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I.I. Bejar R. Chaffin S. Embretson

Cognitive and Psychometric Analysis of Analogical Problem Solving

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Isaac I. Bejar
Division of Education Policy
Research
Educational Testing Service
Princeton, New Jersey 08541, USA

Roger Chaffin
Trenton State College
Trenton, New Jersey 08625, USA

Susan Embretson
University of Kansas
Lawrence, Kansas 66045, USA

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To John B. Carroll whose contribution to psychometrics and cognition precipitated their merger in understanding aptitude.

Preface

If one were to conduct an analysis of any profession the "ability to think analogically" is more than likely to be one of the requirements for success, be it an architectural studio, a research laboratory, a legal office, or a nuclear plant. Cognitive scientists are aware of the prominence of analogical reasoning in all forms of reasoning and learning, and have devoted substantial effort to ascertaining its nature. Test builders, like cognitive scientists, are aware of the centrality of analogical reasoning and figure, correctly, that a test that samples a student's ability to think analogically may well be a good predictor of success in a variety of fields. This book is the result of a project to investigate analogical reasoning from both an individual differences and a cognitive perspective.

The book is directed to both researchers and practitioners concerned with the nature and measurement of analogical reasoning. Cognitive scientists, linguists, psycholinguists, and natural language researchers will find the semantic taxonomy and accompanying empirical results food for thought. Test developers will find it reassuring that performance on verbal analogy items is not just a reflection of the size of a person's vocabulary, and that tests can be *designed* according to principles, rather than *assembled* to satisfy a set of statistical specifications. Psychometricians will find that content and response modelling can go together and that there are distinct benefits in approaching psychometric response modelling from that integrative perspective.

Although the project was carried out in a "testing context" we believe it complements the related basic research literature and hope that it will be a small contribution to the psychological literature in its own right. The book also illustrates the benefits of combining psychometric and experimental approaches to understanding the nature of individual differences. Lee Cronbach is credited with alerting the rest of us to the need for that integration. However, the effort got started in earnest, with Jack Carroll's *New Structure of Intellect*, and for that reason we dedicate the book to him, with thanks.

The book came about from the confluence of several events. As I.B. was preparing a proposal to study determinants of analogical problem solving he became aware of R.C.'s work on semantic relations. A one-year scholarly visit, which was extended to a second year, was arranged. It was during that visit that a taxonomy of semantic relations was developed, in collaboration with Leslie Peirce of the Test Development staff. The taxonomy can be found in Chapter 3, and played a central role in the development of the project. A second fortunate event was that S.E. was due for a sabbatical leave and decided to spend half a year at ETS. She, of course, had had a long standing interest in analogical reasoning, and had been one of the few researchers to attempt studying the role of semantic class on test performance. Finally, and the most

crucial event, the Graduate Records Examination Board decided to fund the proposal.

We owe thanks to more colleagues and friends than we have room to acknowledge but some individuals deserve special mention. Lawrence Stricker, John De Jong, reviewed early versions of the manuscript, Min hwei Wang carried out many statistical analyses and file transfers to and from the dreaded mainframe; Mary Enright designed and carried out the analyses reported in Chapter 7. Research assistants Lora Moses, Becky Walzer, Som Lok Leung, and Sean Whalen admirably performed a variety of tasks. We are also grateful to subjects from Princeton University and to Jessie Cryer who, in addition to her regular duties, coordinated the recruitment of subjects. The project, of course, could have not been carried out without the help of Test Development staff at ETS, most notably Cheryl Wild, Richard Adams, Charlotte Solomon, and Ned Walthall. Finally, we are especially indebted to Debra Friedman who in addition to acting as a project coordinator also took the responsibility for maintaining the database, carried out many of the statistical analyses, and, as a sign of the times, took responsibility for the production of this manuscript. It is more than likely that this book would have never been completed without her penchant for detail, organizational skills, and good humor.

Isaac I. Bejar
Roger Chaffin
Susan E. Embretson
Princeton, NJ

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