International Society for Intelligence Research 2005

Alfred Binet

Program
Sixth Annual Conference
Hyatt Regency
Albuquerque, NM

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We would like to thank the Templeton Foundation for their generous support and Elsevier for sponsoring the reception. We also thank Rosalind Arden for her assistance in planning this conference.

9:55-10:20	**Whetzel (57)**	9:55-10:20	**Irwing (33)**		**Diminishing returns**
	IQ & wealth of nations		**Sex differences evid.**	10:05-10:20	**Break**
10:20-10:45	**Hunt (32)**	10:20-10:45	**Johnson (34)***	10:20-10:45	**Sefcek (49)***
	IQ & prosperity		**Sex diff. and the brain**		**IQ, life history**
!0:45-11:10	**Gottfredson (27)**	!0:45-11:10	**Webb (55)**	!0:45-11:10	**MacDonald (40)**
	Innovartion and accid.		**Spatial ability & talent**		**IQ, life history**
11:10-11:35	**Prokosch (45)***	11:10-11:35	**Kovacs (37)***	11:10-11:35	**Wenner (56)***
	IQ & mate selection		**Sex diff. & RAPM**		**Profiling approaches**
11:35-12:05	**Lee (38)***	11:35-12:05	**Puts (46)***	11:35-12:05	**Figueredo (22)**
	IQ & primate clade		**CAH and digit ratio**		**Exec. Function & JD**
12:05-1:30	**Lunch**	12:05-1:30	**Lunch**	12:05-1:30	**Lunch**
1:30-1:55	**Kaplan (36)**	1:30-1:55	**To Mind Institute**	1:30-1:55	**te Nijenhuis (52)**
	Leaning and IQ	1:55-2:20	**Haier (15)**		**Score gains: no *g***
1:55-2:20	**Geary (26)**		***g* and grey matter**	1:55-2:20	**Luo (39)**
	Evol. of brain, cog., IQ	2:20-2:45	**Thoma (53)**		**Cog. capacity and IQ**
2:20-2:45	**Miller (42)**		**Speed-IQ & MEG**	2:20-2:45	**Wai (54)***
	Mutual mate choice	2:45-3:10	**Schmidhorst (48)**		**Top 1% accomplish.**
2:45-3:00	**Break**		**Functional connectivity**	2:45-3:10	**McGrew (41)**
3:00-3:25	**Hill (30)**	3:10-3:35	**Jung (35)**		**Databases for research**
	Adapt. func. of high IQ		**Biochemical markers**	3:10-3:25	**Break**
3:25-3:50	**Gangestad**	3:35-3:50	**Break**	3:25-3:50	**Demetriou (18)**
	Discussant	3:50-4:15	**Stough (51)**		**Thinking & self-aware.**
4:00-5:00	***Nuebauer (43)***		**MRI, personality, IQ**	3:50-4:15	**Downey (19)***
	Neurobehavior and IQ	4:15-4:40	**Stough (50)**		**EI differentiation**
5:00-6:00	**Dist. Contribution Int.**		**Brain elec. Activity**	4:15-4:40	**Bonus (13)***
	Hunt	4:40-5:05	**Bigler**		**EI differentiation**
6:00-7:30	**Elsevier Reception**	5:15-6:15	***Andreasen (9)***	4:40-5:05	**Andrews (10)**
			The creating brain		**IQ, depression & stress**
		6:15-7:30	**Mind Tour & Reception**	5:05-5:30	**Beaujean (11)***
					Span tasks

Notes:

*** Students or postdocs who may be eligible for student awards**

Only first author or presenting author are listed

Symposia

Invited Presentations

International Society for Intelligence Research (ISIR) Program 2005

(Numbers in parentheses refer to page of abstract)

All sessions will be in the Fiesta Room with registration in the Boardroom Alcove.

Thursday, December 1, 2005

Papers (8:00-9:40): Group Differences
Chair: Detterman

8:00-8:25 Cvorovic, Rushton, and Figueredo (17)
Intelligence and life history variables in Serbian Gypsies.

8:25-8:50 Nyborg, Albeck, Hartmann, and Larsen (44)
Race differences in general intelligence *g* in relation to blood pressure, body proportions, hormones, and personality: A cross-sectional study of 4,000+ White, Hispanic, and Black middle-aged males.

8:50-9:15 Cochran and Harpending (14)
The evolutionary biology of human IQ diversity: Some current directions and hints.

9:15-9:40 Hunt and Carlson (31)
Criteria for studies of race and intelligence.

9:40-9:55 **Break**

Papers (9:55-12:05): Papers: Wealth and Evolution
Chair: Brody

9:55-10:20 Whetzel and McDaniel (57)
IQ and wealth of nations: Prediction of national wealth.

10:20-10:45 Hunt and Wittmann (32)
Relations between national intelligence and indicators of national prosperity.

10:45-11:10 Gottfredson (27)
Innovation, fatal accidents, and the evolution of general intelligence.

11:10-11:35 Prokosch (45)*
Intelligence and mate choice.

11:35-12:05 Lee (38)*
The evolution of general intelligence in the primate clade.

12:05-1:30 **Lunch**

Papers (1:30-3:50): The Evolution of Intelligence (25)
Chair: Gangestad and Arden

1:30-1:55 Kaplan (36)
Learning, intelligence, and life history evolution.

1:55-2:20 Geary (26)
The origin of mind: Evolution of brain, cognition, and general intelligence.

2:20-2:45 Miller (42)
Mutual mate choice for intelligence as a fitness indicator.

2:45-3:00 **Break**

3:00-3:25 Hill (30)
The adaptive function of high cognitive ability in hunter-gatherers: Feeding niche or social complexity?

3:25-3:50 Gangestad
Discussant

4:00-5:00 **Invited Presentation**
Neubauer (43)
Neurobehavioral explorations of human intelligence and related constructs.
Chair: Arthur Jensen

5:00-6:00 **Distinguished Contributor Interview**
Earl Hunt
Interviewed by David Lubinski

6:00-7:30 **Elsevier Reception – Lobby Atrium**

Friday, December 2, 2005

Papers (8:00-9:40): Miscellaneous Papers
Chair: Hunt

8:00-8:25 Firmin (23)
Web-based IQ tests: A concept whose time has not yet come.

8:25-8:50 Firmin, Hwang, Evens, Bennington, and Keyser (24)
Correlations among the Quick Picture Reading Test and the Shipley Institute of Living Scale with the Slosson Intelligence Test-Revised

8:50-9:15 Widaman (59)
Factorial invariance and the representation of within-groups and between-groups differences: A reconsideration.

9:15-9:40 Fagan, Holland,., and Wheeler (20)
The prediction, from infancy, of adult IQ and achievement.

9:40-9:55 **Break**

Papers (9:55-12:05): Gender Differences
Chair: Gottfredson

9:55-10:20 Irwing (33)
Sex differences in general cognitive ability: A re-examination of the evidence.

10:20-10:45 Johnson (34)*
Linking brain structure and function underlying sex differences in mental ability: A concrete proposal.

10:45-11:10 Webb, Lubinski, and Benbow (55)*
Spatial ability: A neglected dimension in talent searches for intellectually precocious youth.

11:10-11:35 Kovacs and Mackintosh (37)*
Sex differences in Raven's Advanced Progressive Matrices.

11:35-12:05 Puts, McDaniel, Jordan, and Breedlove (46)*
Possible organizational effects of early androgens on human spatial ability" Meta-analyses of CAH and digit ratio studies.

12:05-1:30 **Lunch**

1:30-1:55 **Transportation to The Mind Institute, 1101 Yale Blvd. NE, Albuquerque, NM 87106 (Tel: 505-272-7578)**

Symposium (1:55-5:05): Brain Imaging Studies of Intelligence: Closing in on the Neuroanatomy of Individual Differences (28)
Chair: Haier

1:55-2:20 Colom, Haier (presenter), and Jung (15)
Correlated vectors, g, and gray matter: A frontal-parietal network and the Einstein hypothesis.

2:20-2:45 Thoma (53)
Investigating the cortical temporal dynamics of the speed-intelligence relationship using magnetoencephalography (MEG).

2:45-3:10 Schmithorst and Holland (48)
Sex differences in associations of brain anatomical and functional connectivity with IQ in children.

3:10-3:35 Jung, Levine, Yeo, and Haier (35)
Biochemical markers of individual differences in cognitive functioning

3:35-3:50 **Break**

3:50-4:15 Stough, Timoshanko, Desfosses, and Desmond (51)
Magnetic resonance imaging (MRI) relating to differences in personality, cognitive ability (IQ) and emotional intelligence.

4:15-4:40 Stough, Ciorciari, and Tarasuik (50)
Brain cortical electrical activity associated with emotional intelligence.

4:40-5:05 Bigler
Discussant.

5:15-6:15 **Invited Address**
Andreasen (9)
The creating brain: The neuroscience of genius.
Chair: Jung

6:15-7:30 **Mind Institute Tour and Reception**

Saturday, December 3, 2005

Papers (8:00-10:05): Misc. Papers
Chair: Luo

8:00-8:25 Harlaar and Plomin (29)*
Genes, *g*, and chaotic home environments.

8:25-8:50 Beaujean and Osterlind (11)*
Assessing the Lynn-Flynn effect in the College Basic Academic Subjects Examination.

8:50-9:15 Wicherts (53)*
Flynn effect in the Woodcock-Johnson Cognitive Ability and Achievement Tests, 1976-1999.

9:15-9:40 Condon and Schroeder (16)
An examination of Spearman's law of diminishing returns.

9:40-10:05 Reynolds and Keith (47)*
A test of Spearman's law of diminishing returns in the Kauffman Assessment Battery for Children, Second Edition.

10:05-10:20 **Break**

Symposium (10:20-12:05): Life History Strategy and Mental Abilities (21)
Chair: Figueredo

10:20-10:45 Sefcek, Miller, and Figueredo (49)*
General intelligence, life-history, and covitality: A test of evolutionary hypothesis.

10:45-11:10 MacDonald, Vásquez, and Figueredo (40)
Intelligence and life history strategy: A replication using short form measures.

11:10-11:35 Wenner, Figueredo, Rushton, Jacobs (56)*
Profiling Approaches to Life and Employment (PALE)

11:35-12:05 Figueredo, Armenta, Valdez, Nava, Borrani, Contreras, Vega, and Ríps (22)
Executive function and juvenile delinquency: Preliminary data.

12:05-1:30 **Lunch**

Papers (1:30-3:10): Intelligence and Achievement
Chair: Lubinski

1:30-1:55 te Nijenhuis, van Vianen, and van der Flier (52)
Gains on *g*-loaded tests: No *g*.

1:55-2:20 Luo (39)
Using measures of basic cognitive capacities to identify individuals with exceptional levels of intelligence.

2:20-245 Wai, Lubinski, and Benbow (54)*
Creative accomplishments covary with ability even among the top 1%.2:20-2:45

2:45-3:10 McGrew (41)
Secondary sources of national and clinical databases: New research opportunities of ISIR scholars and students.

3:10-3:25 **Break**

Papers (3:25-5:30): Self-Awareness and Emotional Intelligence
Chair: Stough

3:25-3:50 Demetriou (18)
Mental processing, thinking and self-awareness: Towards an integrated theory.

3:50-4:15 Downey and Stough (19)*
Does emotional intelligence predict scholastic achievement in adolescents?

4:15-4:30 Bonus, Austin, and Saklofske (13)*
Emotional intelligence: Evidence for differentiation and new theoretical direction.

4:30-5:05 Andrews, Silberg, and Eaves (10)
Intelligence may buffer the depressogenic effects of social stress in adolescents.

5:05-5:30 Beaujean, Knoop, Craig, Frisby, Crouch, and Holliday (11)*
A comparison of forward and backward digit and spatial span tasks.

The Creating Brain: The Neuroscience of Genius

Nancy C. Andreasen, M.D., Ph.D.
Andrew H. Woods Chair of Psychiatry at the University of Iowa Carver College of Medicine
Director of The MIND Institute in Albuquerque, NM

This presentation will review empirical and theoretical work concerning the nature of creativity and its relationship to mental illness. It will discuss the definition of creativity and the factors that reinforce it or diminish it. Through a combination of empirical data and case studies, it will examine the nature of the creative personality and the creative process. Although creativity (referred to as "genius" throughout most of the 19th and early 20th centuries) requires above average intelligence, it is qualitatively different. Creativity, in its essence, is the capacity to perceive novel relationships and ideas and to use or express them in a way that is esthetically pleasing or intellectually useful. The creative personality is adventuresome and open to experience. Subjective accounts indicate that the creative process frequently arises from preconscious or unconscious sources. Neuroimaging studies suggest that the neural basis for the ability to perceive novel relationships may arise from intense interaction between heteromodal association cortices. Examination of the relationship between "nature and nurture" in the etiology of creativity suggests that neither is solely dominant and that both are important; creativity was have a familial component. Examination of the relationship between creativity and mental illness indicates that creative writers have an increased incidence of mood disorder, but that there may be a relationship between creativity in math and physics and schizophrenia.

References

Andreasen NC (1987): Creativity and mental illness: prevalence rates in writers and their first-degree relatives. *Am J Psychiatry*; 144(10):1288-1292
Andreasen NC (2005): The Creating Brain: The Neuroscience of Genius. Washington, DC: The Dana Press

Intelligence May Buffer the Depressogenic Effects of Social Stress in Adolescents

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Several studies show a negative correlation between intelligence and depression, but it is not clear why. We present evidence that intelligence may buffer the depressogenic effects of stressful life events, which are thought to be causes of depression. We used an epidemiological sample of adolescent twins (526 males, 572 females) living in Virginia for which we had data on depression, stressful life events (SLEs), and intelligence (assessed by the Raven's Progressive Matrices). We found good evidence of interactions between intelligence and certain SLEs for predicting depression; (a) parents nagging on adolescent (interaction found in boys); (b) regularly dating a new person (interaction found in boys); and (c) breaking up with a regular dating partner (interaction found in girls). In all cases, the interaction indicated that intelligence had a buffering effect. These results also suggest that a natural use of intelligence is in dealing with complexities in social relationships, which may have implications for social theories of the evolution of intelligence.

A Comparison of Forward and Backward Digit and Spatial Span Tasks

A. Alexander Beaujean, [a,b] Andrew J. Knoop,[a] Craig L. Frisby, [a] Christie Crouch,[a] and Greg Holliday [a]

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Previous research has shown that the backward Digit Span task on the Wechsler Intelligence Scales has a higher correlation with IQ, as well as a higher *g* loading, than the forward version of the same task (Jensen & Figueroa, 1975; Sen, Jensen, Sen, & Arora, 1983). Presumably, this is due to the difference in information-processing resources required for the two tasks, with the backward task requiring more (Jensen, 1980, 1981). In the third edition of the Wechsler Memory Scales, there are similar tasks to the Digit Span tasks, except that they use visually-presented stimuli (i.e., Spatial Span tasks). To date, there has been no research on how the Spatial Span tasks operate with respect to individual differences, although there have been hypotheses generated about such tasks (Jensen & Figueroa, 1975). Consequently, the purpose of this project was to: a) assess the correlations between forward and backward Spatial Span tasks and IQ, and b) compare the *g*-loadings of the forward and backward Spatial Span tasks to the forward and backward Digit Span tasks.

References

Jensen, A. R. (1980). *Bias in mental testing*. New York: Free Press.

Jensen, A. R. (1981). *Straight talk about mental tests*. New York: Free Press.

Jensen, A. R., & Figueroa, R. A. (1975). Forward and backward digit span interaction with race and IQ: Prediction from Jensens theory. *Journal of Educational Psychology*, *6*, 882{893.

Sen, A., Jensen, A. R., Sen, A. K., & Arora, I. (1983). Correlation between reaction time and intelligence in psychometrically similar groups in America and India. *Applied Research in Mental Retardation*, *4*, 139{152.

Assessing the Lynn-Flynn Effect in the College Basic Academic Subjects Examination

A. Alexander Beaujean [a,b,c] and Steven J. Osterlind [a]

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This study examined the Lynn-Flynn Effect (LFE) using data from the Mathematics section of the College Basic Academic Subjects Examination (Osterlind, & Merz, 1990) from1996 to 2001. This study used Item Response Theory (IRT) methods to assess the magnitude of change in cognitive abilities, because, as Beaujean (2005) showed, under certain conditions, score comparison methods derived from Classical Test Theory are unable to distinguish between real rises in cognitive abilities (Lynn, 1989) and mere psychometric artifacts (Burt, 1952; Brand, 1989)---a limitation IRT comparison methods were able to overcome. This study found a trend similar to that of Sundet, Barlaug, and Torjussen (2004) and Teasdale and Owen (in press), namely a dysgenic effect since the mid-1990s.

References

Beaujean. A. A. (2005). *Using Item Response Theory to Assess the Lynn-Flynn Effect*. Unpublished doctoral dissertation, University of Missouri-Columbia.

Brand, C. R., Freshwater, S., & Dockrell, W. B. (1989). Has there been a "massive" rise in IQ levels in the west? *Irish Journal of Psychology, 10*, 388–394.

Burt, C. (1952). *Intelligence and fertility* (2nd ed.). London: Eugenics Society

Flynn, J. R. (1982). Lynn, the Japanese, and environmentalism. *Bulletin of the British Psychological Society, 35,* 411

Lynn, R. (1982). IQ in Japan and the United States shows a growing disparity. *Nature, 306,* 291–292.

Lynn, R. (1989). A nutrition theory of the secular increases in intelligence: Positive correlations between height, head size, and IQ. *British Journal of Educational Psychology, 59*, 372–377.

Osterlind, S. J., & Merz, W. R. (1990). *College Basic Academic Subjects Examination technical manual*. Columbia, MO: University of Missouri.

Sundet, J. M., Barlaug, D. G., & Torjussen, T. M. (2004). The end of the Flynn Effect? A study of secular trends in mean intelligence test scores of Norwegian conscripts during half a century. *Intelligence, 32*, 349–362.

Teasdale, T. W., & Owen, D. R. (in press). A long-term rise and recent decline in intelligence test performance: The Flynn Effect in reverse. *Personality and Individual Differences*.

Emotional Intelligence: Evidence for Differentiation and New Theoretical Direction

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Current *trait* or *ability* Emotional Intelligence (EI) tacitly assumes a linear relationship between EI score level and dispositional tendencies or individual EI skill (e.g., empathy, mood regulation) abilities. It was proposed that EI may be better viewed as a 'meta-ability': higher EI is defined as skill at suiting use of particular EI skills to a given situation. This conjecture in addition to applications of Spearman's 'law of diminishing returns' in IQ, extensions of Spearman's law to personality and EI, and the potential causes of differentiation prompted us to determine if EI differentiates by EI level. Data from five samples which took four different EI tests (one *ability,* three *trait*) were factor analysed (after Jensen, 2003) to see if the first principal axis factor (PAF1) explained more variance in low-EI groups than high-EI groups. *F* ratios of the variance explained in each group had approximately the same effect size (across-samples average $F = 1.33$, $p < .01$) as IQ differentiation results. The differences in variance were robust across samples and tests and provide preliminary support for the 'meta-ability' theory by showing that EI test responses are more variable in high-EI participants.

The Evolutionary Biology of Human IQ Diversity: Some Current Directions and Hints.

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Intelligence is an evolutionary puzzle. There is great diversity within and between populations yet every correlate of intelligence, it seems, should enhance Darwinian fitness. An exception is myopia, which would be crippling in a forager society but less important for farmers.

Modern humans apparently left Africa ca. 40,000 years ago and appeared soon afterwards in western Eurasia and in Australia. The southern arm peoples arrived with middle Paleolithic technology that persisted unchanged for tens of millenia while the northern arm peoples were host to the famous "creative explosion" of the upper Paleolithic with elaborate tools, worked bone, beadword and other adornment, sculpture, and painting. We discuss the hypothesis that incorporation of Neanderthal genes led to elevated intelligence (or something closely related) in the northern arm. We will mention some likely examples of such assimilated genes.

The probability that an assimilated gene persists in a population is vastly greater when it confers a selective advantage so we expect a priori to see far fewer assimilated neutral genes, for example those modifying details of skeletal morphology.

We have suggested that modifications of BRCA1 and BRCA2 elevate IQ in Ashkenazi Jews: it is now known that several genes of the microcephalin complex modulate the action of BRCA1 in early CNS development.

The evolutionary rates of complex traits are limited by the rate of appearance of favorable mutations, so large populations are expected to evolve faster. The phenomenon is well known in the insecticide resistance literature for example. If IQ is favored by selection it should increase most rapidly in large populations, for example among the northern arm peoples as opposed to those on island isolates. We discuss the appearance and spread of an ASPM variant, one of the microcephalin complex genes, as an example. A puzzling pattern among candidate genes for elevating IQ is that they seem not to have spread in Africa.

Correlated Vectors, *g*, and Gray Matter: A Frontal-Parietal Network and the Einstein Hypothesis

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We have reported that regional gray and white matter volumes are correlated with Full Scale IQ. Here we report that WAIS subtests with high g-loadings show more brain areas correlated to gray matter volume than subtests with low g-loadings (Colom, Jung et al. submitted). We also use Jensen's Method of Correlated vectors to show which FSIQ correlations with regional gray matter are due mostly to the g factor (Colom, Jung et al. submitted). The results support the view that intelligence is built on brain structures distributed across the brain and this distribution is modulated by age and sex.(Haier, White et al. 2003; Haier, Jung et al. 2004; Haier, Jung et al. 2005)

A number of studies have emerged designed to elucidate the functional, structural, and neurochemical underpinnings of intelligence within discrete brain structures. Here we review these studies and report a striking consensus pointing to a distributed network of brain regions underlying intelligence and reasoning in humans (Jung and Haier submitted). These areas include: dorsolateral prefrontal cortex (Brodmann areas 9, 45-47), angular/supramarginal gyri (Brodmann areas 7, 39, 40), the anterior cingulate (Brodmann area 32), temporal lobe (Brodmann areas 21, 22, 37), fusiform gyrus (Brodmann areas 18 & 19), and white matter regions (i.e., arcuate fasciculus). A parsimonious hypothesis emerges suggesting that a frontal-parietal network predicts individual differences found on psychometric measures of intelligence and reasoning. Based on reports of parietal enlargement in Albert Einstein's brain, we call this the Einstein Hypothesis and test it against findings from lesion studies, including missile wounds, frontal lobotomy/leukotomy, temporal lobectomy, and lesions resulting in damage to the language network (e.g., aphasia). It is critically important that the relevant structural, functional, and neurochemical parameters underlying intelligence and reasoning be described to aid the development of intervention strategies when aging or the ravages of injury and disease adversely affect higher cognitive functioning.

Colom, R., R. Jung, et al. (submitted). "Distributed brain sites for the *g*-factor."
Colom, R., R. Jung, et al. (submitted). "Finding the g-factor in brain structure."
Haier, R. J., R. Jung, et al. (2005). "The neuroanatomy of general intelligence: sex matters." Neuroimage **25**(1): 320-327.
Haier, R. J., R. E. Jung, et al. (2004). "Structural brain variation and general intelligence." NeuroImage **23**(1): 425-433.
Haier, R. J., N. S. White, et al. (2003). "Individual differences in general intelligence correlate with brain function during nonreasoning tasks." Intelligence **31**(5): 429-441.
Jung, R. and R. Haier.J. (submitted). "Where in the brain is intelligence: The Einstein Hypothesis."

An Examination of Spearman's Law of Diminishing Returns

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In this paper we investigate Spearman's Law of Diminishig Returns (LODR), which states that the *g* saturation for cognitive-ability tests is lower at higher-ability levels than at lower-ability levels. We used data from the Johnson O'Connor Research Foundation's (JOCRF's) aptitude-testing program, in which individuals pay a fee to take a diverse battery of aptitude/ability tests, usually for purposes of career planning. Because the JOCRF population is diverse in terms of age (14 to 75), we partialled all test scores for age. We then selected the 15,089 examinees in the 18-30 age range and performed a principal-components analysis (PCA) of their scores on 12 cognitive-ability tests. Next, we carried out a median split of their scores on the first component (*g*) and performed separate PCAs for the low- and high-ability groups. As predicted by the LODR, the first component accounted for a higher percentage of variance in the low-ability group than in the high-ability group (19.9 versus 15.2). Comparisons of standard deviations for the two groups indicated that differences in variance on the 12 tests were generally small and unlikely to account for the differences in the principal components. Overall, our sample had little representation of persons at the lower ability levels (who tend not to seek career testing), and so our findings should be seen as contrasting moderate versus high levels of ability.

Following Legree et al. (1996), Deary et al. (1996), and others, we also performed splits on each of the individual tests and compared the resulting first principal components. The lower-ability groups always yielded larger first components, but the differences were small (e.g., percentages of variance = 34.2 and 31.6 for a median split on English Vocabulary).

Regarding the patterns identified by Jensen (2003) in his study of LODR, we also found in our PCAs of high- and low-ability examinees that: (a) the *g* loadings across tests were more variable in the high-ability than the low-ability group (coefficients of variation = .44 and .23, respectively); and (b) the decline in loadings between the low- and high-ability groups was much steeper for the less *g*-loaded tests (e.g., the loading for perceptual speed went from .33 to .16, whereas the loading for Analytical Reasoning only declined from .56 to .53). Thus, it appears that the "core" of *g* holds together at the higher-ability levels, but the more-peripheral abilities become increasingly independent. When examining higher-ability persons, assessors are likely to need separate indices of the latter abilities in addition to measures of *g*.

Intelligence and Life History Variables in Serbian Gypsies

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347 Serbian Gypsies aged 15-70 years living in three different villages in and around the capital city of Belgrade were given the Raven's Progressive Matrices, a non-verbal culture-reduced measure of general intelligence (either the Standard version, or the simpler Colored version—usually administered to children). The Gypsies were also assessed for several life-history behavior traits such as fertility and birth spacing, physical traits such as head size, and self-report traits of delinquency, mate value, and social attitude. The mean Gypsy IQ score is 70 with males scoring higher than females. Preliminary analyses show the IQ scores have low but predicted relations with cranial capacity ($r = 0.16$, $p < 0.001$, $N = 346$), spousal assortment ($r = 0.17$, $p < 0.06$, $N = 119$ pairs), age at first child ($r = 0.24$, $p < 0.001$, $N = 226$), number of offspring (negatively, $r = -0.214$, $p < 0.001$, $N = 346$), and the self-report measures ($r = 0.11$, $p < 0.05$, $N = 305$). This Gypsy population averaged a lower IQ than other tested Gypsy groups (IQ = 85), which may be due to inbreeding depression arising from too many within-group marriages.

Mental Processing, Thinking, and Self-Awareness: Towards an Integrated Theory

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This presentation summarizes a series of studies directed to the integration of the information processing, the differential, and the developmental modeling of the mind into an overarching theory. Specifically, one set of studies investigated longitudinally the relations between several dimensions that are considered important by all three traditions. Namely, processing efficiency, working memory, and thinking. Participants, aged from 8 to 16 years, were tested with a large array of tasks addressed to these three dimensions.
Confirmatory factor analysis indicated that these dimensions are organized in a three-stratum hierarchy. Structural equation modeling indicated that the dimensions are interrelated in a cascade fashion so that more fundamental dimensions are part of more complex dimensions. That is, processing efficiency predicts the condition of working memory, which, in turn is related to the condition of different thinking domains.

Growth and dynamic modeling suggested that all dimensions as well as their relations change systematically with time. Mixture growth modeling suggested that there are four types of developing persons, each being defined by a different combination of performance in these aspects of the mind. Some types were more efficient and stable developers than others. These analyses indicated that processing efficiency is the developmental factor whereas working memory is the individual differences factor in regard to thinking.

Another set of studies investigated the relations between processing efficiency and self-awareness. In these studies four groups of participants were examined. (i) Efficient processors and efficient reasoners, (ii) efficient processors and weak reasoners, (iii) weak processors and efficient reasoners, and (iv) weak processors and weak reasoners. These participants were tested by a specifically designed inventory that probes self-representation about these dimensions. The results suggested that processing and reasoning efficiency are directly represented in one's cognitive self-concept. That is, efficient processors and efficient reasoners represent themselves as more powerful reasonsers than persons who are weak processors and weak reasoners. In fact, confirmatory factor analysis suggests that self-awareness is a strong dimension of *g* from preschool age.

These findings are discussed from the point of view of information processing, differential, and developmental models of intelligence and the self and an integrative model is proposed. The model describes how the various processes are interwoven during development. The implications for current cognitive science and psychometric theories of intelligence are discussed. The implications about possible connections between cognitive science and the study of self and personality are also discussed.

Does Emotional Intelligence Predict Scholastic Achievement in Adolescents?

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The current study examined the relationship between emotional intelligence (EI) and scholastic achievement in adolescents. Two hundred and nine secondary school students (86 males and 123 females, age's were 13.81 years (SD=1.00) for males and 13.97 years for females (SD=1.24)) each completed the Adolescent Swinburne University Emotional Intelligence Test and academic achievement data was collected for all subjects from year seven to eleven. The hypothesis that there would be a moderate, positive relationship between EI and overall scholastic grade was partially supported. Exploratory analyses found that dimensions of EI differentially predicted eight secondary school subject grades. It was concluded that the development of EI may offer educators significant opportunities to develop better scholastic performance and social and emotional competencies.

The Prediction, from Infancy, of Adult IQ and Achievement

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A sample of 66 young adults (18 to 24 years old), who were originally tested at 6 to 12 months of age on the Fagan Test of Infant Intelligence (FTII) for their ability to recognize briefly presented photos of previously unfamiliar faces were recently revisited. A current estimate of IQ was obtained from each. A measure of achievement was derived by computing the ratio of years of education attained divided by current age. The intellectual functioning of the sample at 21.9 years, (SD 1.3 years) was in the average range with a mean IQ of 106.7 (SD 14.4). The average educational level achieved was 14.2 years (SD 2.2). Information processing ability estimated during the first 6-12 months of life was predictive of adult IQ ($r = .34$ $p < .006$) and of academic achievement ($r = .25$ $p < .05$). Corrected for unreliability, these coefficients are $r = .59$ and $r = .44$, respectively. The present results support earlier studies indicating the continuity of intelligence from infancy and illustrate the validity of basic measures of information processing for the long-term prediction of achievement.

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Symposium: Life History Strategy and Mental Abilities

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Symposium Overview

This symposium includes multiple presentations that attempt to relate Life History Strategy to human mental abilities. Various different methods of measurement, including several short forms of the Ravens Progressive Matrices, the Arizona K-Factor Battery, and Covitality and Personality assessments, are attempted and compared, and various different participant populations, from University students to USA community samples to Mexican juveniles, are sampled. The basic conclusions from this corpus of work appear to be that life history traits, such as the K-Factor and Social Deviance, seem to be relatively independent of General Intelligence, however measured. Nevertheless, these same life history traits appear to be associated with neuropsychological assessments of Executive Function. The significance of these tentative conclusions is examined in this series of talks.

The first presentation by Jon Sefcek develops the measurement models for the K-Factor and the Covitality Factor and relates these measures to performance on various tests of General Intelligence. Issues in administering laborious IQ tests to volunteer college student samples are discussed. An 18-item short form of the Ravens Progressive Matrices, the RAPM-18, which was designed to minimize the problems of respondent burden, is introduced and validated. The second presentation by Kevin MacDonald presents data from another college student sample, this time utilizing short forms for measuring Life History Strategy and Covitality as well as Personality. The short form of a "Super-K" Factor so constructed is compared to performance on the RAPM-18. The third talk by Christopher Wenner measures Life History Strategy and Social Deviance in a community sample. These measures are then compared to tests of General Intelligence as well as Executive Functions, with the latter being more strongly associated with the life history traits than the former. The fourth and final talk by A.J. Figueredo compares measures of Social Deviance to those of Executive Functions in a sample of delinquent and non-delinquent Mexican adolescents. Again, a link to Executive Function was found.

Executive Function and Juvenile Delinquency: Preliminary Data

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We conducted a study of 56 delinquent and 80 non-delinquent Mexican juveniles between 11 and 15 years of age that related executive functions to social deviance. A Deviance Factor was constructed which loaded positively on antisocial behavior, self-control problems, impulsivity, and risk-taking, and loaded negatively on both susceptibility to peer pressure and future orientation, accounting for 99% of the reliable variance. Performance on two measures of executive functions correlated significantly and negatively with the Deviance Factor: the Wisconsin Card Sort (-.28) and a modified version of the Stroop Test (-.25) that emphasized set-shifting abilities. Executive functions include the abilities entailed in planning for the future, inhibiting or delaying responding, initiating behavior, and shifting between activities flexibly. The ability to set goals, plan, sequence, prioritize, organize, initiate, inhibit, pace, shift, monitor, control, and complete actions all involve executive functions.

Multiple regressions were also performed to test both group and individual differences in executive functions and social deviance. The delinquent group performed significantly lower than the non-delinquent group on both the Stroop Test (-.46) and the Wisconsin Card Sort (-.26). Older juveniles also performed significantly better on the Stroop Test (.46) than younger juveniles. However, when entered simultaneously into a single multiple regression equation after controlling for sex, age, and the between-group effects, only the Stroop Test significantly predicted the Deviance Factor, indicating that there was no incremental validity of the Wisconsin Card Sort over that of the Stroop Test in predicting individual differences. Older juveniles were also significantly higher on the Deviance Factor (.19) than younger juveniles. Not surprisingly, the delinquent group scored significantly higher than the non-delinquent group on the Deviance Factor (.40).

Web-Based IQ Tests: A Concept Whose Time Has Not Yet Come

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Web merchants have found means to sell countless products to customers willing to pay for the services. This includes IQ tests on sites such as Queendom, Tickle, and IQ TEST.
I have found no research studies in the literature relating IQ tests offered on the internet to the three fundamental principles of psychological testing (reliability, validity, and standardization). Consequently, this domain of research appears to be virgin with multiple needs for empirical inquiry. In another venue (Firmin, Hwang, Burger, & Lowrie, 2005), we assessed the three major sellers of IQ scores on the world wide web. Here, I provide a theoretical/philosophical treatment regarding moving traditional IQ testing to web milieux.

In this paper, I argue that the internet is an inappropriate venue for IQ testing. Following is the rationale. First, standardized conductions can not adequately be established. Second, there are financial motivations for web test developers to inflate IQ scores beyond what psychometrically we believe to be normal distributions. My own findings suggest that indeed for at least some web companies, this has occurred. Third, IQ testing on the web limits the administered items to non-manipulatives (e.g., no paper folding, bead stringing, block arranging, and other items often comprising "performance" items on an IQ test). Fourth, there is no opportunity for the psychologist to incorporate behavior observations into the final report. Fifth, psychology licensure and certification is relegated to state laws—not federal—presenting a particularly sticky problem for web based IQ testing conducted across state lines. Sixth, identity integrity become a problem with web based IQ testing. And finally, practice effects are an issue with web based testing as potential test takers can hop from one web based IQ test to another, becoming more skillful and test wise with each practice.

In conclusion, I do not believe that technology, per se, is the overriding difficulty with web IQ tests. That is, on grander considerations—technology is a friend of psychology. However, I argue that technology has not yet reached the stage where it is ready for IQ specific applications, given the potential problems that it brings at this time.

Correlations Among the Quick Picture Reading Test and the Shipley Institute of Living Scale with the Slosson Intelligence Test-Revised

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We examined correlations between the Quick Picture Reading Test (research edition) (QPRT), the Shipley Institute of Living Scale (research edition) (SILS), and the Slosson Intelligence Test Revised-3 (SIT-R-3). A sample of 120 participants from various age groups were administered all three measurements, and analysis was conducted via the Pearson Product-Moment Correlation Coefficient.

The coefficient levels of .52 ($p<.01$) for the correlation between the QPRT and the SIT-R-3, and .58 ($p<.01$) for the correlation between the QPRT and the Shipley vocabulary standard score indicate the QPRT may be used for simple purposes to quickly obtain a rough estimate of reading ability, rather than taking the time and money to administer an entire SILS or SIT-R-3. The correlation coefficients were not high enough to suggest that the QPRT may be used to obtain the detail and accuracy of the information gained from the SIT-R-3 and the SILS, or that these tests are in any way interchangeable.

The SILS and the SIT-R-3 may be measuring different dimensions of intelligence. The correlation between the SIT-R-3 total standard score and the Shipley vocabulary standard score was the highest of the three correlation coefficients obtained for the SIT-R-3 and the SILS, indicating that both tests may provide a measure of the verbal dimension of intelligence. The lower correlations between the standard scores for the SIT-R-3 and the abstraction and block pattern standard scores suggest that the SILS may measure several dimensions of intelligence that the SIT-R-3 does not. In sum, we conclude that while these tests are valuable screening tools for estimating intelligence, one test cannot replace the other to obtain the same information.

The Evolution of Intelligence: Symposium

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Symposium Overview

In the biological world, humans are distinguished by a large brain and unique cognitive capacities. The selection pressures that shaped these characteristics have been debated for decades. In recent years, theories in this domain have become increasingly precise and yield novel predictions that may test them. This symposium and its four talks will showcase promising views and lines of within the area, as presented by leading theorists and researchers. Papers will be presented by Kaplan, Geary, Miller, and Hill. Gangestad will lead a general discussion of these papers.

The Origin of Mind: Evolution of Brain, Cognition, and General Intelligence

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Natural selection will result in the evolution of brain, cognitive, and emotional systems that are sensitive to and process the types of information that have been correlated with survival and reproductive outcomes during the species' evolutionary history. The resources associated with these outcomes fall into three categories – social, biological, and physical – and for people compose the respective domains of folk psychology, folk biology, and folk physics. The primary dynamic that has driven and is currently driving human evolution is competition with other people and groups of other people for resource control (e.g., of other people, food, and land). In addition to the elaboration of folk-psychological systems (e.g., theory of mind), social competition results in variability in social dynamics and through this creates pressures for the elaboration of systems of brain and mind that can anticipate, mentally represent, and devise behavioral strategies to cope with these complex social dynamics. These systems create self-centered mental models that enable the simulation of the 'perfect world', a world in which other people behave in ways consistent with one's best interest, and biological and physical resources are under one's control: These mental models enable people to devise behavioral strategies to cope with the actions of others and to better compete with others for social influence and resource control. The systems that evolved to support the use of mental models are known as general fluid intelligence, working memory, and attentional control. The combination of these systems and folk knowledge is the foundation upon which human intellectual and cultural advances have been built.

Innovation, Fatal Accidents, and the Evolution of General Intelligence

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Since the 1970s, most evolutionary psychologists have conceptualized human intelligence as an aggregation of many independent, highly specific problem-solving modules, much like a Swiss army knife (Tooby & Cosmides, 1992). Some now cite the evidence for a *g* factor to argue that human intelligence is domain general. Their favored explanation for its evolution is that runaway selection for the ability to manipulate conspecifics was unleashed within groups when humans gained mastery over their external environment ("ecological dominance"; e.g., Geary, 2005). However, their explanadum is actually a postulated social or Machiavellian intelligence, which leaves *g* unexplained. I compile evidence from psychometrics, job analysis, personnel selection, accident analysis, and hunter-gatherer societies to show how external ecological forces could, in fact, have selected for *g* during the last half million years and also accelerated its selection after *Homo sapiens* emerged about 150,000 years ago.

The following facts illustrate one such mechanism that could have selected for higher *g*: (1) fatal accidents (unintentional injuries) are a major cause of death in all societies, including the most technologically primitive (e.g., the Ache, !Kung), (2) fatal accidents disproportionately kill reproductive-age individuals, usually males while engaged in provisioning-related activities, (3) preventing accidents and limiting the injury they cause is highly *g* loaded, (4) hazards are ubiquituous in daily life, myriad in kind, and low-probability killers, so they tax attentional resources while tempting neglect, and (5) the fruits of provisioning competence are widely shared within human groups, but provisioning-related injuries are not. Daily life's myriad hazards are like lightly *g*-loaded items on a very long mental test for avoiding accidental death: no single one matters much, but they cumulate over time and individuals to disproportionately cull the lower-*g* members of a group.

Most hazards are evolutionarily novel because they are by-products of human innovations. While innovations lowered *absolute* rates of mortality, the new hazards increased *g*-related *relative* risk of death from unintentional injury. Rate of selection for *g* could have accelerated (i.e., *g*-related *relative* risk of death increased) when humans began flooding their EEA with innovations (fire for cooking and hunting, weapons, tools, rafts, etc.) whose hazards could exceed the limits of normal human tolerance (crushing, piercing, poisoning, drowning, brain trauma, etc.). I describe specific mechanisms that could have accelerated selection for *g* since the speciation of *Homo sapiens*: double jeopardy, the Spearman-Brown pump, spiraling complexity, contagion of error, and the migration ratchet. The general thesis is that the most powerful ecological forces selecting for *g* were not the joint threats to survival that riveted the attention of early human groups (starvation, warfare, etc.), but the relentless parade of less obvious, less compelling threats to the survival of individuals, one by one.

Brain Imaging Studies of Intelligence: Closing in on the Neuroanatomy of Individual Differences

Organized by Dr. Richard Haier and Dr. Rex Jung

Symposium Overview

Intelligence research has accelerated recently with technological advances that allow imaging of the human brain in unprecedented structural and functional detail. This symposium includes the latest findings from studies combining psychometric and imaging methods. Dr. Haier will report new analyses (in collaboration with Roberto Colom) using the Method of Correlated Vectors to identify structural brain correlates of *g*. Dr. Robert Thoma will report on identifying brain areas related to speed of processing for tests related to intelligence. Dr. Vince Schmithorst will report a study in children showing sex differences in white matter correlates of IQ. Dr. Jung will report a study showing a sex-specific relationship between the neuro-metabolism of white matter in certain brain areas and intelligence. Dr. Con Stough will present two papers concerning the biological basis of emotional intelligence. Dr. Dr. Erin Bigler will serve as a discussant.

Genes, g, and Chaotic Home Environments

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Applied to family life, chaos refers to high levels of confusion and disorganization in the home. Chaotic home environments are associated with a range of adverse outcomes, including lower cognitive ability. It is clear, however, that not all children from chaotic homes have impaired cognitive abilities. Such variability would be observed if there were genetically-influenced individual differences in the experience of early home chaos. We sought to test this hypothesis in a nationally-representative sample of twins in England and Wales 7 (n = 4800 pairs). Parent-rated family chaos was assessed when twins were age 3 and 4 years using the Confusion, Hubbub and Order Scale (CHAOS; Matheny, Wachs, Ludwig & Philips, 1995). General cognitive ability ('g') was assessed at age 7 by a composite of four cognitive ability tests (Petrill, Rempell, Oliver & Plomin, 2002).

Quantitative genetic analyses showed that variance in 'g' at age 7 was primarily due to three latent sources: additive genetic influences (.29), shared environmental influences (.27) and non-shared environmental influences (.31). Even so, our measure of home chaos uniquely accounted for .03 of the variance in cognitive ability (95% confidence intervals: .02 -.04). There was also evidence that chaos moderated the extent to which genetic influences accounted for variance in 'g'. Total genetic variance increased as a function of higher levels of family chaos. Conversely, total shared environmental variance decreased. These findings provide evidence that (a) family chaos in early childhood is a significant predictor of individual differences in cognitive ability at age 7; and (b) latent genetic vulnerabilities interact with family chaos in the heritability of 7-year 'g'.

We conclude that poorer cognitive outcomes at age 4 may emerge when genetically vulnerable children encounter high levels of early family chaos. These findings frame hypotheses for a molecular genetics project that seeks to further clarify the relationships between genes, 7-year 'g', and chaotic home environments.

References

Matheny, A. O., Wachs, T. D., Ludwig, J. L., & Phillips, K. (1995). Bringing order out of chaos: Psychometric characteristics of the Confusion, Hubbub, and Order Scale. *Journal of Applied Developmental Psychology, 16*, 429-444.

Petrill, S.A., Rempell, J., Oliver, B., Plomin, R. (2002). Testing cognitive abilities by telephone in a sample of 6-to 8-year olds. *Intelligence, 30*, 353-360.

The Adaptive Function of High Cognitive Ability in Hunter-Gatherers: Feeding Niche or Social Complexity?

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We report results of a study that has implications for the debate over feeding-niche-complexity versus social-complexity payoffs for intelligence in human evolution. We have found, in a population of hunter-gatherers, that a composite measure of cognitive ability is positively associated with social status but not with hunting ability. The community surveyed has neither words nor phrases for either *status* or *intelligence* in their lexicon, yet their peer-assessed intelligence test scores are strongly associated with observed test scores. We also found that intelligence test scores were associated with social status though hunting ability was not.

Criteria For Studies of Race and Intelligence

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Statements about racial differences in intelligence probably draw more emotional fire than any other topic in the study of intelligence. The reason is obvious. Both within and across nations there are clear associations between racial characteristics and various measures of economic and social well-being. There are also racial and ethnic differences in performance on conventional intelligence tests. These associations could be partly due to genetically determined differences in mental competence, within the normal range. On the other hand, they could also be due to cultural and environmental factors. The three sets of variables are so confounded that it is extremely hard to separate them. The issue becomes important because interdependence between identifiably different racial-ethnic groups is becoming an increasing fact in multi-racial and integrated international concerns. Unfortunately, but perhaps inevitably, the very suggestion that there may be racial differences is, in some people's eyes, evidence that the investigator is racist. On the other hand, sloppy research, careless statements, overgeneralizations, or simplifications of findings can do harm both to society in general and, by discrediting their goals, to well planned studies of racial differences.

In this paper we review briefly what is known about racial differences in both criterion and intelligence test performance. We then consider the implications of recent genetic and physiological findings. We argue that the results are sufficiently flexible to permit many possible models of causation. Intelligence researchers simply do not know which of these models is correct. We next consider what sorts of findings are required (a) to establish racial-ethnic differences and to (b) link them into a causal network. We conclude that at present many of the links in this network are simply missing. On the other hand, conceivable future research studies may fill in the gaps in our knowledge. Until these studies are done we see no need for any "default hypothesis," regardless of whether it is a hypothesis of no difference, vast differences, or anything in between.

Relations Between National Intelligence and Indicators of National Prosperity

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The relation between human talent and national indicators of economic and social well being has become a topic of interest not only to psychologists, but to economists and political commentators as well. In 2002 Lynn and Vanhanen reported strong correlations between Gross Domestic Production per Capita (GDP/C) and estimates of national intelligence, as indicated by conventional intelligence tests (IQ). Reanalysis of this relation, using the Lynn and Vanhanen data set, have confirmed and refined their results. This is somewhat surprising, for the face validity of the Lynn and Vanhanen estimates of national IQ varies widely by country. Of the 185 reported numbers, 104 were estimates based on the other 81 observations. A variety of tests were used, the age of the respondents varied, sample sizes varied drastically from nation to nation, and in one case the estimate for one nation was based on test results from ethnically related residents in another nation! Nevertheless, a positive finding is something to be explained, not to be explained away. We present here further analyses relating the Lynn and Vanhanen estimates to estimates of student scholastic achievement, on a nationwide basis, using the PISA data base, in which the same material is presented to large national samples of 15 year old students. We also consider the relationship between the PISA data base, the Lynn-Vanhanen estimates, and several indicators of national economic and social well being. Some consideration will be given to the TIMS data base as well. Strong relationships between measures of intellectual competence and economic indicators will be shown. Competing explanations will be considered.

Sex Differences in General Cognitive Ability: A Re-examination of the Evidence

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Throughout the twentieth century, all major authorities have concurred that there is no mean difference in general cognitive ability. Most famously perhaps, on the basis of an analysis of five samples, Jensen (1998) concluded that, "no evidence was found for sex differences in the mean level of *g"*. Recently however, some dissenting voices have emerged. In particular, Lynn (1994, 1998, 1999) has challenged this consensus by proposing a developmental theory of sex differences in GCA. He maintains that before the age of 16, males and females have approximately similar IQs because of the earlier maturation of girls. From the age of 16 onwards, males demonstrate a significant advantage in IQ, which in adults reaches between 3.8 and 5 IQ points. He attributes the consensus that there is no sex difference in *g,* to a failure to note this age effect.

This paper considers a range of evidence pertaining to this issue. Two meta-analyses of the Progressive Matrices are presented: firstly, a combined sample of 80,928 comprising studies of the general population and standardization samples; secondly a sample of 20,432 based on 22 studies of students. Both samples show a pattern of sex differences in *g*, which closely approximates Lynn's predictions. Next, the claim that the observed sex difference on the Progressive Matrices is due to the well-established sex difference in visualization, is examined. The results of our factor analysis of the Standard Progressives Matrices (Lynn, Allick & Irwing, 2004), combined with Colom's IRT analysis (Abad, Colom, Rebollo & Ecorial, 2004), render such an interpretation unlikely. Finally, a number of analyses based on the WAIS or WAIS like tests are reexamined. The recent demonstration of problems with the method of correlated vectors suggests that at least two such analyses claimed to support a null sex difference demonstrate exactly the opposite.

Linking Brain Structure and Function Underlying Sex Differences in Mental Ability: A Concrete Proposal

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Recent work with the 42 mental ability tests administered to participants of the Minnesota Study of Twins Reared Apart (MISTRA) has suggested that there are important dimensions of mental ability that function independently of *g*. Two of these dimensions, rotation-verbal and focus-diffusion, appear to involve trade-offs: greater residual rotation ability implies less residual verbal ability and vice-versa, and the focus-diffusion dimension functions similarly. These dimensions also show strong sex differences. Men tend to fall closer to the rotation pole of the rotation-verbal dimension, women to the verbal pole. Men tend to fall closer to the focus pole of the focus-diffusion dimension, women to the diffusion pole. The two dimensions are basically uncorrelated.

Individuals lying at different positions along these dimensions may have brains that differ structurally and/or functionally, leading to differences in the ways they approach mental ability tasks. If so, and these dimensional differences underlie sex differences, we should expect a lack of factorial invariance in test scores across groups of men and women and across groups of individuals lying at different positions on the two dimensions, indicating that the tests do not measure the same constructs in the same ways in the different groups. I demonstrate such a lack of factorial invariance in each of the three mental ability batteries included in the MISTRA assessment. In addition, I show that the WAIS alone can be scored to correlate .7 with each of the two dimensions, making possible practical individual assessment. I propose that use of these scores may help to clarify brain-mapping studies attempting to relate brain structure and function.

Biochemical Markers of Individual Differences in Cognitive Functioning

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Background: Proton Magnetic Resonance Spectroscopy (^{1}H-MRS) is a powerful tool to assess individual differences in neurochemistry *in vivo*. Various researchers have linked N-acetylaspartate (NAA), a marker of neuronal function and viability, to cognition in both disease and health[1]. Here we examine the regional specificity of white matter neurometabolism underlying individual differences in normal brain functioning.
Methods: In a sample comprised of 27 healthy young subjects, we obtained ^{1}H-MRS measures from three white matter voxels including bilateral frontal and left occipito-parietal regions. We also obtained measures of intellectual (Wechsler Adult Intelligence Scale – III) and broad neuropsychological functioning described previously[2]. Spectra were processed automatically with LCModel, and corrected for percent tissue within each voxel.
Results: Of the three white matter regions studied, we found that a model including only left occipitoparietal white matter predicted intellectual performance [$F(1,25) = 8.65$, $P = .007$; $r2 = .26$], providing regional specificity to our previous findings of NAA–IQ relationships. Moreover, we found that a complex combination of left frontal and left occipito-parietal NAA strongly predicted performance in women, but not men [$F(2,7) = 21.84$, P b .001; adjusted $r2 = .82$].
Discussion: Our results highlight a biochemical substrate of normal intellectual performance, mediated by sex, within white matter association fibers linking posterior to frontal brain regions. These results replicate our earlier findings[2,3] within a new study sample, and highlight the importance of white matter structural and chemical integrity to intellectual performance. Moreover, they highlight the "neural efficiency" hypothesis[4] that suggests optimal brain organization underlying individual differences in cognitive processes.

1. Ross, A.J. & Sachdev, P.S. Magnetic resonance spectroscopy in cognitive research. *Brain Res Brain Res Rev* **44**, 83-102 (2004).
2. Jung, R.E. et al. Biochemical markers of cognition: a proton MR spectroscopy study of normal human brain. *Neuroreport* **10**, 3327-31 (1999b).
3. Jung, R.E. et al. Biochemical markers of intelligence: a proton MR spectroscopy study of normal human brain. *Proc R Soc Lond B Biol Sci* **266**, 1375-9 (1999a).
4. Haier, R.J. et al. Regional glucose metabolic changes after learning a complex visuospatial/motor task: a positron emission tomographic study. *Brain Res* **570**, 134-43 (1992).

Learning, Intelligence and Life History Evolution

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Human life histories, as compared to those of other primates and mammals, have at least four distinctive characteristics: an exceptionally long lifespan, an extended period of juvenile dependence, support of reproduction by older postreproductive individuals, and male support of reproduction through the provisioning of females and their offspring. Another distinctive feature of our species is a large brain, with its associated psychological attributes: increased capacities for learning, cognition, and insight. I discuss a theory that unites and organizes these observations and generates many theoretical and empirical predictions. I present some tests of those predictions and outline new predictions that can be tested in future research.

Sex Differences in the Raven's Advanced Progressive Matrices

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The RAPM is generally considered as a paradigmatic measure of Gf or fluid cognition. The received view based on numerous studies is that there are no substantial sex differences in performance on the RAPM. However, the overall score of the RAPM may not reflect differences in specific cognitive processes or rules needed to solve the individual items. Carpenter, Just & Schell (1990) have identified five such rules and it has been recently proposed that there are sex differences in the use of these rules, but these differences become balanced and hence disappear in the overall score. In this study based on a sample of approximately 1500 mostly high ability subjects we test the hypothesis that there are sex differences in the specific rules.

The Evolution of General Intelligence in the Primate Clade

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Many cognitive scientists and evolutionary psychologists have adopted as their guiding paradigm the proposition that the mind is a bundle of "software" modules that have each been independently optimized for some narrow domain (face recognition, universal grammar, "cheater detection," or what have you). This view has proven fruitful, and it must surely play a large role in any comparative account of mental abilities. This paper proposes, however, that a truly complete account may also have to accommodate a construct of *general* mental ability accounting for differences among taxa. Such a domain-general ability is not incompatible with the notion of modules dedicated to specific tasks. Computers provide an enlightening analogy. A computer with a faster CPU or more RAM than another computer will run every program more efficiently, but qualitative differences may arise if different programs are installed on each machine.

This paper proposes that in the primate lineage leading to *Homo sapiens* there has been selection for precisely this kind of "hardware" capacity permitting adaptive behavior across a range of domains. Johnson, Deaner, and van Schaik (2002) reviewed several experiments testing the performance of different primate genera in various cognitive tasks (reversal learning, the "patterned string" problem, etc.) and found a good fit to a model where the different genera differ along a *single dimension* of domain-general mental ability. The fit is so good, in fact, that a model allowing for *only* a general ability and assuming no genus-task specificity barely changes the rank order of the genera from a model that does allow such specificities.

Brain size data on sixteen of the twenty-five genera reviewed in Johnson et al. (2002) are given in Jerison (1973). The Spearman rank-order correlation between raw brain weight and general mental ability is 0.7653 (p=0.000549). The rank-order correlation between N_c (a measure that takes body size into account) and mental ability is 0.6396 (p=0.006916). It is noteworthy that brain size is the most prominent physiological correlate of g, the construct that accounts for differences in mental ability *within* the human species.

A distinct phylogenetic pattern emerges from the rank orders of mental ability and brain size. The more recently a genus shares a common ancestor with man, the higher its rank in both variables tends to be. This pattern coincides with the pattern of molecular evolution elucidated in a serious of papers by Bruce Lahn and his colleagues (for a review, see Evans et al., 2004). Genes known to code for some aspect of brain development show a much higher ratio of nonsynonymous to synonymous mutations in primates relative to rodents. Moreover, the magnitude of this ratio shows a correlation with the recency of common ancestry with man.

Taken as a whole, this data provides tantalizing suggestions as to a generality of g even wider than has supposed by differential psychologists. It may turn out that a deep understanding of g will not prove possible without connecting this construct to the broad sweep of evolutionary history.

Using Measures of Basic Cognitive Capacities to Identify Individuals with Exceptional Levels of Intelligence

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Measures of basic cognitive capacities (BCC), such as those of processing speed and working memory, were found to effectively distinguish children with mild mental retardation (MMR) from their age peers without MMR in a large scale study (Luo et al., 2005). Findings from the same study also indicate that children with MMR can be further classified into two subtypes, with some of them seriously deficient in both processing speed and working memory and others deficient only in working memory. These results raise the question whether deficiencies in the same BCC could also effectively identify adults with MMR, and whether the same subtypes of MMR exist in the adult group. Moreover, the findings also bring about the possibility of using measures of BCC to classify individuals with other exceptional levels (very low or very high) of intelligence. In the present study, data from the concurrent normative sample (N = 1250) of the Wechsler Adult Intelligence Scale-III and the Wechsler Memory Scale-III were analyzed to clarify these questions. Exceptional groups defined by several IQ cut-off points (≤ MMR level, ≤ 85, > 115, > 130), together with the lower and upper halves of the sample divided by the 100 IQ point, were predicted in logistic regression models using measures of processing speed and working memory. Classification results and the receiver operating characteristic (ROC) curves resultant from the models indicated a very strong discriminative power of BCC measures for the identification of individuals with MMR levels of intelligence, and the same two subtypes of MMR observed among children were also evident among adults. The discriminative power of BCC measures was also strong at higher levels of intelligence, although there was a notable decrease in the power at higher IQ cut-off points. The area under the ROC curve representing the probability of correct classification was 0.98 at the MMR cut-off, whereas that at the opposite extreme (IQ > 130) was 0.94. Theoretical curves based on the binary normal distribution assumption were fitted to the observed areas under the empirical ROC curves to gauge the varying strength of correlation between the BCC measures and IQ at the chosen IQ cut-offs. The correlation between the measures of BCC and IQ projected by the theoretical curve was 0.90 around the MMR cut-off, near the upper limit allowed by the measurement reliability of the BCC composite (0.92). The projected correlations decreased at the higher IQ cut-offs, with the correlation projected to be 0.75 at the 130 cut-off. The variation in the strength of correlation with different levels of intelligence seems to be consistent with what Spearman termed as "the law of diminishing returns", but other explanations for the variation are also possible.

Intelligence and Life History Strategy: A Replication Using Short Form Measures

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We sampled 96 undergraduate students at state university in Southern California to constructively replicate the MIDUS K-Factor results. In our secondary analysis of the MIDUS data, presented last year at ISIR, the K-Factor, the Covitality factor, and the general Personality factor were found to be significantly correlated with each other, supporting the hypothesis that a high-K life history strategy predicted high somatic effort and was also manifested in the behavioral display of sexually selected mental traits. Thus, a single higher-order common factor, the "Super-K" Factor, was constructed that included the K-Factor, the Covitality factor, and the general Personality factor.

We used the short-form "Mini-K" to substitute for the full battery of indicators used to measure the K-Factor, Rand SF-36 Short Form Health Survey to substitute for the Covitality Factor, and Ten-Item Personality Inventory (TIPI) to substitute for the general Personality Factor. To help validate the TIPI, we used the Interpersonal Adjective Scales - Big Five Version (IASR-B5) to provide an alternative measure of the Big Five Personality factors. Simple unit-weighting was used to construct the theoretically-specified common factors. The general factor constructed from the IASR-B5 correlated .76 ($p<.0001$) with the general personality factor constructed from the TIPI. The short-form "Super-K" Factor constructed loaded .78 ($p<.0001$) on the Mini-K, .76 ($p<.0001$) on the SF-36, and .81 ($p<.0001$) on the TIPI.

The 18-item short form of the Ravens Progressive Matrices (RAPM-18) was also administered to this sample, and was found to have an internal consistency reliability of .82. However, the RAPM-18 did not correlate significantly with either the Mini-K short form or the short form of the "Super-K" Factor constructed. This same null result was obtained when respondents were disaggregated by whether or not English was their native language. This essentially replicates Sefcek et al.'s (2005) findings that Life History Strategy does not appear to correlate significantly with General Intelligence.

Secondary Analyses of National and Clinical Databases: New Research Opportunities for ISIR Scholars and Students

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The secondary analyses of published correlation matrices and/or large national databases have resulted in significant contributions to our understanding of human intelligence. The purpose of this informational presentation is to acquaint ISIR scholars with research datasets that are now available for secondary analyses. Participants will become familiar with research datasets available from the Woodcock-Muñoz Foundation (WMF), a private, non-profit operating foundation that supports the advancement of contemporary intelligence theory and assessment. WMF research programs are intended to facilitate the bridge between contemporary intelligence theory and applied intellectual assessment practices. ISIR scholars and students will be provided an overview of three broad categories of data resources, as well as a means for requesting access to these data.

The Human Cognitive Abilities Project (HCA) is intended to facilitate the investigation of the structure and organization of human cognitive abilities via secondary analysis of historical and contemporary data sets. The WMF HCA project supports internal and external programs of research using the *original datasets associated with Carroll's 1993 seminal work*, as well as emerging contemporary datasets. The primary goals of the HCA project are to (a) electronically archive, document, and make accessible the 460+ data sets used in Carroll's factor analytic review, (b) extend Carroll's factor analytic work vis-à-vis the supplementing of Carroll's (largely pre-1985) data sets with additional contemporary data sets, and (c) facilitate the development and implementation of plans for a retrospective re-analysis of the data sets analyzed by Carroll with contemporary statistical methods (e.g., confirmatory factor analysis) and prospective analysis of contemporary (post 1985) datasets.

The Clinical Data Base Project (CDB): The WMF Clinical Data Base (CDB) is an ongoing and expanding data collection project designed to facilitate research that will contribute to a better understanding of the neuropsychological and cognitive basis of a variety of diagnosed cognitive, learning, and mental exceptionalities. The CDB (current n = 2000+) includes detailed subject demographic and diagnostic information (based on the W*HO ICD DX* system). Specific cognitive ability measures include: general intellectual ability, long-term retrieval, short-term/working memory, comprehension-knowledge, fluid reasoning, cognitive processing speed, auditory and visual-spatial processing, attention, listening, learning efficiency, word finding/verbal retrieval, and aspects of executive functioning. Specific achievement abilities include: reading, mathematics, written language, and knowledge. The sensory and motor battery includes tests that evaluate simple and complex visual, auditory, and tactile perception, and gross and fine motor functioning.

Research Grants Program (RGP): The WMF provides a mechanism for researchers to request access to three editions of the nationally standardized *Woodcock-Johnson* Battery of tests for research purposes. Comprehensive cognitive/achievement variables and subject demographic information, from the preschool to geriatric ages, are available from the original 1997 *WJ* (n=4,730), the 1989 *WJ-R* revision (n=6,359), and the 2001 *WJ III* (n=8,818). The cognitive portion of WJ-R and WJ III are organized as per contemporary Cattell-Horn-Carroll (CHC aka *Gf-Gc*) theory.

Mutual Mate Choice for Intelligence as a Fitness Indicator

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Both human sexes favor sexual partners who show high fitness (high genetic quality, low mutation load), as advertised through fitness-indicators such as facial attractiveness, body symmetry, social status, and general intelligence. Such mutual mate choice may have super-charged the evolution of human intelligence, driving it to higher levels than ecological and social selection pressures alone would have favored. In this talk I'll briefly outline this fitness indicator theory, and review some relevant old and new data, including evidence that (1) recurrent harmful mutations help explain persistent genetic variance in the *g* factor, (2) more *g*-loaded cognitive tasks correlate more positively with body symmetry, a known fitness index, (3) women near peak fertility, just before ovulation, show stronger preferences for creativity, sense of humor, and general intelligence, suggesting that they perceive these traits (unconsciously) as good genes indicators. Also, this mutual choice model better explains the fact that males show equal mean intelligence (due to sex-equal mutation loads), but higher variance (due to higher male reproductive skew and sexual competition). By contrast, almost all socio-ecological models of intelligence evolution (e.g. through social competition, ecological dominance, or hunting) would predict that intelligence should show (1) higher male mean scores, (2) no *g* factor across diverse cognitive abilities, (3) low phenotypic and genetic variance, (4) low heritability, (5) low correlations with body symmetry and other fitness indicators, (6) low sexual attractiveness, and (6) no ovulatory cycle effects on female preferences for it.

Neuroscientific Explorations of Human Intelligence and Related Constructs

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Individual differences in human cognitive ability are among the psychology topics with the longest research tradition. Since the early accounts by Galton, Spearman, Binet and others major breakthroughs have been attained regarding the *description* (i.e. the structure and the assessment) of human psychometric intelligence. With very few exceptions, however, it was not before the mid 1960s that attempts to *explain* individual differences in intelligence have been launched. These attempts came in three forms: 1. Elementary cognitive approaches, which led researchers to conclude that speed of processing and working memory capacity form the cognitive basis of individual differences in intelligence; 2. behavior genetic research showing a substantial genetic influence especially with increasing age; 3. neurophysiological and neurobiological approaches to human intelligence, which are the focus of this lecture. After a short outline of the early ERP approaches to intelligence the lecture shall elaborate on three aspects: I. brain mapping studies of intelligence-related individual differences in brain activation patterns. II. hypotheses and empirical findings on intelligence-related individual differences in brain structure. III. neuroscientific explorations of other (partially intelligence-related) performance constructs in psychology, viz. talent and giftedness, creativity, and expertise. On the basis of these three explorations a perspective towards a broad physiological theory of human performance shall be developed.

Race Difference in General Intelligence *g* in Relation to Blood Pressure, Body Proportions, Hormones, and Personality: A Cross-Sectional Study of 4,000+ White, Hispanic, and Black Middle-Aged Males

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Experts disagree about whether the well-established race differences in IQ or general intelligence *g* are due to still unidentified genes or environmental factor X. This study examines a recent alternative hypothesis (Robbins et al., 2005) that higher black blood pressure (BP) explains part of the white-black *g* difference and that hypertension medication will reduce the gap. We also included a sample of Hispanics to see whether the hypothesis generalises cross-racially. Data on 3,649 white, 200 hispanic, and 523 black middle-aged veterans came from the Vietnam Experience Study (VES: Centers for Disease Control, 1986). We first factored *g* out of a battery of 19 highly diverse tests and presented descriptive statistics of race differences in *g*, standard BP measures, body proportions, various endocrine measures and Eysenckian personality factors. We then applied various statistics to study linear and non-linear relationships among *g,* BP, endocrine and personality.

Systolic BP shows low correlations with young *g*, old *g*, or overall *g* (0.0 – -0.04) for whites and blacks, and not at all for Hispanics. Diastolic BP correlated -.04 with white *g*, -.14 with black *g,* and again not with Hispanic *g*. Psychoticism was the only personality factor that correlated with BP and then only for diastolic BP in blacks (0.11). Body height is a weak predictor for BP except for systolic BP in Hispanics, but weight correlates about .4 with BP for all races. Serum Testosterone and High Density Lipoprotein Cholesterol (HDL-C) relate negatively to BP whereas Total Cholesterol and Cortisol relate positively to BP in some or all races. Finally, regression analysis suggests that black subjects are six times less sensitive to changes in HDL-C than white subjects, implying that medical HDL reducing treatment is less effective for black than white subjects. These results provide basis for questioning the hypothesis that any significant part of the white-black gap in *g* can be explained by white-black differences in BP, and further the notion that proper treatment for high black blood pressure will reduce the *g* gap. Conversely, we believe that untreated higher black BP will increase the white-black *g* gap in old age.

Intelligence and Mate Choice

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The role that intelligence plays in human mate choice was examined. A large amount of research indicates that intelligence is an important criterion when selecting for a potential partner, and this preference varies both between sexes, with women valuing it more than men, and according to which mating strategy, long-term vs. short-term, one adopts. The question that remains to be answered is *why* such a preference has evolved. Most research has assumed that intelligence functions to indicate direct parental investment and resource acquisition, especially in males. However, there is also a possibility that intelligence functions to indicate indirect "good genes" benefits apart from any direct payoffs. In order to assess the plausibility of both mechanisms, this study examined five empirical questions: 1) How accurate are women at assessing intelligence given only brief exposure?, 2) How important is intelligence in a potential long-term mate?, 3) How important is intelligence in a short-term mate?, 4) Does female conception risk influence either the accuracy of assessing intelligence or the preference for intelligence?, and 5) Does the degree of female intelligence influence the accuracy of assessing intelligence or the preference for intelligence? Male behavioral data was collected using video-recordings, and women then made various assessments based on relative male performance. Menstrual cycle data and objective intelligence measures were also collected. Potential implications for the evolution of human intelligence via sexual selection are discussed.

Possible Organizational Effects of Early Androgens on Human Spatial Ability: Meta-Analyses of CAH and Digit Ratio Studies

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Hormonal manipulations indicate that early androgens organize sex differences in spatial ability in animal models. In humans, spatial ability is also sexually dimorphic, and information about the effects of prenatal androgens on spatial ability can be obtained from studies of congenital adrenal hyperplasia (CAH) and the ratio of the second and fourth finger lengths (2D:4D). CAH is a condition characterized by prenatal overproduction of adrenal androgens, and several lines of evidence suggest that 2D:4D reflects prenatal androgen exposure. Some studies have found that these proxy measures of prenatal androgenization predict spatial ability, others have found no significant relationship, and yet others have obtained results in opposite directions. In light of these mixed findings, we conducted meta-analyses of published literature and unpublished results to determine if, across studies, either of these indications of prenatal androgens significantly predicts spatial ability. We conducted meta-analyses on effect sizes using both fixed and random effects models. In addition, we applied a trim and fill analysis to the data in search of asymmetry that might be an indication of publication bias. Results indicate that (1) females with CAH have better spatial abilities than control females, (2) males with CAH have worse spatial abilities than controls, and (3) there is probably little or no correlation between digit ratio and spatial ability in either sex. Implications of these results for understanding the relationship between early androgens and spatial ability are discussed.

A Test of Spearman's Law of Diminishing Returns in the Kaufman Assessment Battery for Children, Second Edition

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According to Spearman's "law of diminishing returns," positive correlations among cognitive ability tests are higher in low ability groups versus high ability groups. Raw data from the Kaufman Assessment Battery for Children, Second Edition standardization sample were studied to determine if the phenomenon is present in this intelligence battery. The sample used in this study included 2175 participants ranging from 7 to 18 years in age. The sample was split into two groups: One group included individuals who had a Fluid-Crystallized Index (FCI) of 100 or below (low IQ group) and a second group included those who had a FCI of above 100 (high IQ group). The FCI is comparable to a Full Scale IQ score.

Principal component analyses were used to replicate a previous study of the Wechsler Intelligence Scale for Children, Revised (Jensen, 2003). Confirmatory factor analyses using nested factor models were used to answer questions related to the changes in factor variances, subtest loadings on the *g* factor, and intercorrelations among broad ability factors.

Results from the PCAs indicated that the law of diminishing returns was present in the KABC-II, although it was not produced uniformly across the subtests. Results from the CFAs indicated that higher *g* is associated with lower *g* variance, a depression of subtests' g loadings, and lower intercorrelations between the broad ability factors.

The law of diminishing returns was present in the KABC-II*: g* appears less general and more differentiated in a high IQ group compared to a low IQ group. This phenomenon was not produced uniformly across subtests, but it was also not produced *only* by the subtests with the weakest *g* loadings

Jensen, A. R. (2003). Regularities in Spearman's Law of Diminishing Returns. *Intelligence, 31*, 95-105.

Sex Differences in Associations of Brain Anatomical and Functional Connectivity with IQ in Children

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Recent research (1, 2) has provided evidence for disparities between the sexes in terms of the neuroanatomical bases for general intelligence in adults. We present some recent results from MRI studies supporting this hypothesis in children. In a functional MRI (fMRI) study involving a silent verb-generation paradigm (3), both boys and girls displayed associations of task-related cortical activity with IQ in brain regions in the left hemisphere including the precuneus, medial temporal gyrus, Broca's area, cingulate gyrus, and medial frontal gyrus. However, the functional connectivity between these regions, measured as a weighted sum of pairwise covariances between fMRI time courses, displayed a significant age-X-gender-X-IQ interaction. There was a positive association of functional connectivity with IQ in older girls (ages > 13 years), but not older boys (ages > 9 years); and in younger boys (ages < 9 years) but not in younger girls (ages < 13 years). The transitional age appears to be older in girls (around 13 years) than in boys (around 8-9 years) for age-related changes in associations of functional connectivity with IQ.

A previous diffusion tensor imaging (DTI) study has also shown correlations of white matter organization, as measured by fractional anisotropy (FA), with intelligence in white matter association areas, including frontal and occipito-parietal areas (4). The study population however was heavily weighted toward girls (N = 47; 34 F, 13 M). We present preliminary results from a more recent DTI study with a more balanced study population. FA in frontal regions displayed a significant gender-X-IQ interaction, and was significantly associated with IQ in girls but not in boys. FA in occipito-parietal areas, however, was significantly associated with IQ in both girls and boys. The FA in the left arcuate fasciculus was significantly associated with IQ in girls (all ages), but only in older boys (> 13 years).

These results indicate that brain maturational processes such as gray matter pruning and white matter organization may have different developmental trajectories in boys and girls and disparate associations with intelligence and cognitive function.

1. Haier RJ, Jung RE, Yeo, RA, Head K, Alkire MT. The neuroanatomy of general intelligence: sex matters. Neuroimage 2005;25(1):320-7.
2. Jung RE, Haier RJ, Yeo RA, Rowland LM, Petropoulos H, Levine AS, et al. Sex differences in N-acetylaspartate correlates of general intelligence: an 1H-MRS study of normal human brain. Neuroimage 2005;26(3):965-72.
3. Holland SK, Plante E, Weber Byars A, Strawsburg RH, Schmithorst VJ, Ball WS, Jr. Normal fMRI Brain Activation Patterns in Children Performing a Verb Generation Task. Neuroimage 2001;14(4):837-43.
4. Schmithorst VJ, Wilke M, Dardzinski BJ, Holland SK. Cognitive Functions Correlate with White Matter Architecture in a Normal Pediatric Population: A Diffusion Tensor MR Imaging Study. Human Brain Mapping 2005: In Press.

General Intelligence, Life-History, and Covitality: A Test of Evolutionary Hypotheses

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Recent adaptationist accounts of human mental and physical health have spurred-on the debate over the evolution of human intelligence. Two of the major competing accounts, Rushton's (1995) life-history model and Miller's (2000) fitness indicator model have each argued for different adaptive pressures as the impetus for the development of intelligence. Rushton's Differential-K theory (K) proposes that novel environments, such as the colder climates of Europe and Asia, drove the evolution of a variety of mechanisms in which to solve an ever-increasing array of new adaptive problems. These mechanisms working together are thought to develop a coherent life-history strategy that incorporates high parental investment, longevity, and physical and mental health within stable environments, while the opposite (low parental investment, short life-span, and lower-level health and cognitive functioning) is thought to develop in unstable environments. Miller's perspective describes intelligence as one of many sexual signals, or fitness displays, along with physical and mental health (denoted here as "Covitality"). Similar to a peacock's tail these signals have been described as indicators of underlying genetic quality.

In the tradition of strong inference, the current two studies utilizing undergraduate students from Southern Arizona were developed to determine which hypothesis better accounts for general intelligence, or '*g*'. Study 1 ($N = 132$) used theoretically derived unit-weighted factors to examine the relationships among K, measured by the Arizona K-battery (see Figueredo et al., 2005); *g* (measured by the Ravens Standard Progressive Matrices, Mill-Hill vocabulary scale, and Shipley Institute of Living Scale); and a variety of general physical and mental health measures. Due to testing limitations identified in the first study, the second study ($N = 192$) developed an 18-item short form of the Ravens Advanced Progressive Matrices (RAPM-18). Reliability of this scale was moderately high $r = .73$, outperforming other short-version scales of the Ravens. Across all studies, no significant relationships were found between *g* and either K or Covitality (for all, $r \geq -.08$, $p \geq .25$), while K and Covitality were significantly related to each other ($r \geq .30$, $p \leq .001$). These results suggest that while physical and mental health may be indicators of life-history, intelligence is not accounted for by either K or Covitality.

Brain Cortical Electrical Activity Associated with Emotional Intelligence

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Previous research has outlined a theoretical basis for EI as well as significant empirical relationships relating to important outcome variables such as leadership, satisfaction with life and other life related criteria. However, little is known about the biological basis of this construct. An exploratory study was performed to investigate whether a biological basis of EI could be established. EEG from 24 participants aged between 18 and 44 (M=24.79, SD=6.08), was recorded whilst completing an ability based computerized EI task. Participants also completed the self-report Swinburne University Emotional Intelligence Test (SUEIT). Participants were separated into a high and low EI groups based on their scores on the SUEIT. The topographical distribution of brain activity for the two groups demonstrated differences in both EEG spectra and Alpha coherence.

Magnetic Resonance Imaging (MRI) Relating to Differences in Personality, Cognitive Ability (IQ) and Emotional Intelligence

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The aim of this pilot study is to investigate the relationship between general intelligence, emotional intelligence, and brain structure. In this pilot study we report the first 20 participants in a larger study assessing Magnetic Resonance Imaging (MRI) differences related to personality, performance on the Raven Progressive Matrices and the Mayer, Salovey, Caruso Emotional Intelligence Test (MSCEIT).

Because it is non-invasive and without significant risk, magnetic resonance Imaging (MRI) and Magnetic Resonance Spectroscopy (MRS) permits *in vivo* quantitative measurements of brain structure and connectivity. Proton magnetic resonance spectroscopy (MRS) is a powerful new research technique for the non-invasive functional study of the biochemistry of the brain, able to detect the metabolites myoinositol (MI), N-acetyl aspartate (NAA), Choline (Cl) and Creatine (Cr). Specific predictions were that Higher scores on the emotional intelligence measure will positively correlate with greater volume and higher neural connectivity within the limbic system. Higher scores on general intelligence would positively correlate with total cerebral volume, the volume of frontal, prefrontal and parietal regions and with the number of neural connections within the brain. Higher scores on general intelligence would also correlate with higher levels of choline in frontal cerebral areas.

Score Gains on g-Loaded Tests: No *g*

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IQ scores provide the best predictor of success in education, job training, and work. However, there are many ways in which IQ scores can be increased, for instance by means of retesting or participation in learning potential training programs. What is the nature of these score gains? Jensen (1998) argued that the effects of cognitive interventions on abilities can be explained in terms of Carroll's three-stratum hierarchical factor model. We tested his hypothesis using test-retest data from various Dutch and American test batteries and learning potential data from South-Africa using Raven's Progressive Matrices. The results from the various studies showed that: (1) there are small or even negative correlations between score gains and the *g* loadedness of the scores, (2) the *g* loadedness of scores decreases after the intervention training, (3) the score gains are largely on test specificities and narrow abilities, and (4) the intervention training leading to score gains is not *g* loaded.

Our results support Jensen's hypothesis. The generalizability of test scores resides predominantly in the *g* component, while the test specificity component and the narrow ability component are virtually non-generalizable. As the score gains are not related to *g*, the generalizable *g* component decreases, the non-generalizable test specificity and narrow ability components increase, and the training itself is not *g* loaded it is easy to understand why the score gains did not generalize to scores on other cognitive tests and to *g*-loaded external criteria. Reeve and Lam (2005) claim that retesting does not change the nature of what is being tested, but our findings show the opposite.

Ceci (1991) has shown that increased schooling leads to higher IQ scores, but are these gains hollow or predominantly generalizable? Our results argue for the former. It may be that rather than psychological or educational interventions, biological interventions (such as diet, vitamin supplements, vaccination against infectious disease) provide the most cost effective method of producing true changes in cognitive ability, especially for those in deprived environments.

Investigating the Cortical Temporal Dynamics of the Speed-Intelligence Relationship Using Magnetoencephalography (MEG)

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In computers, faster processing speed allows for increased computational capacity. In humans, faster reaction time (RT) is correlated with intelligence, and high speed on RT tasks is thought to reflect an underlying biological substrate for high intelligence (1).). Recent research in our lab used magnetoencephalography (MEG; 2) to assess neural timing during (a) a choice RT task on which RT was negatively correlated with scores on the Raven's Advanced Matrices Test, and (b) a control, simple RT task. Source dipole analysis showed that the time most closely related to fluid intelligence lies between dipole latencies associated with sensory processing and motor preparation--time presumably most critical for the integration of multi-modal information and for response selection (3).). L2 minimum norm (Freesurfer) analysis showed that cortical regions most active during the integration period include bilateral inferior frontal gyri, middle frontal gyri, anterior cingulate cortex, anterior temporal cortex and nearby insular cortex. Activity in these regions, associated with higher order cognitive processes such as attentional control and response selection, suggests that the ability to make a rapid "choice" in a choice RT task may be a small but representative sample of intelligent behavior.

(1) Jensen, A.R. (1998). *The g Factor*. Jaeger: Westport, CT.
(2) Orrison, W.W., Lewine, J.D., Sanders, J.A. & Hartshorne, M.F. (1995). *Functional Brain Imaging*. St. Louis: Mosby.
(3) Thoma, R.J., Yeo, R.A., Gangestad, S., Davis, J., Paulson, K.M., Halgren, E. & Lewine, J.D. (in preparation). Neural dynamics of the Speed-Intelligence Relationship and the Effect of Developmental Instability. Manuscript in preparation for Brain *Research: Cognitive Brain Research*.

Creative Accomplishments Covary With Ability Even Among the Top 1%

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In a recent letter published in *Science* and signed by 79 individuals, most of whom were academics or academic administrators, it is stated that "there is little evidence that those scoring at the very top of the range in standardized tests are likely to have more successful careers in the sciences" (Muller et al., 2005, p. 1043). In this study, the creative achievements of three cohorts of intellectually talented participants identified before age 13, and tracked into their mid 30s (N > 2, 500), are used to evaluate this supposition empirically (over criteria ranging from earning a math-science PhD, securing a patent, and achieving tenure at a top 50 U.S. university). When modeling creativity or the development of scientific expertise, these findings underscore the importance of assessing individual differences within the top 1% of ability (which constitutes one third of the ability range). They also falsify the "ability threshold hypothesis" (viz., the idea that beyond a certain ability level, more ability does not matter).

Spatial Ability: A Neglected Dimension in Talent Searches for Intellectually Precocious Youth

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Mathematical and verbal abilities have been considered in talent searches and educational programming for intellectually talented youth for more than three decades; however, although the relevance of spatial ability has been observed in a variety of educational and vocational choices and outcomes for older populations, its importance in talent development for intellectually gifted youth has only recently begun to be appreciated. Because spatially gifted students have not been identified or studied extensively, our educational system may not be prepared to meet their unique educational needs. Efforts combining ability and preference dimensions have augmented our understanding of the development of mathematically or verbally gifted adolescents; therefore, this more integrative approach was utilized here.

The preference profiles of adolescents with high spatial abilities exhibited many of the same characteristics as the profiles of same-sex MSE graduate students, including high theoretical values and interests in science and math, suggesting that spatially gifted students might constitute an untapped pool of future scientific talent. Next, a series of discriminant function analyses (DFA) used spatial ability and preferences (either values or interests) to predict criterion group membership (in science-math, humanities, or other categories) along a series of 5-year longitudinally assessed developmental choices. Sample sizes varied (due to item missingness) from 443 to 547 (228-281 males, 215-266 females). Within each DFA, a strong and consistent first function emerged, which exhibited high correlations with spatial ability, and theoretical and reversed social preferences. Finally, a parallel set of DFAs utilized preferences and markers of three specific abilities (mathematical, verbal, and spatial) for a subset of participants. Because the sample size was limited, these analyses were combined across sex; sample sizes varied from 159 to 211. A robust function emerged, similar to those found earlier, with positive correlations with spatial and mathematical abilities, and theoretical and reversed social preferences. This cluster of traits, in place in early adolescence, repeatedly demonstrated its relevance to math- and science-related pursuits, readily distinguishing science-math criterion groups from humanities and other groups. The findings documented here have both scientific and applied implications: They enhance our understanding of the nature of intellectual talent, and they also can be used to inform the design of appropriate educational opportunities for spatially gifted students.

Profiling Approaches to Life and Employment (PALE)

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The PALE project is conducted in collaboration with the Tucson branch of the Department of Labor's Job Corps program, which is designed to help young people develop employment skills. Our extant pilot work includes complete data on N = 37 participants, approximately half were female, and ages ranged from 18 to 27 years.

Life History Strategy was measured with the Mini-K Short Form, Multi-dimensional Measure of Work Ethic, Mate Value Inventory, Hopkins Symptom Checklist (general health), and Impulse Control Questionnaire; Social Deviance was measured with the Delinquency Short Form (D-20), Life Experiences Questionnaire-Revised, Drug Abuse Screening Test -10, Mating Effort Scale, Lilienfeld Psychopathy Scale, Self-Monitoring, and Impulsive Behaviors Questionnaire; General intelligence (*g*) was measured with the Shipley Institute of Living Scale, Verbal and Abstraction; and Executive Functions were measured with the Rey-Osterreith Complex Figure Test, Trail-Making B, and the Delayed Route from the Rivermead Behavioral Memory Test, Extended Version.

Simple unit-weighting was used to construct the theoretically-specified common factors. We constructed a strong Life History Factor, with loadings ranging from .53 to .76, and a strong Deviance factor, with loadings ranging from .51 to .78. We also constructed an Executive Functions factor, with loadings ranging from .39 to .71. Further, the Abstraction and Verbal components of the Shipley were each correlated .88 with their own common factor. Surprisingly, bivariate correlations strongly indicate no relationship between *g* and Life History, *g* and Deviance, and Deviance and Life History. However, the Executive Functions Factor was moderately correlated with the Life History Factor (r =.32, p < .056), but not with the General Intelligence (r = -.07, p < .69) or with the Deviance Factor (r =.06, p < .73).

These preliminary data suggest that Executive Functions, rather than General Intelligence, may be a critical mediator between Life History Strategies and social behaviors.

IQ & Wealth of Nations: Prediction of National Wealth

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In their book, *IQ and the Wealth of Nations*, Lynn and Vanhanen (2002) proposed the hypothesis that "the intelligence of the populations has been a major factor responsible for the national differences in economic growth and for the gap in per capita income between rich and poor nations." (p. xv). Throughout the book, they show that there are large differences in intelligence among nations and that these differences are causally related to economic prosperity. To test their hypothesis empirically, they computed the correlations between national IQ and real gross domestic product per capita (1998). They then regressed national income in 1998 on IQs using a linear model and accounted for 38 percent of the variance. They also investigated additional variables that added to the prediction of national wealth, such as economic freedom and index of democracy and showed that these other variables also contributed to national wealth.

Last year, McDaniel and Whetzel (2004) responded to questions raised about the accuracy of Lynn and Vanhanen's conclusions due to the limited data available to estimate national mean IQ (Ervik, 2003; Volken 2003), particularly for the non-industrial nations and African countries which typically fell at the lower end of the IQ distribution. Specifically, they set all IQ values below 90 to equal 90 and they trichotomized the IQ distribution. These analyses showed that even very imprecise estimates of IQ are excellent predictors of real gross domestic product per capita. In addition, their analyses showed that a non-linear equation explained more variance in GDP than the linear model.

This paper adds to the previous contribution by using recent data on national wealth, government issues (economic freedom, level of democracy), education issues (amount spent on public education by the government per student and average years of schooling of adults), health issues (health spending per capita and life expectancy), and oil produced per capita. Specifically, using updated data, we

- replicated Lynn and Vanhannan's original findings using IQ, economic freedom and democracy to predict GDP,
- quantified the variable oil production and found small incremental prediction beyond IQ and economic freedom,
- replicated McDaniel and Whetzel's findings about the curvilinear relationship between the IQ and GDP and that even imprecise estimates of IQ lead to high levels of prediction of GDP,
- expanded the predictor set to include education spending per student and health spending per capita and found that educational spending provides no incremental prediction of GDP beyond IQ, and that health spending does provide prediction of GDP beyond IQ,
- examined the set of the highest predictors of GDP and found that economic freedom, health spending per capita and IQ explained 90% of the variance in national wealth.

Flynn Effect in the Woodcock-Johnson Cognitive Ability and Achievement Tests 1976-1999

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There has been an extensive debate concerning the nature, causes, and implications of the secular increase of scores on cognitive ability tests (i.e., the Flynn Effect). The aim of this study is to compare the scores on unaltered subtests across the US standardization samples of the Woodcock-Johnson (WJ; Woodcock & Johnson, 1977), the Woodcock-Johnson-R (WJ-R; Woodcock & Johnson, 1989) and the Woodcock-Johnson-III (WJ-III; Woodcock, McGrew, & Mather, 2001). Structural equation modeling with mean structure is employed to shed light on the precise nature of the trend in scores on both the cognitive ability and achievement tests. In addition, with tests of measurement invariance (i.e., the absence of measurement bias) with respect to cohorts and periods, it is investigated whether score gains could be attributed to latent increases in ability or to measurement artifacts such as heightened test sophistication. Moreover, we consider trends over time with age held constant (e.g., 30-40 year-olds in 1976 vs. 2000), as well as differences between cohorts (e.g., those born in the 1950s vs. those born in the 1960s). Disentangling cohort effects from time-of-measurement effects may contribute to our understanding of the Flynn Effect, because the causes of these two types of effects are different. For instance, hypotheses concerning the effects of nutrition, family size, and heterosis are related only to cohorts, whereas most hypotheses concerning test artifacts are related to time-of-measurement.

Factorial Invariance and the Representation of Within-Groups and Between-Groups Differences: A Reconsideration

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In a recent paper in *Intelligence*, Lubke, Dolan, Kelderman, and Mellenbergh (2003) argued that factorial invariance had implications for the study of within-group and between-group differences. Lubke et al. identified several levels of factorial invariance, the most restrictive being strict factorial invariance in which factor loadings, manifest variable intercepts, and unique factor variances are invariant across groups. Lubke et al. argued that a finding of strict factorial invariance implies, at a mathematical level, that the sources of within-group differences are identical to the sources of between-group differences. Several implications of this claim were drawn, such as the claim that a finding of high heritability of within-group differences (i.e., within-group differences are due primarily to differences in genetic endowment) implies that between-group differences are also due to genetic sources of variance. In 1974, Lewontin posed a thought experiment in which between-group differences were due to completely different sources than within-group differences. Lubke et al. argued that data consistent with the Lewontin thought experiment would lead to a rejection of strict factorial invariance if a model were fit to such data.

The core of the present presentation is to dispute the central conclusion offered by Lubke et al. The most important issue is the relation between levels of factorial invariance and the claim that strict invariance implies that between-group and within-group differences are due to the same underlying causes. First, the multiple-group confirmatory factor model will be described, together with increasing levels of factorial invariance (configural, weak, strong, and strict). Then, the central conclusion by Lubke et al. will be described as being due either to a linguistic error or to an error in conceiving the relation between parameters and sources of variance in hypothetical examples Lubke et al. considered. If strict factorial invariance holds, then the latent variables underlying the manifest variables are responsible for (a) within-group differences on the manifest variables, and (b) between-group differences in mean and variance on the manifest variables. Therefore, the latent variables, or factors, are mathematical entities that represent or embody all information about within- and between-group differences on the manifest variables. However, these latent factors can be combinations of genetic and environmental variance, and different combinations of genetic and environmental sources of variance can influence within- and between-group differences on the manifest variables.

Two simulated data sets designed to embody competing hypotheses for the Lewontin thought experiment will be described. In one data set, the sources of within-group differences are also responsible for between-group differences; in the second data set, the sources of within-group differences explain none of the between-group differences. Consideration of these data sets leads to the formulation of rules for study design that will enable a test of the hypothesis that sources of within-group differences are also responsible for between-group differences. The implications of these findings for research on intelligence are then explicated.

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Notes