

**International Society for
Intelligence Research (ISIR)**

1st Annual Conference



Cleveland, Ohio

**November 30, December 1 & 2,
2000**

**Abstracts of Symposia & Paper
Presentations**

*We wish to thank the Schubert
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Western Reserve University,
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whose generous support made
invited speakers possible.*

International Society for Intelligence Research (ISIR)

November 30, December 1 and 2

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Conference Coordinator
Heidi Braunschweig

ISIR 2000 Conference – Brief Schedule

Note: All sessions from 9:00 to 5:00 will consist of a 20-minute presentation and 10 minutes for questions and discussion.

Time/Day	Thursday, November 30	Friday, December 1	Saturday, December 2
9:00 – 9:30	Doppelmayr, Klimesch, & Stadler EEG Alpha Power and IQ	Mingroni The Heterosis Theory	Wilhelm Inductive and Deductive Reasoning
9:30 – 10:00	Stough, Thompson, Bates, & Nathan Neurochemical Basis of IQ	te Nijenhuis & van der Flier IQ Differences for Dutch and Immigrants	Youngstrom & Frazier Over-Factoring on Commercial Tests
10:00 – 10:30	Nyborg, Nielsen, Naeraa, & Kastrop Estrogen and Androgen in Turner's	Brody Analysis of Validation of Sternberg Test	Hunt Crystallized IQ in a Multifaceted World
10:30 – 11:00	Nguyen & McDaniel Symposium: Brain Size and IQ	Jensen Race g Factor Differences and Mental Growth	Stankov Metacognitive Aspects of Test-Taking and IQ
11:00 – 11:30	Grubb & McDaniel Symposium: Memory and IQ	Rushton South African Black-White IQ Differences	Galley Oculomotoric Parameters, Tapping, and IQ
11:30 – 12:00	Jensen Symposium: Discussant	Fagan & Holland Equal Opportunity Eliminates IQ Differences	Carlin, Soraci, Strawbridge, & Loiselte Visual Search Performance
12:00-12:30		McBride & Norman Paradoxical Brain Size and IQ Differences	
2:00 – 2:30	Thompson & Plomin QTLLs and g	Gottfredson Symposium: Life's Trials: Gradients of Risk	Johnson, Vernon, & Jog Motor Packaging and Neural Efficiency
2:30 – 3:00	Detterman Simulation of System Theory and g	Gordon Symposium: IQ Commensurability	Luo, Thompson, & Detterman Mechanisms of Cognitive Components
3:00 – 3:30	Luo, Thompson, & Detterman Cognitive Composition of g	Jensen Symposium: Discussant	Petrill, Luo, Thompson, & Detterman Inspection Time and ECT's
3:30 – 4:00	Garlick Problems with g	Ruthsatz Becoming an Expert in the Musical Domain	Gabriel Down Syndrome Cognitive Phenotype?
4:00 – 4:30	Schroeder Circular Structure for g-Free Abilities	Kaufman Thinking in Creative Writers and Journalists	Tiu, Thompson, & Youngstrom Definition of Reading Disability
4:30 – 5:00	Rushton & Rushton Brain Size and Musculo-Skeletal Traits	Palmer, Donaldson, & Stough Emotional Intelligence and Life Satisfaction	Gignac and Vernon Method of Correlated Vectors at Item Level
5:15 – 6:45	Invited Speaker: Marcel Just Brain activation dynamics of fluid IQ	Invited Speaker: Timothy Salthouse Analytic Models of Intellectual Aging	Meeting: The Future of the ISIR Conference

International Society for Intelligence Research (ISIR) Program

(Numbers in parentheses refer to page of abstract)

Thursday, November 30

Paper Session (8:30-10:00)

Chair: Detterman

- 9:00-9:20 Dopplemayr, Klimesch, and Stadler (9)
EEG Alpha Power and the Performance in Intelligence Tests (IST-70 and
LGT-3)
- 9:30-9:50 Stough, Thompson, Bates, and Nathan (10)
Examining the Neurochemical Basis of Intelligence: Recent Research
- 10:00-10:20 Nyborg, Nielsen, Naeraa, and Kastrup (11)
Estrogen and Androgen Treatment Affect the Development of General and
Specific Intelligence Differently in Young Girls with Turner's Syndrome

Symposium (10:30-12:00): Brain Size and Brain Function Correlates of g

Chair: Jensen

- 10:30-10:50 Nguyen and McDaniel (14)
Brain Size and Intelligence: A Meta-Analysis
- 11:00-11:20 Grubb and McDaniel (13)
Working Memory, Short-Term Memory, and Intelligence: A Meta-
Analysis
- 11:30-12:00 Jensen
Discussion

Lunch (12:00-2:00)

Paper Session (2:00-3:30)

Chair: Stankov

- 2:00-2:20 Thompson and Plomin (15)
Quantitative Trait Loci (QTLs) and General Cognitive Ability ('g')

2:30-2:50 Detterman (16)
A Simulation of System Theory Reproduces Significant Attributes of g

3:00-3:20 Luo, Thompson, and Detterman (17)
The Cognitive Composition of g: Complex Cognitive Processes or
Aggregation of Elemental Processes

Paper Session (3:30-5:00)

Chair: Lee Thompson

3:30-3:50 Garlick (18)
Problems with Current Explanations of g and the Advocacy of a New
Approach

4:00-4:20 Schroeder (19)
A Circular Structure for G-Free Abilities: Robustness Across Sex, Age,
and G.

4:30-4:50 Rushton and Rushton (20)
The Effect of Increasing Brain Size in Musculo-Skeletal Traits: Progress
in Evolution

Invited Speaker (5:15-6:45)

Chair: Brody

Speaker: Marcel Just, D. O. Hebb Professor, Psychology, Carnegie Mellon
University, Pittsburgh, PA

Title: The Brain-Activation Dynamics Underlying Fluid Intelligence

Friday, December 1

Paper Session (9:00-10:30)

Chair: Ruthsatz

9:00-9:20 Mingroni (21)
The Heterosis Theory

9:30-9:50 te Nijenhuis and van der Flier (22)
Group Differences in Mean Intelligence for the Dutch and Third World
Immigrants

10:00-10:20 Brody (23)
An Analysis of the Construct Validation of the Sternberg Triarchic
Abilities Test

Paper Session (10:30-12:00)

Chair: Stough

10:30-10:50 Jensen (24)
Racial g Factor Differences and Mental Growth Trajectories

11:00-11:20 Rushton (25)
South African Black-White Differences in g Show a “Jensen Effect”

11:30-11:50 Fagan and Holland (26)
Equal Opportunity Eliminates Racial Differences in IQ

12:00-12:20 McBride and Norman
Apparently Paradoxical Brain Size and IQ Differences Among Races and
Sexes: Toward an Understanding (27)

Lunch (12:30-2:00)

**Symposium: Charting Relative Risk Along the IQ Continuum: Health and Social
Psychology (Organizer: Gottfredson)**

Chair: Jensen

2:00-2:20 Gottfredson (29)
Life’s Trials: Gradients of Risk Across the IQ Continuum

2:30-2:50 Gordon (30)
IQ Commensurability of Racial-Ethnic Differences in the Prevalence of
Welfare Dependency: Rounding Out the Relations Between IQ and
Underclass Status

3:00-3:20 Jensen
Discussant

Papers (3:30-5:00)

Chair: Gabriel

3:30-3:50 Ruthsatz (31)
Becoming an Expert Performer in the Musical Domain: It Takes More
Than Just Practice

4:00-4:20 Kaufman (32)
Narrative and Paradigmatic Thinking Styles in Creative Writers and Journalists

4:30-4:50 Palmer, Donaldson, and Stough (33)
Emotional Intelligence and Life Satisfaction

Invited Speaker (5:15-6:45)

Chair: Gottfredson

Speaker: Timothy Salthouse, Department of Psychology, University of Virginia,
Charlottesville, VA

Title: Analytic Models of Intellectual Aging

Saturday, December 2

Paper Session (9:00-10:30)

Chair: Petrill

9:00-9:20 Wilhelm (34)
Individual Differences in Inductive and Deductive Reasoning

9:30-9:50 Youngstrom and Frazier (35)
Evidence and Implications of Overfactoring on Commercial Tests of Cognitive Ability

10:00-10:20 Hunt (36)
Crystallized Intelligence in a Multifaceted World

Paper Session(10:30-12:00)

Chair: Luo

10:30-10:50 Stankov (37)
Metacognitive Aspects of Test-Taking and Intelligence

- 11:00-11:20 Galley (38)
Oculomotoric Parameters and Speed Tapping, Very Short Psychomotoric Times, Correlate with Psychometric Intelligence
- 11:30-11:50 Carlin, Soraci, Strawbridge, and Loiselle (39)
Comparisons of the Visual Search Performances of Individuals With and Without Mental Retardation

Lunch (12:00-2:00)

Paper Session (2:00-3:30)
Chair: Rushton

- 2:00-2:20 Johnson, Vernon, and Jog (40)
Motor Packaging and Neural Efficiency: Implications from the Systematic Examination of Clinical Populations
- 2:30-2:50 Luo, Thompson, and Detterman (41)
On the Mechanisms of Elemental Cognitive Components in g
- 3:00-3:20 Petrill, Luo, Thompson, and Detterman (42)
Inspection Time and the Relationship Among Elementary Cognitive Tasks, General Intelligence and Specific Cognitive Abilities

Paper Session (3:30-5:00)
Chair: Hunt

- 3:30-3:50 Gabriel (43)
The Down Syndrome Cognitive Phenotype: Does it Exist?
- 4:00-4:20 Tiu, Thompson, and Youngstrom (44)
The Definition of Reading Disability
- 4:30-4:50 Gignac and Vernon (45)
Method of Correlated Vectors at the Item Level

Meeting (5:15-5:45)
Chair: Detterman

Topic: The Future of the ISIR Conference.

EEG Alpha Power and the Performance in Intelligence Tests (IST-70 and LGT-3)

M. Doppelmayr, W. Klimesch, and W. Stadler

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According to literature, the relationship between human EEG and cognitive performance still appears unclear. On one hand, there are studies comparing alpha frequency with intelligence (e.g. Anokhin, A. & Vogel, F.; *Intelligence*, 1996, 23,1-14.) and on the other hand there are comparisons of EEG power with IQ. Some of these latter studies (e.g., Jausovec, N.; *Intelligence*, 1996, 23, 159-173.) report a positive relationship between absolute alpha power and intelligence. Others using event-related desynchronization (ERD) as a measure have found different result (Neubauer A. & Pfurtscheller, G.; *Intelligence*, 1995, 20, 249-266.). Klimesch (Klimesch W.; *Brain Research Reviews*, 1999, 29, 169-195) has emphasized that a consistent interpretation of alpha power and memory performance has to take into account both tonic absolute power and phasic or event-related (ERD) changes in relative alpha power. Furthermore, Klimesch (Klimesch W., et. al.; *Neuroscience Letters*, 1998, 244, 73-76.) has shown that specific alpha subbands are selectively related to either attentional processes or to semantic operations.

In the present study, the hypothesis was tested whether alpha power in 3 different subbands (lower-1, lower-2 and upper alpha) was related to specific aspects of intelligence. For 74 subjects, EEG was recorded during a resting session with eyes closed. Following the EEG recording, two different intelligence tests (LGT-3 and IST-70) were administered. A strong positive correlation between test scores and general alpha power was found. Inspection of the differences between the two intelligence tests and alpha power subbands revealed big differences. Whereas the upper alpha band shows the strongest correlation with the IST-70, power in the two lower alpha bands shows the most consistent relationship with the LGT-3. Taking into account that the IST-70 has a strong emphasis on semantic memory demands, whereas the LGT-3 focuses highly on the ability to learn new material, we conclude that upper alpha is related to the ability to process semantic information whereas the two lower alpha bands are more associated with attentional demands dominating during the encoding of new information.

Examining the Neurochemical Basis of Intelligence: Recent Research

Con Stough

Neuropsychology Laboratory, Swinburne University, Australia

Jim Thompson

Brain Science Institute, Swinburne University, Australia

Timothy Bates

School of Behavioural Sciences, Macquarie University, Australia

Pradeep Nathan

Brain Science Institute, Swinburne University, Australia

Inspection Time (IT), an information processing correlate of psychometric intelligence has been extensively studied. Previous research has shown that IT is a reliable correlate of psychometric intelligence across different developmental periods, mirroring developmental trends of fluid intelligence. Despite this extensive previous literature, very little is known about the biological basis of IT. We report recent results from our laboratories examining the neurochemical determinants of IT and psychometric measures of intelligence. Several studies are reported in which we examine performance on the IT task and psychometric measures of IQ before and after modulating key human central nervous system neurotransmitters and receptor systems (e.g., Cholinergic, Serotonergic, Noradrenergic and Dopaminergic systems). The results of these studies indicate a primarily cholinergic basis for IT, although other aspects of psychometric intelligence may have serotonergic and dopaminergic determinants in addition to a cholinergic basis. The results are consistent with data reporting cholinergic depletion and poor IT performance in Dementia of the Alzheimer's Type. Speculatively, we propose that compounds that enhance the release of the neurotransmitter Acetylcholine will improve IT and the variance that IT shares with IQ test performance.

Estrogen and Androgen Treatment Affect the Development of General and Specific Intelligence Differently in Young Girls with Turner's Syndrome.

Helmuth Nyborg

PNE Research Center, Institute of Psychology, University of Aarhus, DK-8240 Risskov, Denmark

Johannes Nielsen, Rune W. Naeraa

The Turner Center and Cytogenetics Laboratory, Institute of Biological Psychiatry, DK-8240 Risskov, Denmark

and Knud W. Kastrup

Department of Paediatrics, Copenhagen County Hospital, Glostrup, Denmark.

Girls with Turner's syndrome lack X chromosome material, do not secrete proper amounts of growth and sex hormones and, accordingly, suffer from stunted body growth and psychosexual immaturity; they have low normal verbal IQ but encounter severe problems when trying to solve spatial tasks. Turner girls are routinely offered growth and sex hormone therapy, and this makes them uniquely suited to test the hypothesis that plasma sex hormones influence the development of intelligence. The present study subjected scores from a battery of standard and specialized cognitive tests to a hierarchical Schmid-Leiman type factor analysis and derived psychometric g and three orthogonal factors, named verbal, spatial, and memory. The four intelligence measures were taken for pre- as well as post-medicated Turner girls and for normal randomly selected age-matched school-girls and boys, acting as controls. Medicated groups included Turner girls treated for one year with growth hormone (GH) alone, low dose estradiol (E_2) alone, low dose E_2 +GH, high dose E_2 alone, high dose E_2 +GH, and girls expected to menstruate spontaneously and accordingly treated with GH only. A final group first received two years Oxandrolone treatment (OX, an anabolic steroid), paused, then entered one year with low dose E_2 +GH; their intelligence was measured immediately before and after the E_2 +GH treatment. We found that control boys outscored girls in g. Neither GH nor E_2 treatment nor any combination of the two exerted any effect on the development of g, but the OX treatment raised g to far above the average of other Turner groups and even above the mean of control girls. Unfortunately, the ensuing low dose E_2 +GH treatment depressed g to the average female control level. Control boys outscored girls on the spatial factor. All types of treatment elevated the abnormally low pre-medication spatial scores of Turner girls with about 2 SDs, and brought their development at least on par with that of control boys. Control girls outscored control boys on the verbal factor. However, with the exception of GH, all treatment types depressed Turner verbal ability to a level below that of control boys. Control boys outscored girls on the memory factor, and treatment had no consistent effects on development of the memory factor score. The results suggest that androgen (or its brain metabolites, but not plasma estrogen per se), promotes early development of general intelligence, g. The development of spatial ability is enhanced by growth hormone, androgen and by estradiol, whereas verbal ability is depressed, and memory inconsistently affected. Elsewhere it has been suggested that hormone-intelligence relationships observed in Turner girls may apply also to normal intellectual development. However, the small number of Turner girls in each treatment regime most likely makes firm generalizations from the present study premature.

Symposium: Brain Size and Brain Function Correlates of g

Brain Size and Intelligence: A Meta-Analysis

Nhung T. Nguyen & Michael A. McDaniel

Virginia Commonwealth University

**Working Memory, Short-Term Memory and Intelligence: A
Meta-Analysis**

W. Lee Grubb, III & Michael A. McDaniel

Virginia Commonwealth University

Discussant:

Arthur Jensen

Symposium description: This symposium presents a series of papers concerning brain size and brain function (memory capacity) correlates of g .

Working Memory, Short-Term Memory and Intelligence: A Meta-Analysis

W. Lee Grubb, III and Michael A. McDaniel

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The relation between short-term memory capacity and cognitive ability has been a topic of research interest for over 30 years. During that period, the concept of working memory has evolved and has been offered as a form of memory distinct from short term memory. Kyllonen and Christal (1990) offered evidence that reasoning ability is primarily working-memory capacity. Engle, Tuholski, Laughlin, and Conway (1999) have argued that working memory is substantially related to general fluid intelligence. They further argue that, relative to working memory, short-term memory is less related to general fluid intelligence. Studies examining working and short-term memory with intelligence use a diverse set of measures and often have relatively small sample sizes. These study characteristics are responsible, in part, for the relatively confusing array of study results. The current research seeks to clarify and extend the knowledge gained through past primary studies by summarizing the literature using psychometric meta-analysis (Hunter & Schmidt, 1990). We followed Kyllonen and Christal's (1990) practice and assigned the cognitive tests into reasoning and knowledge categories. We also created two additional categories, one for ACT/SAT measures and one for IQ tests. As seen in the table, working memory tests correlate substantially with reasoning tests while short-term memory tests have correlations of lower magnitude with reasoning. In addition, working memory is more correlated with reasoning tests than with knowledge tests. Confusing this nice scenario, however, we find short-term memory tests more highly correlated with ACT/SAT tests than are working memory tests. We recommend that primary authors in this area make a clearer assessment of whether their measures assess working or short-term memory, develop and use a set of "marker" memory measures that clearly assess the intended constructs, use standardized cognitive ability measures rather than home grown measures, assess memory and cognitive ability measures as continuous variables rather than forming experimental groups through dichotomization, and estimate and report reliabilities for all measures.

Distribution	Total N	K	Observed Distribution		
			Mean r	SD	% variance due to sampling error
Analyses for Reasoning Tests					
All Memory tests	37,260	92	.38	.09	22
Working memory	36,462	86	.38	.09	23
Short-term memory	798	6	.19	.07	100
Analyses for Knowledge Tests					
All Memory tests	19,746	75	.21	.12	19
Working memory	19,746	75	.21	.12	19
Short-term memory		0			
Analyses for ACT/SAT					
All Memory tests	5,810	45	.30	.15	26
Working memory	4,328	31	.27	.14	26
Short-term memory	1,482	14	.39	.12	47
Analyses for IQ tests					
All Memory tests	692	22	.38	.18	75
Working memory		0			
Short-term memory	692	22	.38	.18	75

Brain Size and Intelligence: A Meta-Analysis

Nhung T. Nguyen & Michael A. McDaniel

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The relation between brain size and intelligence has been a topic of interest for close to a century. Historically, most research in this area has estimated brain size through head size measurements. More recently, MRI technology permitted a more direct assessment of brain size. There have been several good narrative reviews of this literature. However, narrative reviews can be criticized on a variety of grounds (Cooper & Hedges, 1994) including the subjectivity involved in integrating conflicting results without the aid of statistics. The current research seeks to clarify and extend the knowledge gained through recent narrative reviews by examining the topic using psychometric meta-analysis (Hunter & Schmidt, 1990). Unlike previous reviews, the current study estimates both the observed and the estimated population distributions and attempts to evaluate empirically the sources of variability in results across studies. As indicated in the table, the magnitude of the correlation between brain size and intelligence is moderated by how brain size is measured, how intelligence is measured, and whether the sample is composed of adults or children. By partitioning the data by these moderating variables, the relationship between brain size and intelligence is shown to be less variable than other reviews have indicated. Additional variance can be explained by examining the moderators hierarchically. For all distributions examined, the observed and population distribution means are positive and the lower bound of the credibility interval for the population distribution is always positive. The correlations between brain size and intelligence are of the largest magnitude when brain size is measured through an MRI, when a test is used to measure intelligence, and when the sample consists of children.

Distribution	Total N	K	Observed Distribution			Population Distribution		
			Mean r	SD	% variance due to artifacts	Rho	SD Rho	90%cv
All Correlations	90,931	78	.20	.05	40	.24	.04	.19
Analyses by Type of Brain Size Measure								
MRI	529	11	.31	.11	100	.33	.00	.33
Capacity	3,692	17	.18	.10	41	.21	.09	.09
Length	5,497	3	.11	.03	72	.16	.02	.13
Perimeter	55,447	32	.21	.03	55	.26	.02	.22
Analyses by Type of Intelligence Measure								
Test	84,050	73	.20	.04	46	.25	.03	.20
Not a test	6,881	5	.11	.03	93	.16	.04	.15
Analyses by Type of Sample								
Adults	45,330	48	.19	.04	41	.22	.03	.18
Children	45,481	29	.21	.05	20	.25	.05	.19

Quantitative Trait Loci (QTLs) and General Cognitive Ability ('g')

Lee Thompson

Department of Psychology, Case Western Reserve University, Cleveland, OH, USA

and Robert Plomin

University of London, London, England

General cognitive ability or 'g' can be reliably measured, is stable across the life span, and is a useful predictor of many outcomes. Quantitative genetic research finds 'g' to be one of the most heritable behavioral traits, and developmental research suggests that the heritability of 'g' increases with age. Additionally, specific cognitive abilities and 'g' share a high degree of genetic overlap, indicating that genes influencing 'g' have robust effects. Given this impressive resume, it is hard to imagine a better behavioral candidate than 'g' for the application of cutting-edge molecular genetic techniques to the study of complex behavioral traits. The purpose of this presentation is to provide an overview of the IQ QTL Project, the first systematic genome scan for association using a new technique called DNA pooling. Conceived in 1990, the study is ongoing and has moved the search for genetic influences on 'g' beyond simple estimation of the magnitude of genetic effects to the identification of specific QTLs. The IQ QTL Project will not only advance our understanding of the biological foundation of 'g', but because of the pioneering nature of the study, it also serves as a much needed methodological model or template for all genetic research on complex traits. This presentation will outline and explain the methods used in the IQ QTL Project, report significant findings to date, and briefly discuss the future of research on the genetics of 'g'.

A Simulation of System Theory Reproduces Significant Attributes of g

Douglas K. Detterman

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USA

This research involved simulation of various cognitive systems based on the assumptions derived from the system theory of mental retardation developed by Detterman. Various systems were simulated and then resulting data were compared to known outcomes for similar data from actual research. The system of primary interest was one with high wholeness consisting of a central process and three input and three output peripheral processes. Random normal deviates were assigned to each process. Each “behavioral result” from this system consisted of the action of an input, the central process, and an output. Based on system theory, this behavioral output was set at the minimum value of the three processes involved. There were nine behavioral outcomes. The nine behavioral outcomes were then considered equivalent to primary data usually collected from tests and cognitive tasks. Findings from analyses of these primary data suggest that significant aspects of g result from the conditions imposed on the simulated data. The findings also suggest that the most productive research approach will be to precisely identify the cognitive processes that contribute to differences in intelligence.

The Cognitive Composition of g: Complex Mental Processes or Aggregation of Elemental Processes?

Dasen Luo

Indiana University of Pennsylvania, Indiana, PA, USA

Lee Ann Thompson and Douglas Detterman

Case Western Reserve University, Cleveland, OH, USA

The literature on human intelligence has demonstrated the pervasive quality of 'g', yet an understanding of the cognitive processes comprising 'g' is elusive. To test the hypothesis whether 'g' can be better represented by a few elementary cognitive abilities or by complex mental processes, we aggregated 4 chronometric variables (reaction time, stimulus discrimination time, inspection time, and perceptual speed) and 4 working memory elementary tasks to represent the elemental cognitive components underlying the 2 sets of tasks, presumably Processing Speed and Working Memory. The two aggregated variables were related to intelligence test battery scores and scholastic test scores in a sample of 532 primary school children recruited in the Western Reserve Twin Project. The hypothesis of psychometric g reflecting elemental processes, such as those represented by the two aggregated variables, was tested in the study. Using the first-order and second-order semi-partial correlations among IQ scores and scholastic performance scores with the 2 aggregated variables statistically controlled, it was shown that at least 2/3 of the variability shared among these scores, which represents the influence of psychometric g, was rooted in the elemental cognitive components of Processing Speed and Working memory. Structural equation models treating the two aggregated variables as independent variables and some ability and scholastic factors as dependent variables also suggested that the two aggregated variables accounted for more than 2/3 of the explained variability in these ability and scholastic factors. The results of the study provided evidence that although psychometric g may be more reliably measured by complex ability tests, the main part of g rests on the aggregation of elemental cognitive processes rather than complex mental processes, which presumably are the components of information processing speed and working memory processing, respectively. The results of the study also demonstrated that when elementary cognitive task variables are aggregated, they not only have better known cognitive underpinnings than traditional ability tests, but also have suitable psychometric properties for practical testings of intelligence.

Problems with Current Explanations of *g* and the Advocacy of a New Approach

Dennis Garlick

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The study of intelligence has been characterized by much excellent research throughout the last century. Much is now known about the structure of individual differences in human abilities. However, despite considerable evidence to the contrary, the view that a general factor of intelligence plays an important role in intellectual performance is still controversial. The possibility that this factor is substantially heritable is even more controversial. Previous arguments have been made that resistance to these findings have been based on an unscholarly approach to the evidence, and an unwillingness to accept what is an undesirable reality. While these arguments may have some merit, the position of this paper is that the position of a general factor is made more untenable by the lack of a convincing account of the cause or explanation of such a phenomenon. Arguments will be made against current approaches to explaining *g*, including speed and efficiency of neural processing, differences in working memory capacity, and the sampling of independent processing modules. A new approach, which is based on individual differences in a general adaptation mechanism, will be advocated which is much more consistent with recent advances in neuroscience and cognitive science. This approach will also be shown to be able to account for many empirical findings in intelligence research which current theories are not able to. It will be argued that if intelligence research is to move forward, it must take heed of the problems that exist with current approaches. At the same time, the adoption of a new approach provides many new and exciting opportunities for future research.

A Circular Structure for G-Free Abilities: Robustness Across Sex, Age, and G

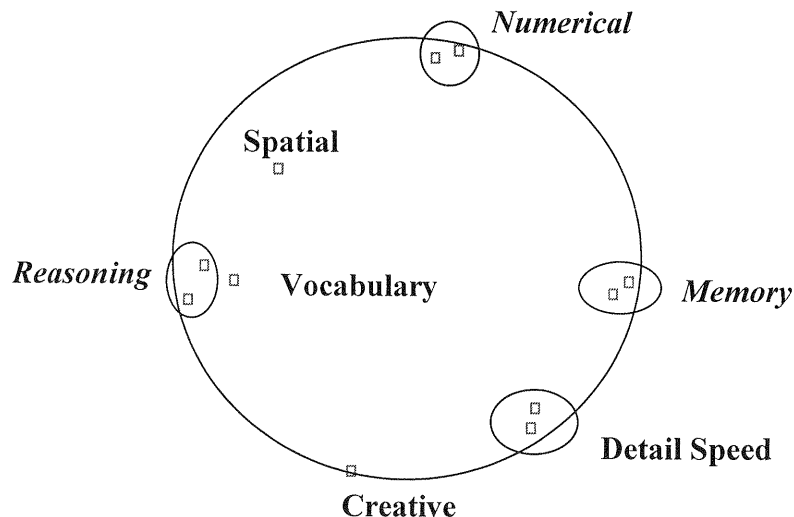
David H. Schroeder

Johnson O'Connor Research Foundation, 161 E. Erie St., Room 304, Chicago, IL 60611

Although *g* has proven to be quite useful in many circumstances (Jensen, 1998), additional ability dimensions can be important too, especially in applications such as vocational guidance in which persons may fall within a limited range on *g*. Carson and Schroeder (2000) recently factor-analyzed data on vocational-aptitude tests and found a circular structure for Factors 2 and 3 (see figure). This structure corresponds rather well with Holland's (1997) structure for vocational interests and Prediger's (1999) structure for self-rated abilities. In this study I attempted to reproduce the Carson-Schroeder structure in another data set and evaluate the structure's robustness across sex, age, and levels of *g*. The sample consisted of 8,258 adolescents and adults who took the JOCRF's battery of ability tests in 1996-97. First the test scores were partialled for sex and age, and the first unrotated principal component (*g*) was extracted and then partialled from the data. The next two components were extracted and rotated. Most of the tests formed a circumplex resembling the Carson-Schroeder circumplex. We then extracted two factors each from the *g*-partialled data for various groups based on sex, age, and level of *g*. Most of the tests maintained their respective positions in the structure across these groups. Scores on two tests tended to shift position from one subgroup to the next. We eliminated those tests from the set, and that yielded a clear circumplex structure that was highly robust across subgroups and replicated on data from JOCRF clients from 1994-95 and 1989-90. If these dimensions are shown to correlate highly with the Holland interest dimensions, this could provide a powerful model for understanding choice and performance in careers, schools, and other settings.

References

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- Jensen, A. R. (1998). *The g factor: The science of mental ability*. Westport, CT: Praeger Publishers.
- Prediger, D. J. (1999). Basic structure of work-relevant abilities. *Journal of Counseling Psychology*, 46, 173-184.



The Effects of Increasing Brain Size on Musculo-Skeletal Traits: Progress in Evolution?

J. Philippe Rushton and Elizabeth W. Rushton

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MRI-measured brain size correlates 0.40 with IQ scores. But large brains are metabolically expensive and also require a prolonged life history. For example, across 21 primate species, brain size correlates 0.80 to 0.90 with: (1) length of gestation, (2) age of eruption of first molar, (3) body weight, (4) age of weaning, (5) birth interval, (6) sexual maturity, and (7) life span. More controversially, Jensen (1998, *The g Factor*), building on Rushton and Ankney (1996, *Psychonomic Bulletin & Review*), calculated an "ecological correlation" of 0.96 between brain size and IQ across the three population groups of East Asians, Europeans, and Africans. And Rushton (2000, *Race, Evolution, and Behavior*) found East Asians and Europeans give birth at later gestational ages than do Africans, and their children reach puberty later and live longer. In this paper, we extend these findings and report correlations ($r_s = 0.90$) between brain size (420 to 1350 cm³) across seven population groups, over five million years, from australopithecines to *Homo habilis* to *Homo erectus* to modern Africans, Europeans, and East Asians on musculo-skeletal traits using both cranial traits (temporal fossae, post-orbital constrictions, mandibles, dentition, nuchal muscle attachments) and post-cranial traits (pelvic widths, femoral heads, tibial plateaus). With increasing brain size there is the cost of increasing skeletal gracility. We conclude that in the evolutionary competition to find and fill new niches, there has always been "room at the top." As such, new impetus is given to traditional ideas of "biological progress," from Aristotle through Darwin to E. O. Wilson.

The Heterosis Theory

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The secular rise in IQ, known as the Flynn effect, is well known to researchers in the field of intelligence. Less well known to workers in this field is the fact that the Flynn effect is just one of three major trends that have characterized human populations, across the industrialized world, for approximately the past two centuries. In addition to IQ, body size has undergone dramatic change in many countries. This trend is seen most clearly in height, but entails other changes as well. In addition to changes in final body size, there has been an increase in the rate, or tempo of growth. Growth now ceases at an earlier age, and both menarche and the adolescent growth spurt occur earlier now than in the past. Similarities in the location, timing, and magnitude of these three trends argue in favor of a common cause.

Current thinking as to the cause of these trends focuses almost exclusively on environmental factors. Genetic factors are often deemed negligible, when they are mentioned at all. However, the characteristics of the secular trends do not fit the profile of environmentally driven change. In many respects, they look like the effects of genetic changes in the affected populations. The magnitude, steadiness, rate of change, uniformity, and pervasiveness of the trends are difficult to explain within our current environmentalist framework for understanding the trends. Furthermore, an environmental approach to explaining the trends makes little sense from the perspective of Darwinian evolutionary theory.

In this paper, the case will be made that the secular trends in body size, tempo of growth, and IQ are primarily the result of genetic changes in the affected populations. The proposed mechanism for this genetic change is heterosis, also known as hybrid vigor. Evidence in support of this hypothesis will be presented. Also, possible methods for further testing the hypothesis will be outlined.

Group Differences in Mean intelligence for the Dutch and Third World Immigrants

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Evidence from 11 samples indicates that the mean IQ of the population of third world immigrants in the Netherlands is lower than the Dutch population mean by approximately one standard deviation for Surinamese and Antillians, and by approximately one and a half standard deviation for Turks and Moroccans. Since all Dutch studies have shown that cognitive tests are at the most slightly biased against immigrants and since IQ tests provide the best prediction of success in school and organizations, it could be that the immigrants' lower mean IQ is an important factor in their low status on the Dutch labor market. However, the IQs of the second generation immigrants are rising.

An Analysis of the Construct Validation of the Sternberg Triarchic Abilities Test

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Sternberg et al. published two papers reporting the results of a study designed to provide a construct validation of the Sternberg Triarchic Abilities Test (STAT). This talk reviews the data and analyses reported by Sternberg and his colleagues. Relations among the triarchic abilities are considered and the relationships between the triarchic abilities and other measures of intellectual ability are reviewed. Relationships between triarchic abilities and academic performance on measures of analytic, creative and practical knowledge are considered. The psychometric properties of STAT are discussed. The analyses indicate that the “independent” triarchic abilities are substantially related to each other and to standard measures of intelligence. The data fail to conform to some theoretically derived multitrait-multimethod patterns of relationships. It is concluded that STAT is not a measure of abilities that are substantially independent of g.

Racial g Factor Differences and Mental Growth Trajectories

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Previous studies have shown that various psychometric differences between Black and White school-age children of the same age are closely simulated by the same effects observed between two racially identical groups of either White (W) children or of Black (B) children that differ in chronological age (CA) such that the younger/older CA ratio is between 0.80 and 0.85, which approximates the B/W mental age (MA) ratio of B and W children on IQ tests, resulting in the typical W-B mean difference of between 15 to 20 IQ points. This simulation of actual same-age racial group differences by "pseudo-race" groups (i.e., same race/different age groups) has been observed for test characteristics such as testees' selection of error distractors in the multiple-choice Raven matrices test, developmental features in performance on the Gesell Figure Copying Test, various Piagetian conservation and classification tests, and free drawings. Spearman's hypothesis, which is strongly confirmed by previous studies, states that the variable magnitudes of the standardized mean W-B differences on various mental tests is a direct function of the test's g loadings. The present study, based on over 1,000 W and B school-age children in grades 4 through 7, examines whether Spearman's hypothesis is simulated by pseudo-race comparisons. In a battery of 17 diverse psychometric tests, the actual racial comparisons (i.e., same age W-B difference) strongly bear out Spearman's hypothesis. The pseudo-race (i.e., same race, older-younger ages) comparisons clearly simulate the Spearman effect, but is not quite as strong as in the actual race comparison. Predictably, in the pseudo-race comparisons the least g-loaded tests show developmental age differences that are larger than the corresponding differences between the actual racial groups. These findings reflect a distinction between mental growth trajectories for g and non-g factors and lend further support to the hypothesis that the W-B difference in psychometric test performance is predominantly and specifically a g difference, rather than just a generalized difference in all components of test performance.

South African Black-White IQ Differences in g Show a "Jensen Effect"

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Black-White IQ differences in the U.S. are more pronounced on high g-loaded tests than they are on low g-loaded tests. Arthur Jensen dubbed this "Spearman's hypothesis" because Spearman was the first to suggest it. In *The g Factor* (1988), Jensen describes the results of 17 independent data sets of nearly 45,000 Blacks and 245,000 Whites from 171 psychometric tests and finds the g loadings consistently predicted the magnitude of the Black-White difference ($r_s = .63$ to $.71$). Subsequently, Rushton (1998, *Intelligence*, 26, 217-225) proposed that when significant correlations occur between g-factor loadings and variable X, the results be termed a "Jensen Effect," because otherwise there is no name for it, only long explanations of how it was achieved. Jensen's studies on Black-White differences, however, were all carried out in the U.S., so it might be argued that the phenomenon is of limited interest with its explanation sought in local conditions.

However three studies from South Africa found Black-White IQ differences there to also be higher on more g-loaded tests, i.e., they are "Jensen Effects." The studies include: Lynn and Owen (1994, *Journal of General Psychology*, 121, 27-36) who used subtests from the Junior Aptitude Test; Rushton and Skuy (2000, *Intelligence*, 28, in press) who used items from Raven's Progressive Matrices; and Rushton (submitted, *Personality and Individual Differences*), who used subtests from the Wechsler Intelligence Scale for Children-Revised.

Equal Opportunity Eliminates Racial Differences in IQ

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On conventional tests of intelligence, Blacks and Whites differ by about 15 points in IQ. The present study finds that differences in knowledge between racial-ethnic groups for items tested on an intelligence test, the meanings of words, can be eliminated when equal opportunity for exposure to the information to be tested has been experimentally assured. In the present study, these same racial-ethnic groups did differ in word knowledge when equal opportunity was not assured. For both Blacks and Whites individual differences in knowledge of word meanings when equal opportunity was assured were highly predictive of individual differences in knowledge of word meanings when equal opportunity was not assured. Within racial groups, differences in performance between subgroups selected to differ in vocabulary knowledge when equal opportunity for exposure was not assured were not eliminated when equal opportunity for exposure was assured. The data support the view that, within a race, differences in IQ are determined, to some substantial degree, by differences in intellectual ability rather than by differences in exposure to information. The data also support the view that cultural differences in the information provided to people, rather than differences in intellectual ability, account for racial differences in IQ.

Apparently Paradoxical Brain Size and IQ Differences Among Races and Sexes: Toward an Understanding.

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Rushton provided a straight forward accounting of the relationships among head size (brain mass, volume, citing various measurement techniques and sophistication), intelligence (IQ scores, primarily), and the relevant demographics of race (i.e., of African, European, or Asian descent), and sex. Generally, IQ correlates positively with measures of brain size. This finding holds across races. However, within races, the correlation is not so clear: female IQ scores are higher than would be expected given that head size accounts for such significant variability in IQ across races. In fact, within races, female and male IQ scores are identical despite the superiority of brain size for males, on average. Moreover, African male crania are larger than those of European females, although the former score significantly lower on IQ tests than do the latter. Taken together, these findings thus present an apparent paradox for which there may be several possible rationales. This paper identifies possible explanations on the basis of (1) naturally and (2) sexually selected traits, and on (3) standard psychometric practice. McBride identified the latter--IQ test development strategies--as perhaps responsible for the apparent paradox. But this explanation itself is probably only partial, even if it is valid. Based on the assumption that if there were sexually selected pressures for large head size among males during the EEA, there should be vestigial selection bias for larger head sizes today. Confirmatory data are presented, natural selection pressures are accounted for, and a natural x sexual x psychometric explanation is offered and discussed.

**Symposium: Charting Relative Risk Along the IQ Continuum:
Health and Social Pathology**

Organizer:

Linda S. Gottfredson

Chair and discussant:

Arthur R. Jensen

School of Education

University of California at Berkeley

Presenters:

Linda S. Gottfredson

Robert A. Gordon

This symposium illustrates new methods for charting the impact of g on the lives of individuals and groups. The two presentations reanalyze published data on the prevalence of important social outcomes among individuals and populations who differ in average IQ. Both methods of analysis use a wide variety of prevalence data and both reveal that there are systematic shifts in relative risk across the IQ continuum. These patterns, in turn, provide insight into how differences in g shape people's lives.

Life's Trials: Gradients of Risk Across the IQ Continuum

Linda S. Gottfredson

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Ample evidence reveals that higher levels of IQ (g) confer advantages in many realms of life, from performing well in school and jobs to avoiding auto fatalities and repeated hospitalization. Evidence also shows, however, that the impact of higher g differs systematically and substantially according to various attributes of individuals, tasks, and circumstances. For instance, the impact of g on job performance rises quickly with the complexity of the work performed. g 's impact in school and work settings is fairly well understood now, but not so its impact in everyday affairs and on cumulative life outcomes. More insight into the conditions that enhance or diminish the utility of higher g can be gleaned by charting how the risk of different bad (or good) social outcomes rises (or falls) when looking down the IQ continuum. Odds ratios, which are commonly used in epidemiology to assess relative risk, are used here to illustrate how the risks of major social pathologies (e.g., bearing illegitimate children, depending on welfare, being incarcerated), poor job performance, and ineffective health behavior shift across the IQ continuum. These ratios show that the risks usually shift linearly across the IQ continuum, but that the rise in risk levels is steeper for some outcomes than others. The overall pattern of risk gradients suggests hypotheses about how the impact of g is exerted and moderated in different life arenas. The pattern also reveals very concretely how vulnerability to many life-changing outcomes rises dramatically down the IQ continuum.

IQ Commensurability of Racial-Ethnic Differences in the Prevalence of Welfare Dependency: Rounding Out the Relations Between IQ and Underclass Status

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Previous work (Gordon, 1997) presented evidence for the IQ commensurability of Black-White differences in the prevalence of crime and delinquency, mother-headed families, and families living in poverty, using the Population-IQ-Outcome model. *IQ commensurability* refers to a quantifiable consistency between population differences in IQ distributions and population differences in prevalence of such outcomes. For each of the above outcomes, the model successfully fitted data series ranging from 23 to 45 years in length, despite large changes in levels of prevalence. These outcomes are ones often cited as defining attributes of underclass status (Ricketts & Sawhill, 1988). Reservations remain concerning the eligibility of poverty, however, because many poor people do not qualify as underclass in other respects. A more accepted attribute, welfare dependency, has thus far not been tested with the model. In view of uncertainty over poverty, the inclusion of welfare dependency would strengthen the case that the underclass is a phenomenon explained primarily by intelligence. For the first time, employing a variety of welfare measures, data are presented that reveal IQ commensurability for differences among Blacks, Whites, and, tentatively, Hispanics. The recognized fact that persons meeting criteria of underclass status are concentrated by census tract or neighborhood, in conjunction with the full set of findings, testifies to the importance not just of IQ but also of local IQ context as a fundamental component of the Population-IQ-Outcome model. The availability of so many welfare measures is used to illustrate a methodological point.

Becoming an Expert Performer in the Musical Domain; It Takes More Than Just Practice

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Several variables have been separately investigated to account for individual differences in musical achievement. The purpose of this study was to examine these variables collectively by the use of a multiple regression analysis. General intelligence, domain specific skills and deliberate practice are all factors that have been individually implicated as important components in the acquisition of musical achievement. In a recent paper by Detterman and Ruthsatz, the authors suggest that expert ability may be best understood as a combination of all of these factors. The present study tested this theory in the musical domain. Two self-selected high school bands and a competitively selective collegiate orchestra participated in this study. A multiple regression was performed within each group of musicians to see if the three variables, general intelligence, domain specific skills and practice time added significant increments to the prediction of musical achievement. In study one, using the high school band, all variables added significant increment in the prediction equation regardless of the order of entry. The results lend support to a multifaceted understanding of achievement. Furthermore, the results for all three variables were significantly elevated in mean level for the competitively selected collegiate orchestra. This finding supports the assertion that it takes more than practice to become an expert in the musical domain. However, at the collegiate level only practice time was related to musical achievement within this highly talented group. The results suggest that making it to the top depends on both talent and a great deal of deliberate practice.

Narrative and Paradigmatic Thinking Styles in Creative Writers and Journalists

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How do creative writers and journalists differ in cognition, and how are they similar? Both groups of people are verbal, intelligent, and use the written word. Yet the medium and method of writing are quite different. To investigate possible differences between these two types of writers, creative writers and journalists were compared on their thinking styles. This study examined how these two groups differed on Bruner's theory of Narrative and Paradigmatic thought, with the Narrative mode being a story-telling thinking style that seeks connections and the Paradigmatic mode being more logical and scientific. A total of 81 participants (41 creative writing students and 40 journalists) were assessed on Narrative and Paradigmatic thought by having them write captions to a series of photographs. These captions were then rated for the two types of thought. As hypothesized, creative writers scored significantly higher than journalists on the Narrative thinking style. However, an unexpected significant interaction emerged between gender and type of writer. For males, the hypothesized difference in paradigmatic scores was found, with journalists significantly outscoring creative writers on this thinking style. For females, however, a trend in the opposite direction was observed, although that difference was not significant. The significant gender X type of writer interaction found for the paradigmatic thinking style is consistent with previous cognitive and neuropsychological research on gender differences. Overall, these findings indicate that thinking styles are a viable and valid construct that can shed insight on a variety of research topics, particularly in investigations of writing and the creative arts.

Emotional Intelligence and Life Satisfaction

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During the last decade there has been much interest in the notion of ‘emotional intelligence’. Much of this interest stems from the face validity of the construct that seemingly relates to many important human values including successful interpersonal relationships and life satisfaction. This potential has prompted the development of several assessment instruments, which provide a basis from which to empirically determine the nature and extent of these relationships. The aim of the present study was to explore the relationship between emotional intelligence and arguably one of the most important human values that it has been proposed to predict: life satisfaction. Emotional intelligence was assessed in 107 participants using a modified version of the Trait Meta-Mood Scale (TMMS; Salovey et al., 1995) and the Toronto Alexithymia Scale (TAS-20; Bagby et al., 1994). Life satisfaction was assessed using the Satisfaction With Life Scale (SWLS; Diener et al., 1985). To determine the nature of this relationship, personality constructs known to predict life satisfaction were also assessed including positive and negative affect using the Positive and Negative Affect Scale (PANAS; Diener & Emmons, 1984). The Clarity of Feelings sub-scale of the TMMS was found to predict life satisfaction over and above positive and negative affect, suggesting that this variable may account for variance in this important human value not accounted for by previously related personality traits. Implications and directions for further research are discussed.

Individual Differences in Inductive and Deductive Reasoning

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Performance on tests measuring reasoning ability is restricted by working memory capacity. Tests for reasoning ability mostly tap inductive and deductive reasoning. Inductive reasoning increases the semantic content when proceeding from the premises to the conclusion and is therefore not necessarily true. Deductive reasoning does not increase the semantic content but derives necessarily true conclusions whenever the premises are true. Attempts to discriminate inductive and deductive reasoning ability have yielded inconclusive results so far. The attempts so far either used tasks not specifically designed to distinguish both constructs or used tasks that were not unambiguously suited to measure the abilities as pure as desired. In order to overcome these shortcomings 12 tasks were newly developed or selected, 6 requiring inductive and 6 requiring deductive reasoning. The task content in both operative domains was balanced across verbal, numerical, and figural content. Three hundred high school subjects worked on the 12 reasoning tasks and either a battery of 19 mental speed tasks, a self report measure of typical intellectual engagement, and problems frequently used in cognitive psychology (n=129) or 15 reasoning tasks from the Berlin-Intelligence-Structure-Test (BIS-Test) (n=171). Inductive and deductive reasoning can not be discriminated. The correlation of two latent factors is estimated to be one. Correlations with external criteria are not different. A model distinguishing tasks by their content fits the data best. The three content factors in this model are very highly correlated with each other. It is concluded that the communality between inductive and deductive reasoning ability is due to the restriction of performance by working memory capacity and that there are not substantial amounts of specific variance to these classes of tasks.

Evidence and Implications of Over-Factoring on Commercial Tests of Cognitive Ability

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Theoretical and commercial processes have driven a historical increase in the complexity of commercially published tests of cognitive ability. The Cattell-Horn-Carroll model has fueled theoretically informed test development, with new subtests as indicators of lower strata abilities not directly measured on older tests. Educators and clinicians have embraced interpretive schemes that rely on published factor structures, even when statisticians and assessment researchers have disagreed about the true factor structure of the measure. The Freedom from Distractibility Index on the Wechsler scales (Sattler, 1992; Wechsler, 1974, 1991) and the Stanford Binet Fourth Edition (e.g., Boyle, 1990; Thorndike, 1990) are two historical examples where there has been considerable controversy about the factor structure assessed by the respective protocols. The lack of consensus about decision rules for determining the number of factors has led to confusion regarding the number of interpretable factors. A growing body of statistical methodological literature suggests that two decision strategies, Horn's Parallel Analysis (HPA; Horn, 1965) and the Minimum Average Partial (MAP; Velicer, 1976) method, are substantially more accurate than competing algorithms (such as the Kaiser Criterion and maximum-likelihood based fit statistics) for determining the correct number of factors (Velicer, Eaton, & Fava, 2000; Zwick & Velicer, 1986). This paper applies Horn's Parallel Analysis and the Minimum Average Partial technique to the published correlations of several, frequently used tests of cognitive ability. Results indicate that published factor structures consistently overestimate the number of dimensions of cognitive ability reliably measured by the subtests. MAP and HPA tend to agree with each other, with the number of factors retained being one to three fewer than the published structures. These results are not interpreted as indicating that the other purported cognitive abilities do not exist. Instead, results suggest that the subtests do not contain adequate covariance to confirm or refute the existence of the contested dimensions. Results also have important implications for clinical practice: If subtests do not measure a cognitive ability adequately enough to satisfy statistical criteria based on large samples, then the construct is not being measured with enough validity to support decision making about individuals based on observed variable scores.

Crystallized Intelligence in a Multifaceted World

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Crystallized intelligence (Gc) has been identified as one of the major second order factors in human intelligence. It has been defined as "the ability to apply previously learned (often culturally defined) problem solving methods to new situations. Gc is typically measured by a person's competence in ostensibly culturally defined tasks, such as vocabulary evaluation and paragraph comprehension. Here I examine the concept of crystallized intelligence in more detail. In particular, I argue that in a highly differentiated society Gc cannot be defined as a unidimensional concept. At the upper levels, Gc merges into the concept of expertise, which is itself known to be highly specialized. In the normal range, apparently unidimensional measures of the extent to which a student can apply problem solving techniques and concepts for which the student has received instruction break down when we look at student justifications for both right and wrong answers. This point will be illustrated by an examination of student answers and justifications observed in high school students' reasoning about problems in mathematics and physical sciences. Finally, I suggest that the concept of 'practical intelligence' is simply a reflection of crystallized intelligence as applied to particular social situations.

Metacognitive Aspects of Test-Taking and Intelligence

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This paper reviews recent work on the metacognitive traits of self-confidence and self-monitoring. These traits can be measured using typical tests of cognitive abilities. They are also implicated in the work on ecological validity and probabilistic decision-making. It appears that an individual differences perspective may be beneficial for the explanation of the main findings of under- and overconfidence. Individual differences in self-confidence are stable and general across many different cognitive tasks. The trait of self-confidence resides on the borderline between personality and intelligence. This paper also reviews the evidence for age and gender differences and for the predictive validity of self-confidence.

Oculomotoric Parameters and Speed Tapping, Very Short Psychomotoric Times, Correlate with Psychometric Intelligence

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The aim of our study was to broaden the knowledge about the relationship between very elementary cognitive behavior and intelligence. We had previously found substantial correlations (Galley & Galley 1999) between fixation durations and saccadic latencies. These very short times lie in the order of 250 ms. In our new study 271 subjects were recruited and tested by students in three courses of biological psychology supervised by experienced members of the institute. Their eye movements in different tasks (Picture Inspection, Raven, Square Wave Tracking and others) were measured by the electrooculogram with computer aid. The program identified on-line all saccades on a 1 ms time base and stored them on the hard disk of a PC. The speed tapping was performed with a Morse Key and a program which identified and store all key pressures at a 2 ms time base. The German Wechsler Test HAWIE-R (Tewes 1991) was used for measuring the full scale IQ, Performance IQ and the g-factor (the first unrotated factor of principal component procedure). Results show moderate but significant negative correlations (-.2 to -.36) between different psychomotor times (as fixation durations, saccadic latencies, tapping intervals) and IQs. In most instances the slimness of the distributions of the psychomotor times correlate higher than the median of the time measures with the IQs. But contrary to our expectations the different time measures correlate low with each other thus weaken the assumption of a general speed factor as the basis of the g-factor. We used the height of the correlation to the IQ as a tool for searching the qualities which characterize a behavior with closer relationship to intelligence. As a first formulation we propose: all these parameters lie closer to intelligence which *are shaped by inhibition for reaching a definite goal*.

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Comparisons of the Visual Search Performances of Individuals With and Without Mental Retardation

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The ability to focus attention on task-relevant features in visual arrays while inhibiting attention to irrelevant elements is fundamental for performing accurately and efficiently on experimental and educational tasks. The development of standardized methodologies for studying search behaviors and an increased understanding of factors influencing the allocation of attention in complex visual arrays has provided a framework within which intelligence-related differences in this important basic behavior may be studied. We have utilized feature search, guided search, and attentional capture tasks to determine the extent to which individuals with and without mental retardation differ in visual search efficiency, and the factors that govern their allocation of attention. With regard to the latter goal, we are interested particularly in the relative roles of top-down (i.e., goal-based) and bottom-up (i.e., stimulus-driven) processes in the guidance of attention. In our initial studies that utilized a standard feature search task, we found that individuals with mental retardation identified targets significantly more slowly, and demonstrated inefficient search (i.e., serial search) for targets defined by form or size. Thus, some individuals with mental retardation were less perceptually sensitive to the feature differences utilized. However, all individuals with mental retardation were capable of identifying targets quite rapidly (i.e., parallel search) when feature differences were augmented (i.e., color-based search). Recently, we have utilized more sophisticated search tasks to assess the complex interplay between top-down and bottom-up processes, and the relative influence of these processes on the search behaviors of individuals with mental retardation. Our *guided search* studies have used visual arrays within which a small subset of stimuli share the target's color but differ in form, and the remainder of the stimuli differ in both color and form from the target. The participant may be able to limit search to only the small subset that share the target's color, and serially search this subset to determine whether the target is present or absent. Such behavior would indicate sophisticated top-down control of attentional allocation. Results have indicated that individuals with mental retardation do demonstrate this pattern of results. Finally, we have used a standard *attentional capture* task to assess the extent to which bottom-up processes govern attentional allocation. In this task, a single highly salient distractor that is incongruent with the search goal is presented on some trials to determine if it will disrupt performance. Disruption would indicate that visual search is susceptible to the influence of stimulus-driven processes that are orthogonal to the instructed goal of the search task. Results have indicated that individuals with and without mental retardation are susceptible to such distraction, but only when the search task is difficult (i.e., requires serial search for the target). When the target is highly salient, the "capture stimulus" does not influence search times. Thus, these data demonstrate the complex interaction between top-down and bottom-up processes on visual search tasks, and that the search behaviors of individuals with and without mental retardation are similarly governed by these processes. We believe these results advance our understanding of an important basic component of behavioral functioning in individuals with mental retardation, and contribute to the general understanding of human visual search behaviors. Further, knowledge of factors that govern the allocation of attention may be utilized to develop and design sophisticated training programs for individuals with mental retardation.

Motor Packaging and Neural Efficiency: Implications from the Systematic Examination of Clinical Populations

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Movement time (MT) has often been demonstrated to be significantly correlated with intelligence. As it is not immediately apparent why a motor response should be correlated with cognitive ability, this finding is usually dismissed as being a spurious correlation, related to subjects failing to complete their decision prior to responding. It is possible, however, that the programming of motor responses is more efficient in individuals of high ability. This presentation will propose a hypothesis of motor programming efficiency, based on individual and group differences in the generation of meaningful “packages” of information. Given that current animal models of motor planning and execution suggest that these processes are predominantly performed within the basal ganglia, it is likely that individual differences in motor efficiency are localized within this area of the brain. Empirical support for the hypothesis will thus be presented from a study conducted on a sample of individuals with Parkinson’s Disease (PD) - a neurological disorder that affects the efficiency of the basal ganglia. Two very simple motor-speed tasks were utilized - a task providing advance information concerning the movement to be performed, and a task providing no advance information concerning the movement. 40 PD patients and 40 matched controls participated in the study. Four interesting results emerged from the analysis: (1) PD patients had significantly slower MT than controls, $F(1,78)=36.96, p<.0001$; (2) Dopamine replacement medications significantly improved movement time, $F(1,78)=7.16, p<.01$; (3) Control subjects had significantly faster MT on tasks involving motor packaging, $F(1,78)=5.63, p<.05$; and (4) Dopamine replacement medications improved tasks involving motor packaging to a greater extent than tasks that did not, $F(1,78)=3.92, p<.05$. Implications for the use of reaction time paradigms in unimpaired populations are presented, along with suggested directions for expanding this theory through modifications to conventional reaction time paradigms.

On the Mechanisms of Elemental Cognitive Components in *g*

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Recent studies relating elementary cognitive tasks to psychometric *g* have indicated the importance of two elemental cognitive components to *g*, Processing Speed and Working Memory. The exact mechanisms of the two components are still not fully clarified. In the present study, data from a sample of 532 primary school pupils who participated in the Western Reserve Twin Project were analyzed. Two issues regarding the mechanisms of the two elemental cognitive components were addressed: (1) Identification of the mechanism controlling the intra-person between-trial variability measures of the elementary chronometric tasks; (2) Identification of the mechanism underlying the additional variability component shared between some elementary working memory tasks and *g* beyond the influence of the elementary chronometric tasks. The results of the data analyses using the Reaction Time task and the Stimulus Discrimination task demonstrated that, from a nomothetic perspective, the latency and the variability measures of response time in these tasks were inextricably inter-connected, and both were functions of a more fundamental process, the salience of signals in mental representation. The strong correlations between the latency and the intra-person between-trial variability measures of the two tasks, and the non-differentiable correlations of the two classes of measures with *g* suggested that, the two classes of measures are probably also intrinsically connected by the mechanism of signal salience in mental representation. Structural equation models indicated that the additional variability elementary working memory tasks typically share with psychometric *g* beyond the influence of elementary chronometric tasks was the most proximate in a factorial space to a psychometric memory factor, indicating that the additional variability probably represents a distinctive function of working memory processing in *g*, instead of merely reflecting a higher complexity of the working memory tasks than that of the chronometric tasks.

Inspection Time and the Relationship Among Elementary Cognitive Tasks, General Intelligence and Specific Cognitive Abilities

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The relationship between inspection time and psychometric intelligence is well documented. However, the extent to which inspection time relates to intelligence through general intelligence or through group factors has not been fully addressed. It is also unclear whether inspection time contributes variance to psychometric intelligence independent from other elementary cognitive tasks. The current study examined these issues using 568 participants drawn from the Western Reserve Twin Project.

Confirmatory factor analyses suggest that shared variance between inspection and other elementary tasks predict psychometric intelligence primarily through the general intelligence factor. Inspection time also predicts variance in 'g' and Performance independent from other elementary tasks. These suggest that multiple indices of elementary cognitive ability are necessary to more fully understand their relationship with more complex psychometric measures.

The Down Syndrome Cognitive Phenotype: Does it Exist?

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The study of behavioral phenotypes involves studying the phenotypes of individuals with specific genetic disorders. In general, it is believed that individuals with a specific genetic syndrome may tend to exhibit similar physical or behavioral traits because they share a common genetic anomaly, as compared to individuals who are not affected by a genetic disorder (Dykens, 1995, *American Journal of Mental Retardation*, 99, 522-532). Despite a variability of expression of traits within syndromes and the nonspecificity of traits between syndromes, attempts at defining several behavioral phenotypes have met with some success. Most of the success has been in defining medical and behavioral characteristics of groups. For example, medical and behavioral characteristics of syndromes such as Fragile X syndrome, Prader-Willi syndrome, and Down syndrome have been identified. However, there has not been as much success in defining specific cognitive strengths and weaknesses associated with syndromes that can be systematically used to distinguish between a particular syndrome and other syndromes. Therefore, the purpose of the present study was to determine if it was possible to classify individuals to their correct etiological group on the basis of their cognitive test performance. The two groups examined in the present study were individuals with Down syndrome (DS) and individuals with nonspecific mental retardation (MR). Ninety-six individuals participated in the present study: 52 DS and 44 MR. Mean age for the DS group was 31 years (range 16 – 51), and mean age for the MR group was 34 years (range 17 – 65). Groups did not differ significantly for age, $t(95) = -1.196, p > .05$. Participants were given the WAIS-R to measure general cognitive ability and the Cognitive Abilities Test (Detterman, 1988, CWRU, Cleveland, OH) to measure basic cognitive skills. Mean DS Full Scale IQ was 56 (SD = 6.4), and mean MR Full Scale IQ was 57 (SD = 8.9). There were no significant differences between the groups for WAIS-R Full Scale IQ, $t(95) = -.820, p > .05$.

Discriminant analysis was used in an attempt to find group differences between the WAIS-R scaled subtest scores, and to find group differences between the CAT basic cognitive variables. Initial analyses were encouraging. It appeared that discrimination between different etiological subgroups of mental retardation, based on cognitive variables, was possible. The DS and MR groups were successfully differentiated from each other in several analyses. However, because of a concern that age might be affecting the results, a final discriminant analysis, correcting for age, was performed. Once age was removed, the discriminant function was not significant, and the groups could no longer be discriminated based on cognitive variables. Thus, it appears that the cognitive variables themselves were not discriminating between the groups, but rather it was age, mediated through the cognitive variables, that allowed group differentiation. Even though the present study was not successful in developing a cognitive phenotype associated with Down syndrome, there were still important findings. Practical and theoretical ramifications of the results will be discussed. Results will be discussed in terms of the framework that human intelligence is composed of a set of interrelated, yet independent, parts.

The Definition of Reading Disability

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How to define reading disability is still a hotly debated question. Some would contend that measures of intelligence do not play a role in the diagnosis of reading disorder. Others use measures of general intelligence and even specific subtest patterns for diagnosis. This paper examines the subtest scores on the WISC-R for two reading disabled groups: 1) those identified as reading 1.5 standard deviations below expectations based on WISC-R IQ; 2) those identified as reading 1.5 standard deviations below average for their age. Results indicate that reading disability is not a homogeneous group. Both groups can be discriminated from matched controls, as well as each other, based on WISC-R subtest scores. Additionally, Receiver Operating Curve (ROC) analyses indicate that ipsatized subtest scores may have much greater diagnostic utility than previously thought.

Method of Correlated Vectors at the Item Level

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The method of correlated vectors is considered a means of establishing further the correlation between factor scores (e.g., derived from a 'g' factor) and another variable of interest. Traditionally, this method has been applied at the subtest level. In this presentation, evidence for the application of the method of correlated vectors at the item level will be presented. The Advanced Raven's Progressive Matrices and a battery of reaction time (RT) tests were administered to two samples of adults (N = 105 and N = 402). The content of the RT tasks varied from verbal (e.g., Synonyms/Antonyms), analytical (e.g., Sentence Verification), to short-term memory scanning speed (e.g., Digits and Arithmetic). In the first sample, the item-total correlations correlated with the item-RT_g correlations at -.90 (rho = -.89, p<.05). In the second sample, the item-total correlations correlated with the item-RT_g correlations at -.43 (rho = -.49, p<.05). These results are interpreted to suggest that, in cases where only one highly 'g' loaded subtest are administered, it can be demonstrated that the correlation between a subtest and a another variable of interest is, in fact, due to 'g'.

Author Index

- Bates, T., 10
Brody, N., 23
Carlin, M. T., 39
Detterman, D. K., 16, 17, 41, 42
Donaldson, C., 33
Doppelmayr, M., 9
Fagan, J. F., 26
Frazier, T., 35
Gabriel, L. T., 43
Galley, N., 38
Garlick, D., 18
Gignac, G. E., 45
Gordon, R. A., 30
Gottfredson, L. S., 29
Grubb, W. L., 13
Holland, C. R., 26
Hunt, E., 36
Jensen, A. R., 24
Jog, M. S., 40
Johnson, A. M., 40
Kastrup, K. W., 11
Kaufman, J. C., 32
Klimesch, W., 9
Loiselle, R., 39
Luo, D., 17, 41, 42
McBride, D. K., 27
McDaniel, M. A., 13, 14
Mingroni, M., 21
Naeraa, R. W., 11
Nathan, P., 10
Neilsen, J., 11
Nguyen, N. T., 14
Norman, K., 27
Nyborg, H., 11
Palmer, B., 33
Petrill, S. A., 42
Plomin, R., 15,
Rushton, E. W., 20
Rushton, J. P., 20, 25
Ruthsatz, J., 31
Schroeder, D. H., 19
Soraci, S. A., 39
Stadler, W., 9
Stankov, L., 37
Stough, C., 10, 33
Strawbridge, C., 39
te Nijenhuis, J., 22
Thompson, J., 10
Thompson, L. A., 15, 17, 41, 42, 44
Tiu Jr., R. D., 44
van der Flier, H., 22
Vernon, P. A., 40, 45
Wilhelm, O., 34
Youngstrom, E. A., 35, 44