems).

We firmly believe that the psychological configuration of problems cannot be ignored. The researchers and testers of intelligence sited above have only analyzed content as such, within a problem. However, the psychological configuration itself is the main point for real research, because this object represents the uncertainty of a problem. Configurations should also be used as the criterion for dividing problems into classes. For example, puzzles described by K. Duncker (1945) are based on configurations, called contradictories, and differ from word algebra problems which involve functional dependencies (Spiridonov, 2004).

Experimental investigation based upon a simple idea. We can empirically distinguish between two cases: 1) when participants correctly detect regular algebra problems as solvable and the same problems with partial psychological configuration as unsolvable. 2) When participants make detection mistakes failing incomplete psychological configuration. The first case means that participants can successfully recognize one sort of algebra problems, the second – which they are not familiar with it. So it means that we can separate different sorts of algebra problems. Asking participants at divers levels of expertise in math we can find variety of such problems.

We investigated how two groups of participants (schoolchildren (aged 14-15; n=58) and students of technical university (aged 17-18; n=48)) detected unsolvable algebra word problems among a set of such regular problems. A signal detection analysis revealed four different sorts of algebra word problems in our experimental material.

We assume that this effect has importance not only for problem solving area, but also for intelligence measurement because it demonstrates a presence of additional factor usually overlooking in research. Psychological configuration of a test problem can influence on test results.

[08]
Differentiation of Human Cognitive Abilities

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Existing representations of cognitive ability structure are exclusively based on linear patterns of interrelations. However, a number of theories predict that ability interrelations are not linear, but are rather differentially related across levels of functioning, a hypothesis sometimes termed *the ability differentiation hypothesis* or *Spearman's law of diminishing returns*. In this talk I introduce how *nonlinear* factor analytic models can be used to examine this, and related, hypotheses, and present analyses of a large, age-heterogeneous, nationally representative sample of the US population. Results consistently supported the ability differentiation hypothesis. These results are particularly informative about the nature of individual differences in human cognitive abilities, and have implications for cognitive, behavioral-genetic, and selection research.

Selected Readings:

Tucker-Drob, E. M. (2009). Differentiation of cognitive abilities across the lifespan. *Developmental Psychology, 45,* 1097-1118.

Tucker-Drob, E. M., Harden, K. P., & Turkheimer, E. (in press). Combining nonlinear biometric and psychometric models of cognitive abilities. *Behavior Genetics.*

[09]
The Influence of Social Environment on Development of Intelligence and Creativity

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Introduction This report is based on two research works investigating the problem of environmental determinations of abilities: the role of the family and educational surroundings. How is it possible to organize social surroundings with a view of development of intelligence and creative abilities? In the present work 2 aspects of social environment determining the changes of intelligence and creativity were defined. The analysis of the cognitive development determination is focused on the two aspects, which are: 1) information aspect and 2) the aspect of interpersonal interaction. We concern these aspects to affect the development of intelligence and creativity in different ways. Thus, the empirical research was based on the idea that enrichment of educational environment with additional programs and different factors of family surrounding affect the parameters of psychometric intelligence and creativity of children.

Methods To carry out the empirical study an experimental plan with nonequivalent control group was chosen. The experimental group included 79 children and 84 parents. The control group included 76 children and 54 parents. The research took place in Moscow kindergartens within the period of an academic year and consisted of three steps. On the first step the level of intelligence and creativity was measured both in control and experimental groups. Raven's "Colored progressive matrix tests" and Williams' Creativity Assessment Packet were used in both groups. As a result of the analysis of the enriched educational environment an independent variables were defined. On the II step an experimental influence was carried out within an academic year. The number of situations when the participants from experimental group took part in different activities was fixed. Besides we measured the level of independent variables concerning family environment namely 14 factors of family educational influence. The parents had to fill the Factors of Family Education questionnaire. On the third step the level of intelligence and creativity was measured in both groups again.

Conclusions

1. The main part of variability of intelligence and creativity attributed to the environmental influence is explained by the factors of interpersonal interaction. This aspect includes the attitudes and the factors of family surrounding.
2. The informational aspect of the environment (i.e. the enrichment of educational programs) has greater effect on creativity level than on IQ. No influence of this aspect of the environment on the intelligence level was found.
3. The effect of interpersonal interaction aspect is not homogeneous: upbringing behavior patterns of mothers and fathers in a group of similar situations should be considered as independent because of different orientations and the contents of their influence on the development of cognitive functions.

The definition of 2 aspects of social environment seems to be reasonable and productive for further research of environmental influence on the development of abilities. It proves the fact that the existing systems of the enriched education are less effective than some factors of family environment.

[10]
The introduction of schooling and literacy, and their effects on Raven's Colored Progressive Matrices (RCPM) performance: A follow-up among Tsimane, a traditional and transitioning population

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Evidence indicates that schooling and literacy significantly effect test performance when using Raven's Colored Progressive Matrices (RCPM). Here I present data collected among the Tsimane, a forager-horticultural society in central Bolivia. The Tsimane are notable for variable levels of education and degrees of exposure to a market economy, which allows for fine-grained analyses of factors influencing psychometric test performance. Subjects (N=330, ages 8-65) from five communities were administered RCPM, and demographic information related to health, residential patterns, parental education and wealth were collected in 2007. Results indicated that exposure to schooling and child literacy, in particular, significantly correlates with performance on RCPM (p=.0001). A subset of the original sample was retested to determine how literacy, controlled for age, may affect performance. The results from these findings will be discussed as well questions concerning self-selection and investment in human capitol as the Tsimane' shift into a market based economy.

[11]
Temperament and the relationship bewteen fluid and crystallized intelligence

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We examined how the bewteen fluid (Gf) and crystallized (Gc) intelligence depends on temperamental traits postulated in Regulative Theory of Temperament (RTT). According to Cattell's investment theory, Gc could be regarded as the result of applying Gf over time. Cognitive processes as well as non-ability traits (e.g. personality) are responsible for the amount and quality of investment of Gf.

Assuming that temperament could be important mediator between the intellectual potential (Gf) and its development (Gc), we refered to RTT, a concept developed by Strelau. The author distinguished six dimensions. Two of them represent the temporal characteristics of behaviour: briskness (BR) (tendency to react quickly, to keep high tempo of performing activities and to shift easily from one reaction to another) and perseveration (PE) (tendency to continue and to repeat behaviour after cessation of stimuli evoking this behaviour). The four following traits refer to the energetic aspect of behaviour: sensory sensitivity (SS) (ability to react to sensory stimuli of low stimulative value), emotional reactivity (ER) (tendency to react intensively to emotion-generating stimuli, expressed in high emotional sensitivity and in low emotional endurance), endurance (EN) (ability to react adequately in situations demanding long-lasting or high stimulative activity and under intensive external stimulation) and activity (AC) (tendency to undertake behaviour of high stimulative value or to supply by means of behaviour strong stimulation from the surroundings).

In our study (N = 90) we measured temperamental traits, fluid intelligence (with Raven's advanced progressive matrices) and crystallized intelligence (with Polish test APIS). Extremegroups on the six temperament dimensions were created by using a cut-off of median splits – all respondents below median were considered to be low on different temperament dimension, just the opposite to those on median and above it.

Results indicate that subjects with high BR, EN, AC, low ER and PE obtain higher correlation between Gf and Gc in comparison with individuals situated on the opposite poles of those traits. We discuss the results in reference with the Strelau's understanding of temperament's structure.

[12]
Is emotional intelligence an intellectual ability?

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In the field of the emotional intelligence research there is a discussion about the relations between emotional intelligence (EI) and general intelligence. Studies provide controversial results. Associations between EI and general intelligence often depend on the approaches used to measure EI. Self-report measures usually don't correlate with traditional intelligence tests whereas so called objective tests have some correlations with intelligence tests, although these correlations usually are rather low and spare. E.g. studies with MSCEIT often find low correlations (around 0.2) only between the scale Understanding Emotion and measures of crystallized intelligence.

These results challenge the idea that EI is indeed an intellectual ability. To support this idea it is necessary to show that EI positively correlates with at least some other intellectual abilities including g factor. The aim of our study is to obtain new evidence on this topic.

We developed two Russian-language measures of emotional intelligences: Ovsyannikova-Lyusin Videotest of Emotional Intelligence and EmIn Questionnaire (Lyusin, 2006). The Videotest estimates one of the EI components, i.e. emotion recognition accuracy. The EmIn Questionnaire is a self-report measure that consists of four scales: Interpersonal EI, Intrapersonal EI, Understanding Emotions and Management of Emotions. Both measures have satisfactory internal consistency and test-retest reliability (0.76 – 0.84).

In two studies relations between emotional intelligence and IQ measured by Raven Advanced Progressive Matrices were explored. Study 1 ($N = 137$) revealed a low negative correlation between Videotest of EI and IQ ($r = -0.204$, $p = 0.017$). In Study 2 ($N = 59$) no significant correlations between scales of the EmIn Questionnaire and IQ were found with one exception – in female sample a subscale Control of Emotional Expression negatively correlated with IQ ($r = -0.361$, $p = 0.020$).

The results of Study 2 correspond to other authors' evidence, whereas the results of Study 1 are rather unexpected. To explain them we can hypothesize the existence of two mechanisms that underlie emotion recognition and understanding. The first one is based on rational (intellectual) information processing; the second one is irrational and intuitive. Resolving some tasks from MSCEIT, especially verbal tasks from the branch Understanding Emotions, participants rely more on the first rational mechanism. In Videotest of EI participants are more successful if they rely more on their first impression and intuition. Those who tend to use rational processes (supposedly they have higher IQ) turn out to be less successful.

The Videotest of EI provides also indices of emotional sensitivity, i.e. a bias in perception of others' emotions such that a certain type of emotions is 'overperceived'. This sensitivity of different types of emotions can be considered as a component of EI that is often neglected in modern research. One of these indices, Sensitivity to Negative Valence, positively correlated with IQ ($r = 0.307$, $p < 0.001$), another index, Sensitivity to Positive Valence, negatively correlated with IQ ($r = -0.326$, $p < 0.001$).

All obtained results will be discussed in the frame of the debate of the nature of EI as an intellectual ability.

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[13]
Convergent/divergent validity between Social Intelligence, Emotional Intelligence, Abstract Intelligence and Social Competence – A study with Portuguese children

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The present study is focused on the theoretical and empirical validity (convergent and divergent) of social intelligence construct (Interpersonal Problem Solving, Familiarity, Motivation and Self-confidence) towards emotional intelligence (Adaptability, Interpersonal, Intrapersonal: Positive Impression, Intrapersonal: Expression of emotions, Stress Management), social competence and abstract intelligence.
Based on a study with 175 Portuguese children (aged between 7 and 10), we applied Bar-On Emotional Quotient Inventory: Youth Version (EQ-i:YV; original version of Bar-On & Parker, 2004), Emotion Perception Test (Franco & Candeias, 2008); Cognitive Test of Social Intelligence for Children (PRPI-6/11; Candeias *et al.,* 2008), Social Competence Test for Children (PACS-6/11, Candeias *et al.,* 2008) and Coloured Progressive Matrices (CPM, Raven, 1965). Data analysis is based in structural equation model analysis (AMOS 17).
These findings allow a more specific and significant way to assess and to identify social and emotional intelligence towards abstract intelligence and its relationships with social and emotional competences in general, and are one way to promote a new look at theorectical and practical approaches to human abilities and social competence and its implications to assessment and intervenction.

Key words: Social intelligence; Emotional intelligence; Abstract intelligence; Social Competence.

[14]
Social Intelligence, Abstract Intelligence and Social Competence – A study of convergent/divergent validity with Portuguese Youngsters

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Social intelligence studies are becoming increasingly important if one wants to understand individuals' knowledge, thinking and behavioral processes (Kihlstrom & Cantor, 2000). Clearly, individuals' performance involve, at the same time, the type of mental processes (reasoning, memory, perception, creativity) and the type of contents of the task to be performed (verbal, numerical, spatial, figurative, social). Thus it is important in psychological theories on cognition to bear in mind the diversity of sources that can cause and explain inter and intrapersonal differences.
This study focalize multidimensional nature of social intelligence construct and its interface to abstract intelligence and social competence. We present a theoretical foundation of social intelligence based on a triarchic approach about social problem solving process, experience and context. Based in a multitrait design, measures of *social intelligence* (Cognitive Test of Social Intelligence for Children - PCIS - 12/18; Candeias, 2005), *social competence* (Social Competence Test for Youngsters – PACS - 12/18, Candeias, 2005) and *abstract intelligence* (Verbal and Abstract Reasoning - BPRD, Almeida, 1995), were administered to 326 youngsters (aged between 12 and 18). Structural equation model analysis (AMOS 17) supports our analysis of convergent/divergent validity.
These findings allow a more specific and significant way to assess and to identify social intelligence and its relationships with abstract intelligence and social competences, and are one way to promote a new look at human abilities and social competence, specially for assessment and intervention.

Key words: Social Intelligence; Social Problem Solving; Abstract Intelligence; Social Competence; Psychological Assessment.

[15]
The General Factor of Personality: 17 Individual Military Studies, a Large Meta-analysis, and 4 Criterion-related Validity Studies

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Several researchers have noted that the search for the number of basic dimensions in personality resembles the search for basic dimensions in the ability domain (e.g., Musek, 2007; Rushton, Bons, & Hur, 2008; Stankov, 2005). In the area of cognitive ability it is generally agreed on that performance on all cognitive tasks is not independent but rather is always positively associated, the well-known positive manifold. When factor analyzed, these positive intercorrelations yield clusters of higher-order cognitive capacities, resulting in hierarchical models of cognitive ability. The top level of this hierarchy is occupied by the general factor of mental ability, Spearman's *g*. Many meta-analyses have shown *g* to be an excellent predictor of job performance, training performance and job and training turnover.

However, while the existence of a general factor in the ability domain is widely acknowledged, the possibility of a general factor has until recently been virtually neglected in personality research. Only in the past few years it has been proposed that a general factor occupies the top of the hierarchical structure of personality. An ongoing discussion is whether such a factor is substantive and meaningful, just as the *g* factor in intelligence research, or whether it merely reflects artifacts, such as social desirability.

First, we present five large to very large datasets with two to five personality questionnaires used at the Dutch Military to test for the existence of one general personality factor. All datasets yielded a clear general personality factor.

Second, we present a large Schmidt and Hunter style psychometric meta-analysis (K = 212, total N = 144,117) on Big Five intercorrelations showing that the GFP explains 50 percent of Big Five variance and that all Big Five dimensions loaded highly on the general factor.

Third, in two criterion-related validity studies we test the relationship between a general personality factor and turnover in initial military training; we also report on two criterion-related validity studies to test the relationship between a general personality factor and supervisor-rated job performance, and training performance. The four criterion-related validity studies indicate that a general factor is related to training turnover, job performance, and training performance.

So, there clearly is a substantive and meaningful general factor of personality, just as there is a substantive and meaningful general factor of intelligence.

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[16]
Human Intelligence: The state of the art at the heart of research.

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Abstract: Although in the 80s some "systemic" or "plurimetaphorical" models emerged aiming at some kind of integration of paradigms of human intelligence research – the Triarchic Theory (R. Sternberg, 1985), the Theory of Multiple Intelligences (H. Gardner, 1983, *1999*), and the Bioecological Theory (S. Ceci, 1990) – it is argued that the field still lacks a true integration effort, which would be critical for the clear specification of its outline and for the effective establishment of its identity. On the one hand these "systemic" models have not achieved the desired acceptance in the field of intelligence research, as a result of poor construct and incremental validity, when compared to traditional approaches, in particular in the assessment of cognitive abilities. On the other hand the progressive transdisciplinary character of the field implies "dispersion", not "integration", of knowledge, "dispersion" in Peper's (1942) sense, the emergence of new sub-fields, new methodologies, and new technical languages, making it difficult to construct an integrated view of the construct of intelligence and to build an articulated framework for its research.
This presentation is based on a brief analysis of research topics for the period of one year, considering both the papers presented at the 2008 ISIR Annual Conference (Decatur) and the papers published at the journal *Intelligence* during 2009. Taking as a framework Overton's (2006) conceptualization of the levels of scientific discourse [empirical, theoretical, metatheoretical and world views], the levels of observation and explanation suggested by Reuchlin (1995, 1999) [elementarism, holism, and structuralism], and the ontological foundations or world views proposed by Pepper (1942, 1966) [formism, mechanicism, contextualism, organicism, and selectivism], the analysis tries to figure out, from an epistemological and an ontological perspective, the emphases and main goals of current research. These emphases and goals are seen as an invaluable departure point for a metatheoretical approach to the field of intelligence, consistent with two main ideas introduced by this author at the 2008 ISIR conference: 1) initial efforts to bring together, and integrate, diverse research paradigms (or different levels of observation and explanation) must take into account philosophical foundations for research (which means it is a metatheoretical, not a theoretical enterprise), and 2) research on intelligence is less in need of new theories than in need of a deeper metatheoretical, epistemological and ontological evaluation of well established theories and research.
The main point of this presentation is that any truly systemic theoretical approach which seeks integration in the field of intelligence needs to assume a new epistemological foundation, comprising a paradigmatic shift from a split metatheory to a relational metatheory (Overton, 2003; Overton & Ennis, 2006) the latter allowing for the integration of apparently contrasting and conflicting concepts in a dynamical and reciprocal structure, not in a dichotomous approach based on contrasting concepts (like kinds of intelligence, factors underlying cognitive abilities or determinants of individual difference in cognition).

Key-words: human intelligence; integration; paradigms of research; metatheory; systems approach to intelligence.

[17]
The Intelligence Nature

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The present paper is relative to a reflection about the nature of that ability, inclusive human that, seems clear to us, enables the human being on recognizing reality of all the things, principally in which refers to its possible cognitive transcendency in face of its importance for the human living in dynamic balance. In short, this work has as its major finality induce contemplations about Intelligence as a whole, principally in which respects its relevance not only to individual, but to society, because it is proved true the theory that nothing lives in isolation; that everything lives in relations; and that are not but mutual help. For that, Intelligence, that is also the human ability of self-perception; of well adapt to any ambient in which inserts itself; as to know how to labour with day-to-day challenges with an always new way (Jair Tércio, 1985).

We draw Intelligence profile, with the theoretical support of diverse theoreticians, like: John Locke, Jean Piaget, and Howard Gardner, with the complementary support of life and Natural Laws concepts by Jair Tércio. The research that resulted on that systematization was motivated by the observation of the use, not rarely, non-Intelligent that human beings does of Intelligence, considering the fact of them demonstrates to prefer to live with problems, no rarely, dispensable, but with great and almost non-reparably prejudices; possibly because of its poorly meaningful level of this tool – Intelligence – development, what certainly dificults they to know the genuine, or real, nature of Intelligence, because, according to A Arca (2009), there's no need of much analyses to comprehend Intelligence as the capacity that we have to detect possible and/or existent problems, construct instruments to solve them, and, in fact, solve.

What, untill that point, could conclude with this study refers to the fact that it's also proved true the theory that in opposite to intellect, the Intelligence makes possible the true knowledge of reality, this is, it knows even the superficiality as the essentiality; even the parts as the whole; finally, even the all as the One; and that it, Intelligence, generates consciousness, and this one makes possible to us to transform ourselves, and then the society. Well, there is no part without a whole; and no whole without a part.

This way, seems clear to us, that Intelligence cannot be understood as a simple cognitive activity that comtemplates, understand and/or build superficial (or not) concepts. It is notorious the fact that we are living a time of crescent study about this field – Intelligence; they show us, inclusive, that this skill has the capacity to help us in which concern to the recognition of essence, of depth, this is, of the truth that exists in all the things; they center; they reality; why not to sat, absolute reality.
For that, we organized the present paper in a way that we also study: *a)* the relation and differences between Intelligence and intellect; *b)* the relation between Intelligence and consciousness; and *c)* the function of Intelligence in living; considering that to optimize the use of this faculty of ours it is necessary to comprehend, inclusive, its meaning and nature; and, finally, its function.

[18]
Video games performance and general intelligence

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Quiroga et al. (2009) have shown that playing video games require general intelligence even after extended periods of playing. They analyzed edutainment video games (*Big Brain Academy* by Nintendo®) identifying discrete characteristics related to intelligence. This new study analyzes *Professor Layton* by Nintendo®. Forty seven university undergraduates (38 women and 9 men, age range from 19 to 25 yrs) completed several ability tests (DAT-5 VR, SR and AR) before playing the video game for a maximum of 15 hours during 7 weeks. Video game performance was systematically registered after eight variables provided by the program. For the analyses, the sample was divided in two groups: (1) high intelligence, IQ > 100 (M = 111, SD= 6) and (2) low intelligence, IQ < 100 (M=88, SD=7). The main results show that (a) *g* correlates with performance across the entire playing time; (b) high correlations between *g* and performance were observed after seven hours of playing; (c) groups differing on intelligence show similar performance for the first 4 hours of playing, but they diverge afterwards, and (d) the high intelligence group required less time than the low intelligence group to appropriately complete the game. Some applied issues are discussed after these findings.

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[19]
IQ matters in prison: Raven's SPM scores powerfully predict grade point average and somewhat predict disciplinary problems in prison

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In a sample of 167 young male prison inmates (mean age 18.7 ± 1.4 years) we investigated the relationships of general mental ability as measured by Raven's Standard Progressive Matrices (RSPM) to grade point average (GPA) in prison school and to the number of disciplinary problems in prison. The mean RSPM score of the incarcerated young men corresponded to the mean score of 11-year-olds. In prison school, RSPM scores predicted twice as much variance in GPA (~50%) as is usually found in ordinary schools (~25%). Controlling for the Big Five personality traits somewhat attenuated the relationship. An obvious explanation is that following the same curriculum in prison schools that is used in ordinary schools is clearly inappropriate for low-ability offenders. Additionally, RSPM scores predicted the number of disciplinary punishments, even after controlling for the self-reported Big Five personality traits. A plausible explanation is that understanding and following complicated prison rules is too difficult for low-ability offenders. These results may suggest that not considering the ability level of prison inmates works against their rehabilitation.

[20]
Differential and items difficulty analyses between Moroccan and Spanish in general intelligence

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This paper presents a comparison of the scores in the Raven Progressive Matrices between a sample of 202 Moroccans from the cities of Casablanca, Tanger, Marrakech and Meknez and another of 258 Spanish from the city of Valencia. A one way ANOVA analysis has been performed between both samples, the Spanish sample obtaining significant higher scores than the Moroccan one. A second one way ANOVA analysis, taking into account sex, has shown that Moroccan men obtain a significantly higher score than women, whilst this difference is not appreciated in the Spanish sample, where scores for men and women are similar.

Spearman correlations between general intelligence and the two variables of studies and income have been performed. No significant relations have been found for the Spanish sample, but both the studies and income variables show a significant ($p<.05$) relationship with general intelligence for the Moroccan sample.

The third part of our work has focused on the items difficulty. Our target has been the error percentage for Raven Progressive Matrices 60 items where Spanish have got the lower error score for every one. Finally, taking into account the five series, our results show that in the first and the last series (A and E) the difficulty level of the 12 items does not increase in a lineal way since item 11 in A series and item 8 in the E series produce more error than following items in each series.

[21]
Intelligence, emotional intelligence, personality and self-esteem as predictors of academic performance in adolescents

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There are a considerable amount of articles associating separately intelligence (g), personality, especially conscientiousness (C) domain, emotional intelligence (EI) and self-esteem with academic performance. The main aim of this research was to study the predicting value of these cognitive and personality factors on academic performance in adolescents, by means of a structural equation model. Our hypotheses were that g and C would be the main predictors of children's marks, which also would be the result of higher EI and self-esteem. At the same time, we hypothesised that EI and self-esteem would be intercorrelated and both would be predicted by personality, but not g. More specifically, EI would be related to all of the five-factor model domains and self-esteem would be associated to (low) Neuroticism (N) and Extraversion (E). One hundred and forty-three adolescents (69 boys and 74 girls) answered the Raven's Standard Progressive Matrices (SPM), the Junior Spanish version of the NEO-PI-R (JS NEO), the Spanish language "Cuestionario de Inteligencia Emocional en Adolescentes" [Emotional Intelligence Questionnaire in Adolescents] (CIEA), and the Rosenberg Self-Esteem Scale (RSE). The results in part confirmed our hypotheses, as the academic performance was predicted mainly by g and C, but also to a lesser degree by Openness to Experience (O). These variables accounted for 34% of the children's marks variance. The association of (low) N and E with self-esteem was also confirmed by the model. However, contrary to our hypotheses, EI and self-esteem were not intercorrelated and neither of them predicted academic performance. Moreover, EI was associated mainly with C and, to a lesser degree, to Agreeableness (A) and E, but not to O and (low) N. In conclusion, this study confirms that the main predictors of academic performance in adolescents are g and C. We did not find support for the association of EI or self-esteem with academic performance when intelligence and the five-factors of personality were taken into account.

[22]
Emotional Intelligence and Motivation to Leadership: Meaning and value issues concerning the construct of Emotional Intelligence

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Abstract: This research explored the relationship between Emotional Intelligence (Salovey & Mayer, 1990) and the new concept of Motivation to Leadership, as part of the L=P*M*D formula (Leadership = Potentialities*Motivation to Leadership*Development) (Popper, Amit, Gal, Mishkal-Sinai, & Lisak, 2007), in a sample of members of a Portuguese security force institution. The purpose was twofold: first, it addressed the relationship between intelligence and leadership, as mediated by the Motivation to Leadership, a conative variable introduced by Chan (1999), and not by the use of traditional criteria such as measures of effectiveness in leadership involving supervisor and/or supervisee evaluations; Second, it addressed a construct validity problem, seeking evidence supporting the interpretation and use of measures of both constructs in psychological assessment (Messick, 1975, 1980).
The study made use of two tests: the editor's (Multi-Health Systems, MHS) Portuguese translation of the Mayer, Salovey and Caruso Emotional Intelligence Test (MSCEIT, Version 2.0) (2002) and the Portuguese adaptation (CEGOC) of the *Bochumer Inventar zur berufsbezogenen Persönlichkeitsbeschreibung* [Business Inventory of Personality] (BIP) (Hossiep & Paschen, 2007). A questionnaire was also constructed to provide additional personal data concerning leadership experience and the motivation to assume leadership positions.
The findings suggest human resources assessment may benefit from inclusion of Emotional Intelligence as a Potentiality per Popper et al.'s (2007) Leadership Model, L=P*M*D. Nevertheless, the metrological (psychometric) study of the MSCEIT showed that some of the reliability and validity results are quite limited, calling for a refinement of the test or, at least, of its Portuguese editor's version. The factorial validity study, in particular, gave rise to an internal structure inconsistent with the original underlying conceptual framework, that is, a diffuse structure of the data emerged, which is not equivalent to the four conceptual branches of the model of Emotional Intelligence. As a consequence, the validity of the total Emotional Quotient score as a measure of Emotional Intelligence is brought into question, both in terms of psychological meaning and of value to cognitive assessment. Some problems arising from other recent studies with the MSCEIT Portuguese version are mentioned.

Key-words: Emotional Intelligence, Leadership, Motivation to Leadership, MSCEIT.

[23]

Contributions of cognitive abilities for academic achievement: A study on Basic and Secondary Education in Portugal

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The present study addressed the debate regarding the relationship between cognitive performance and school achievement with a transversal panel analysis of Reasoning Tests Battery (RTB; Almeida & Lemos, 2007) and school achievement of 4899 Portuguese students, from 5th to 12th grades. These students performed abstract, numerical, verbal, problem solving, mechanical and spatial reasoning tests. In addition, school marks in some subjects were considered to represent school achievement, as well as a global measure of it. We analysed the correlation coefficients of the battery tests in its three versions (RTB5/6, RTB7/9 and RTB10/12) and school achievement measures throughout the three school levels (from 5th to 6th grade, named 2nd Cicle of Basic Education; from 7th to 8th grade, 3rd Cicle of Basic Education; and from 10th to 12th grade, Secondary Education) and examined the extent to which cognitive performance can predict (or not) school achievement. The correlations between a global measure of cognitive performance and a global measure of school achievement were around .62 for 2nd Cicle of Basic Education, .44 for 3rd Cicle and .33 for Secondary Education level. Moreover, the correlation coefficients between each battery test and each school marks suggested a more significant association between the cognitive abilities and school achievement in which the content's items and the content's subjects resemble with each other. Furthermore, the gradual decrease on correlation coefficients along school levels seems to anticipate the less importance the cognitive abilities tend to assume in predicting school achievement in the highest education levels considered. The verbal and numerical reasoning subtests are the best predictor on regression analysis. Theoretical and applied implications are discussed regarding the relation between school achievement and cognitive abilities, and also about the specific abilities evolved in predicting school achievement.

[24]
Psychometric analyses of an instrument for the assessment of creativity

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Creativity is a characteristic that has been the focus of interest of literature on the human abilities. This paper aims to present the results of a factor analysis of an instrument developed to assess figural creativity of Brazilian children and adolescents, based on Torrance's test of Creativity Thinking. Instrument is composed of three activities that must be answered under the form of drawings. From a sample of 1426 students (754 males attending first to eight grades of basic education of three regions of Brazil) a group of 626 participants was selected based higher fluency scores. A principal component analysis showed the existence of four factors explaining 29.29% of the total variance. The first factor was called enrichment of ideas and is composed of activities scores of elaboration, use of context, internal perspective, uncommon perspective and movement. The second factor was called emotional and is composed of activities scores of expression of emotion, expressive title and fantasy. The third factor was called creative preparation and separates basically some characteristics evaluated in the first activity of the test (expressive elaboration, title, use of context, movement and internal perspective). Finally the four factor was called cognitive aspects and is composed of activities scores of flexibility, fluency, originality and extension of limits. These results indicate the separation of cognitive from the emotional creative characteristics in agreement with scientific literature concerning the multidimensional vision of creativity. In a second study partial credit rasch analysis was applied in order to analyze item maps to gain insight into each activities scores were more indicative of higher levels of creativity (construct representation). Prior to the analysis all variables were recoded to a more suitable 1 to 9 scores. The results had shown that in relation to Factor 1 (Enrichment of Ideas), the characteristics of Uncommon Perspective, Internal Perspective and Movement are the ones that demand higher ability to be scored so are the ones that differentiate high creativity. In contrast elaboration scores would demand little creative ability to be scored. Factor the 2 (Emotivity) difficult items were emotion expression and fantasy and easy ones were expressive titles. In Factor 3 (Creative Preparation) internal perspective and movement are the most difficult and the characteristic of elaboration is the more easy. Finally Factor 4 (Cognitive Aspects) originality and extension of limits are the most difficult characteristics to be scored contrasted to flexibility and fluency which are easy to be scored. Together these results show a multidimensional structure for figural creativity and also the utility of item response theory methods in the creation of simplified versions of the scoring systems for this type of tests. The implication of this multidimensional structure in the understanding of gender differences is also discussed.

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[25]
National Corruption and r-K Variables in 127 Countries

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The Corruption Perception Index was correlated with per capita income and with six variables conceptualized as on Rushton's r-K dimension in 127 countries. The correlations in descending order with the Corruption Perception Index (higher score indicates less corruption) were per capita income .85, life expectance .65, infant mortality -.64, birth rate -.64, skin color (higher number indicates darker skin) -59, and HIV/AIDS -.15. The present findings contrast with previous research in which the r-K variables correlated with violent crime more highly than per capita income. It is here suggested that biological vs. social determination is a function of the biological vs. social nature of the criterion. It is further suggested that the Rushton r-K dimension provides the biological structure and that social variables mold that structure.

[26]
The effects of a 4-week chronic treatment of a cognitive enhancer on Raven Progressive Matrices scores in human participants

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There is evidence from animal studies indicating that administered individually the putative cognitive enhancers Huperzine, Vinpocetine, Acetyl-L-Carnitine, and R-Alpha-Lipoic Acid improve biological processes that underpin cognitive functioning. However, there are no studies examining the effect of combined administration in humans on intelligence test performance. This study was a randomised double blind placebo controlled trial designed study in which participants were either given placebo, or a combination nutraceutical containing Huperzine, Vinpocetine, Acetyl-L-Carnitine, R-Alpha-Lipoic Acid, Rhodiola Rosea and Biotin daily for 4 weeks. Seventy-one participants were randomized into the study to assess whether 4 weeks of treatment improved a range of cognitive and mood measures. Statistically significant improvements in several variables relative to placebo could be attributed to the 4 week administration of this compound indicating a benefit of combination nutraceutical therapy for improving cognitive processes. The most notable change in functioning was an improvement in Raven progressive Matrices scores suggesting that at least at week 4 the intervention improved general intelligence underpinning performance on this task.

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[27]
Construction and psychometric properties of a computer memory battery using classical test theory and item response theory

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Abstract: In accordance with the classical psychometric theory and the item response theory (IRT), the authors constructed a computer memory battery with six tests, which was prepared to be used with the adult population. These tests intend to measure working memory and short-term memory constructs with verbal and non-verbal contents. A factor analysis has been conducted to assess the internal structure of the tests in accordance with the results of 547 undergraduate students. According to the literature, several confirmatory factorial analysis models were conducted. Our results show better fit measures (CFI=.984; TLI=.969; RMSEA=.060) in a model with two independent latent variables of verbal and non-verbal factors. This structure reproduces the initial battery organization. The Cronbach α coefficients showed acceptable to high internal item consistency levels for the six tests (α ranging from .72 to .89). IRT analyses (Rasch and Partial Credit models) revealed good Infit and Outfit measures and high level of precision for parameter estimation. Also, the DIF analysis for gender only reveals one item biased in two of the six tests analyzed. Gender and type of course interaction effects for the tests were analyzed with Rasch measures. Only gender differences for two working memory tests were found. The potential utility of these memory tasks for psychological research and practice will be discussed.

[28]
Intelligence and temporal variability – unique and common sources of variance among finger tapping and reaction time measures

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Psychometric intelligence (IQ) is correlated with reaction time (RT) mean and variability, as well as with accuracy in temporal discrimination and reproduction tasks [1, 2]. We have reported a negative relation between intelligence and variability also in a simple motor timing task, isochronous serial interval production (ISIP). We argue that this relation involves bottom-up mechanisms, i.e. that basic neural properties influence both temporal accuracy and cognitive processes play a role for timing-intelligence correlations. This argument is based on five observations:

1. ISIP is an automatic task, in which millisecond variability is largely inaccessible to conscious control and relatively unaffected by concurrent performance of cognitive tasks [2, 3];
2. ISIP loads little on prefrontal brain regions that are involved in attentional top-down control [4]
3. Correlations between intelligence and ISIP are strongest for tapping intervals below 1 s [2]
4. No worst performance rule could be found for the ISIP-intelligence relation [2]
5. ISIP-intelligence relations were unaffected by manipulations of state motivation during ISIP [5].

If RT variability and intelligence relations involve bottom-up mechanisms is still unclear, but several observations suggest that top-down mechanisms, e.g. attentional slips, play a role in this case:

1. RT performance is strongly affected by concurrent performance of other cognitive tasks [3].
2. Even simple RT involves activation of prefrontal cortical regions [6].
3. RT-intelligence relations show a worst performance rule [7]

These observations suggest that different sources of variance may be involved in RT and ISIP correlations with intelligence. Here, we investigate the correlational structure between intelligence, RT and ISIP with a commonality analysis. Specifically, we measure simple RT (SRT), choice RT (CRT), and local (ISIP-L) and drift (ISIP-D) components of ISIP variability. A group of 72 students performed Raven's SPM Plus and all three chronometric tasks. Raw correlations (*r*) with SPM were -0.33 for ISIP-D, -0.28 for ISIP-L, and -0.33 for CRT variability. Correlations with SRT were not significant. The total variance shared by IQ, ISIP and CRT was on the order of 10 percent. A commonality analysis (Table 1) revealed that commonalities between ISIP and CRT were relatively small: 2.9% for ISIP-L and CRT, and 4.0% for ISIP-D and CRT. The unique contribution of CRT was also small (2.3-3.3%).Both ISIP-D (7.4%) and ISIP-L (5.0%) had in comparison large unique contributions. Overall, unique contributions were larger than commonalities, which indicates that ISIP taps processes specific for IQ that RT measures do not (and vice versa). These results suggest that intelligence-timing variability relations may have two sources. One is mainly reflected in in ISIP-L and involves low-level, bottom-up processes involved in timing. The other is more reflected in ISIP-D and RT and is presumably related to top-down functions such as attention.

Table 1. Analysis of commonalities and unique contributions of ISIP and RT measures to IQ.

Commonality Local and RT	$r^2_{SPM.Local} + r^2_{SPM.RT} - R^2_{SPM.RT.Local}$	0.029
Commonality Drift and RT	$r^2_{SPM.Drift} + r^2_{SPM.RT} - R^2_{SPM.RT.Drift}$	0.040
Unique Local	$R^2_{SPM.RT.Local} - r^2_{SPM.RT}$	0.050
Unique RT (analysed with Local)	$R^2_{SPM.RT.Local} - r^2_{SPM.Local}$	0.033
Unique Drift	$R^2_{SPM.RT.Drift} - r^2_{SPM.RT}$	0.074
Unique RT (analysed with Drift)	$R^2_{SPM.RT.Drift} - r^2_{SPM.Drift}$	0.023

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[29]
The relation between temporal variability and intelligence is not due to differences in top-down control - further evidence using manipulations of motivation during tapping

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Intelligence correlates with accuracy in various timing tasks (1, 2). In principle, such correlations could be due to both bottom-up mechanisms, e.g. basic neural properties that influence both temporal accuracy and cognitive processing, and differences in top-down control. In the former case temporal accuracy of neural activity could play a causal role for differences in intelligence. In the latter case, temporal accuracy may be of no specific importance for intelligence: the correlations could rather reflect individual differences in general mechanisms, e.g. attention, which affect performance in both temporal and non-temporal tasks.

We have investigated the timing-intelligence relation using a simple temporal motor task, isochronous serial interval production (ISIP), i.e. beating/hand movements with a regular beat. The total variability in this task can be divided into local variability (Local) between neighbouring temporal intervals, and drift (Drift), i.e. fluctuations in tempo over several intervals. We have previously argued that Local variability in ISIP is to a large extent automatic and inaccessible to conscious control, whereas Drift may be dependent on short-term memory of previously produced intervals and thus more susceptible to top-down influences (1, 3). Several observations suggest that bottom-up mechanisms are involved in the ISIP-intelligence relation (1): both Local and Drift correlate negatively with intelligence; correlations between intelligence and ISIP are strongest for tapping intervals below 1 s; and no worst performance rule could be found for the ISIP-intelligence relation.

Here, we investigate the nature of the ISIP-intelligence relation further, by manipulating motivation during ISIP performance. Preliminary analyses of data from a group of 65 students are presented. Intelligence was measured using the Wiener Matrizen Test (4). ISIP was performed under two conditions. In the first condition (Low Motivation), the Pts were told that measurements were being made to calibrate the equipment. In the second condition (High Motivation), the Pts were told that the performance would be used for scientific analysis and that they would be given a monetary reward depending on how accurately they performed. The rationale for the design was as follows. State motivation can influence performance by recruiting neural circuitry involved in attentional control to increase selective attention to task (5). If individual differences in such top-down mechanisms play a main role for the intelligence-ISIP relation, we would expect higher correlations during High Motivation than during Low Motivation, since High Motivation loads more on motivationally driven top-down control mechanisms.

T-tests for dependent samples revealed that temporal accuracy was higher during High Motivation for both Local ($t(64) = 3.97$, $p = .0002$) and Drift ($t(64) = 2.81$, $p = .007$). Performance was thus affected by the manipulation of motivation. In contrast, correlations between Local and intelligence did not differ significantly ($p = .38$, Difference Test for Pearson *r*:s) between the Low ($r = -.29$, $p =. 02$) and High ($r = -.14$, n.s.) Motivation conditions; nor was there a significant difference ($p = .57$) in correlations between Drift and intelligence for Low ($r = -.38$, $p = .002$) and High ($r = -.29$, $p = .02$) Motivation. One can also note that for both Local and Drift there are non-significant trends for the *r* values to be *lower* during High than Low Motivation, i.e. the opposite pattern to that predicted by a top-down hypothesis.

We conclude that motivationally driven top-down mechanisms can influence ISIP performance, but that they play no major role for correlations between temporal accuracy in ISIP and intelligence. These results provide further support for that bottom-up mechanisms are involved in relations between temporal accuracy and intelligence.

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[30]
Parents' education, less their money, nurtures the intelligence of their children

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For almost one century research has been carried out on the relationship between parents' socioeconomic status (SES) and intelligence of their children. Older and newer meta-analyses show correlations with SES from *r*=.22 to *r*=.33 and *r*=.42 (corrected). Even in communist countries like in former Poland social status and cognitive development were associated. The popular interpretation of these findings, in the media but also in social science, is that they are caused by differences in the *wealth* of parents. Conventionally, SES is measured by using sum values of parental income, parental occupation and parental education. A catch all variable can statistically explain a lot of variance but does not help understand causal relationships. Thus we use educational and economic indicators independently.

A cross-sectional study in Austria analyzed the relative impact of parental education compared to parental wealth on cognitive development of children. Children were aged 10 to 18 (*N*=235). The social background ranged from welfare recipients to professional (academic) families. Their children's cognitive development was measured with the CAT. Parental wealth was estimated through questionnaires by directly asking for income (money), indirectly by self-assessment of wealth compared to others and by using further indicators for long-term affluence like square footage of housing. Parental formal education comprises school education and professional training. Additional variables describe educational behavior and attitudes of parents as well as smoking. Different path analyses show a stronger impact of parental education than economic status on intelligence.

We conclude that less income but more education is relevant for the positive relationship between parental SES and children's intelligence.