Human Cognitive Abilities
In Theory and Practice
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Human Cognitive Abilities in Theory and Practice

Edited by
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and
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This book is dedicated
to the memory of
Dick Snow
—a talented teacher, a pioneering researcher,
a friend and colleague, and a role model for all of us
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Introduction

Research on human intellectual abilities has a long history in psychology and education. This work, unlike many other areas of social science research, has been widely applied to practical work in schools, clinics, and employment settings. These issues are widely discussed by scientists, practitioners, researchers, scholars, writers, clinicians, and other people.

During the past few years, in our discussions with many influential scientists in this area, a common set of concerns were raised—many scientists perceived an increase in the gap between intellectual abilities theory and practice. For example, scholars studying intelligence consistently mention the widespread use of single IQ measures in research and clinical practice. Some of these discussions focus on theoretical issues and formal models. Some well-known scholars claim that a general factor of intellectual ability is grounded in the findings of extensive research studies. Other equally respected scholars say the evidence does not support the hypothesis of a single factor of intelligence. Some of this controversy stems from the use of different methods for the analysis of cognitive data. This includes different views about the appropriate design and interpretation of factor analytic research. Personal views on these topics are often a key part of these debates.

Such controversy has important practical outcomes. Some practitioners claim optimal efficiency in the use of a single IQ measure, no matter what behavioral outcome is of interest, and cite only the research consistent with this position. Others conclude that multiple measures of cognitive functioning are required, and again cite evidence consistent with this position. These practical considerations are so important to the public that they often overshadow the original theoretical questions. For example, those who construct intellectual ability tests are compelled by market demand to provide a single composite score, whether or not such a construct is appropriate. Test batteries are questioned for not producing a score called IQ, and some new tests are labeled different rather than improved. In such ways, intellectual ability tests are considerably different than other areas of assessment, such as personality and school achievement.

Questions about the current level of progress in matching of theory and
practice led us to believe that a conference on human cognitive abilities (or HCA) discussing these scientific issues would serve some broadly useful functions. Our plan was to start this conference with discussions directed at defining major issues in contemporary research on HCA, and use this to lead to more practically oriented issues. Our HCA conference was held at the Dome Room of the Rotunda at the University of Virginia on September 22 through 24, 1994. This book represents the proceedings of this conference.

Just a few months later, it is interesting to look back on the conference and reflect on the importance of open scientific discussion of these potentially controversial issues. The HCA meeting was opened with a few quotes ascribed to the founder of the University of Virginia, Mr. Thomas Jefferson:

And, finally, that truth is great and will prevail if left to herself, that she is the proper and sufficient antagonist to error, and she has nothing to fear from the conflict unless by human interposition disarmed of her natural weapons, free argument of debate, errors ceasing to be dangerous when it is permitted freely to contradict them. (from the Virginia Act for Religious Freedom, 1786)

No experiment can be more interesting than that we are now trying, and which we trust will end in establishing the fact, that man may be governed by reason and trust. Our first object should therefore be, to leave open to him all the avenues of truth. [letter to Judge Tyler, 1804]

If M. De Becourt’s book be false in its facts, disprove them, if false in its reason, refute it. But, for God’s sake, let us freely hear both sides, if we choose. [letter to Mr. Dufief, 1814]

This institution will be based on the illimitable freedom of the human mind. For here we are not afraid to follow truth wherever it may lead, nor to tolerate error as long as reason is free to combat it. [to prospective teachers, University of Virginia, 1822]¹

In this spirit, each presentation at the meeting was followed by an open and often lively discussion. Raised here were controversial issues of mental testing and public policy, crime and social class differences, race differences in IQ, and the practical uses of behavioral genetic research. Our audience at the Rotunda was diverse in academic and intellectual background—it even included one member of a group allegedly investigating the scientific and personal philosophies of some of the speakers! Only a few short weeks later, these same issues exploded on the front pages of newspapers and prime time television as a consequence of the widespread and diverse reactions to the publication of *The Bell Curve*, written by R. J. Herrnstein and C. Murray.


Although readers of these chapters will find some areas of reasonable agreement, this conference and this book also reflect a diversity of methods and reasoning used to examine a diverse set of problems. Because we do not believe the answers to such questions are yet resolved, it is precisely this kind of diversity that we strive to interject into contemporary discussions on human cognitive abilities. All authors submitted drafts of these articles to the editors and, by design, few editorial changes were advised or made. We hope the reader will be encouraged by this Jeffersonian tradition and use these chapters to promote well-reasoned debate on these contemporary topics.

**CONTENTS OF THIS BOOK**

The contents of this book follow the organization and chronology of the HCA meeting. Three historic figures in the area of human cognitive abilities were invited to give the first HCA conference keynote addresses. These three overviews, as well as a more detailed introduction to each author, are presented in the first section of this book.

The first keynote address was delivered by Dr. John B. Carroll [Professor Emeritus, University of North Carolina]. Dr. Carroll’s recent 1993 book, *Human Cognitive Abilities: A Survey of Factor-Analytic Studies*, provides a classic reference source on the main topic of the conference. An introduction to this work of Dr. Carroll is given here by Dr. Richard Snow [Stanford University].

The second keynote address was presented by Dr. Raymond B. Cattell [Professor Emeritus, Universities of Hawaii and Illinois]. Dr. Cattell’s contribution to knowledge and theory in this area is indicated by his 1971 book, *Intelligence: Its Structure, Growth, and Action*. Dr. Cattell is introduced here by Dr. John Horn [University of Southern California].

The third keynote address was given by Dr. Evegny Sokolov [Chairman of Psychology, Moscow State University]. Dr. Sokolov is the only foreign member of the National Academy of Sciences, and one of his many books, *Perception and the Condition Reflex* [1958], forms the basis of modern research in psychophysiology. Dr. Sokolov is introduced here by Dr. Steven Porges [University of Maryland].

The second part of this book contains talks based on research of a more focused and contemporary nature. Dr. John Horn [University of Southern California] presents research on the theory of fluid and crystallized intelligence. Horn reviews evidence suggesting that single measures of intellectual abilities are not sufficient—for example, they do not capture the age-
related variance in human cognitive functioning. Dr. Richard Snow (Stanford University) discusses current research on abilities regarded as aptitudes and as achievements in school learning situations. Snow discusses the evidence needed for a theory of abilities, and provides evidence on the need for dynamic person-situation interactions in learning. Dr. Sandra Scarr (University of Virginia) discusses theoretical models and empirical research on how families do and do not affect individual differences in intellectual abilities. Scarr compares the goodness of fit of social environmental theories against alternatives provided by those from behavioral genetic theories, and she discusses the social policy implications and misperceptions arising from these kinds of data.

The final two chapters of this section are based on the research of the conference organizers. Richard Woodcock shows how new techniques based on multiple ability measures can be used in a variety of practical settings. Jack McArdle shows how different concepts of test bias may be evaluated and tested using structural equation modeling techniques and logic.

The third section of the book includes some excellent contributions presented at the poster session of this conference. Steven Aggen (University of Virginia) presents research on structural equation models for linking different measurement batteries (the WAIS and the WJ-R), and shows how powerful measurement hypotheses can be tested in the context of large blocks of incomplete data. Steven Boker (University of Virginia) discusses work on computer-based testing using a remote measurement scheme termed psychotelemetry. Fumiaki Hamagami (University of Virginia) presents some models for test-retest data where the data are measured at the item level. Patricia Hulick (University of Virginia) examined issues about gender differences using multivariate data from the WJ-R and multivariate models of factorial invariance. Jennie Noll (University of Southern California) discusses an ongoing project on cognitive aging. Thomas Paskus (University of Virginia) discusses methods for creating optimal cutoff scores on psychometric tests using a decision theory framework.

ACKNOWLEDGMENTS

The HCA conference was initially based on an idea from Robert Harrington at the University of Kansas. This and other ideas were eventually turned into a conference by members of the Jefferson Psychometric Laboratory of the Department of Psychology at the University of Virginia. Support for the research of this laboratory has come from grants from the National Institute on Aging [AG-04704 and AG-07137]. The HCA conference was also sponsored by a special grant from the Riverside Publishing Company, and we thank Riverside President John Oswald, Vice President Fredrick Shrank, and
National Consultant Barbara Wendling for their support and encouragement of this project.

We also owe a special debt of gratitude to Carolyn Nesselroade and Marilyn Rothstein for their overall assistance in organizing all aspects of the HCA meeting. Finally, we also thank all the University of Virginia students who worked on various aspects of HCA, including Steve Aggen, Steve Boker, Aki Hamagami, Patty Hulick, Paolo Ghisella, Jungmeen Kim, Tom Mulligan, Gina Marshall, Laura Paskus, and Tom Paskus.

It is important to note that many other well-known scholars attended this conference (they are cited in the list of participants at the end). These persons contributed to the lively discussion periods following each presentation, and we are grateful for their attendance and their continued support of this work.

—John J. McArdle
—Richard W. Woodcock
Charlottesville, VA
January 1995
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I

KEYNOTE SPEAKERS
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I am pleased and honored to be invited to participate in this conference. The last time I was in Mr. Jefferson’s Rotunda was 36 years ago, when I marched through it and down the lawn to receive a B.A. in Psychology from The University; it is thus a special treat for me to be here. Above all, however, I am most deeply honored to be asked to introduce John B. Carroll (known to his friends as Jack). I feel that I have been a student of Jack Carroll’s ever since my UVa days—not in the sense that I took courses from him or had his supervision in research, but rather as a “distance” learner. I am sure that many others present today feel that way, too.

I have read a good deal of his work and heard him speak many times, and used a lot of his ideas, and yet it is impossible to keep up. He has been such a prolific scholar for so long in the fields I work in—the differential psychology of human abilities and the educational psychology of learning and instruction. But then to recognize that he has also been a pioneering and prolific scholar in several other fields—psychometrics, psycholinguistics, verbal learning and behavior, foreign language learning and teaching, and the teaching of English—it becomes clear that his career has been truly phenomenal. Let me recount it here briefly.

Jack Carroll was born in 1916 in Hartford, Connecticut and attended public schools there. As a young student, he was a language hobbyist and had weekly sessions with Benjamin Lee Whorf, famous for his theory of linguistic relativity. Jack then attended Wesleyan University, graduating in 1937 with a B.A. and highest honors in classics. Through his school years, he became proficient in Latin and classical Greek as well as French and German, and even browsed in the grammars of such languages as Sanskrit and Armenian. I once met him at a conference in Greece and found him teaching himself modern Greek by reading signs, billboard advertisements, and the like.
In 1940, he took his Ph.D. in psychology from the University of Minnesota, but he had also done summer graduate work in linguistics at Michigan and work on psychometrics and factor analysis with Thurstone at Chicago, even though he was nominally a student of B. F. Skinner's at Minnesota. His doctoral dissertation was a factor analysis of verbal abilities. I believe Jack is thus the only psychologist to have ever studied with both B. F. Skinner and L. L. Thurstone—a remarkable combination.

In the period 1940 to 1949, he was an instructor at Mt. Holyoke and at Indiana University, a lecturer at the University of Chicago, and also a U.S. Navy aviation psychologist and a U.S. Army research psychologist. Then, in 1949, he went to Harvard University, where he rose through the professorial ranks to become the Roy E. Larsen Professor of Education. After 17 years at Harvard, moved to spend the years 1967 to 1974 as Senior Research Psychologist at Educational Testing Service. From 1974 through the present he has been the William R. Kenan Jr. Professor of Psychology at the University of North Carolina, Chapel Hill, and has also served as Director of the L.L. Thurstone Psychometric Laboratory there. He became Professor Emeritus at North Carolina in 1982, however, no one noticed this step because his publication rate didn’t change.

He has held offices in many professional and scientific organizations, and won many honors for his work. Just to mention a few: He is a life member of the Linguistic Society of America, a Fellow of APA and AAAS, and a member of both the Psychometric Society and the Psychonomic Society. He has been active in AERA, the Modern Language Association, the National Council of teachers of English and Conference on Research in English, the American Council of Teachers of Foreign Language, and the Association for Computational Linguistics. He is a founding member of the National Academy of Education. He has received the E. L. Thorndike Award for Distinguished Contributions to Educational Psychology, the ETS Award for Distinguished Service to Measurement, the Diamond Jubilee Medal from the London Institute of Linguistics, and an honorary doctorate of science from the University of Minnesota.

Jack is the author of over 400 journal articles, book chapters, reviews, encyclopedia pieces, and other writings. There is no way to do justice to the breadth and depth of scholarship represented in that list. In 1985, Lorin Anderson edited a book that brought together some of Jack’s seminal writings in the field of research on school learning. It included a bibliography of most of Jack’s other work up to that time. However, a range of significant contributions have come out since then, right up to the present.

Beyond all of this, Jack has also written or edited several important books. I want to mention just two of them. In 1964, he published Language and Thought, a small book in a basics concepts series published by Prentice-Hall. At the time of its publication I was just out of graduate school and,
having not had any course work in that field, I read the book. I have had oc-
casion to refer back to it since. It I the only book I know that manage to be
both a clear, comprehensible introduction for the beginner and an advance
in scholarship for the field at the same time—and it accomplishes this in
only about 100 pages.

In 1993, Jack published *Human Cognitive Abilities: A Survey of Factor
Analytic Studies*. As it happened, the publisher, Cambridge University
Press, asked me to be one of the book’s reviewers. I wrote them a very posi-
tive letter and they ended up quoting from my review on the book cover. I
said in that review that:

Jack Carroll has done a magnificent thing. He has reviewed and reanalyzed
the world’s literature on individual differences in cognitive abilities, col-
lected over most of a century, to reach an integrated picture. No one else
could have done it. No one else would have applied so consistent and impar-
tial a system on the literature, reached so balanced, complete, and useful a
conclusion. It is a monumental contribution, destined to be bought and read
in every university in the world over that has a psychology or education de-
partment, an to be on many an individual scholar’s shelf as well. It defines
the taxonomy of cognitive differential psychology for many years to come.

We are all tremendously impressed with and tremendously grateful for
your work, and we are very happy to be here with you today, Jack. Please join
me in welcoming John B. “Jack” Carroll.

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