Advances in Behavior Genetics

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Behavior Genetics of Cognition Across the Lifespan
Along with psychopathology, cognition has been one of the primary phenotypic focal points of the field of behavior genetics since its inception (Plomin et al. 2012). Darwin (1871) discussed commonalities between the mental powers of humans and other animals, implying a genetic basis to cognitive function. Francis Galton’s 1869 examination of eminent families in Britain was one of the earliest attempts to investigate whether cognitive achievements run in families. As definitions and assessments of intelligence were developed and refined over the following decades (for a review see Chap. 1), behavior genetic investigation of intelligence experienced parallel increases in sophistication. In 1963, Erlenmeyer-Kimling and Jarvik summarized results from the first 50 years of modern behavioral genetic research on intelligence and concluded that the pattern of correlations among pairs of varying types of genetic relatedness “closely approaches the theoretical value predicted on the basis of genetic relationship alone” (p. 1477). They were careful to conclude that although genetic factors may play a large role in potential intellectual achievement, environmental factors will contribute to ultimate cognitive performance. Reactions to strong consistent evidence for genetic influences on intellectual ability prompted many behavioral geneticists to painstakingly explain the concept of heritability. Edited volumes on heredity, environment, and intelligence from that era focused on the perceived incongruity between behavioral genetic and socialization theories of intelligence and the correct interpretation of heritability (Ljungman 1975; Vanden- burg 1968; Vernon 1979). In the meantime, behavioral genetic studies continued to accumulate data and refine their approaches to the issue.

Only 20 years after Erlenmeyer-Kimling and Jarvik (1963), a meta-analysis of familial studies of intelligence included twice as many studies (111 vs. 52) and four times as many correlational pairings (113,942 vs. more than 30,000; Bouchard and McGue 1981). Similar to the earlier review, the authors concluded that the pattern of correlations was remarkably consistent with polygenic theory, but did not discount the importance of environmental factors. Ten years later the results were verified using structural equation modeling, allowing the direct estimation of significant nonadditive as well as additive genetic variance (Chipuer et al. 1990). The development of molecular genetic methodologies over the last 20 years have allowed the field to move beyond anonymous genetic variance to the attempt to
identify specific genes or gene loci that contribute to intellectual functioning. A recent genome-wide association study agreed with previous conclusions that genetic variation makes a significant contribution to intellectual performance (Davies et al. 2011). The results are consistent with the accumulated impact of many small genes having small effects on cognitive function.

Parallel with these advances, behavioral geneticists were still arguing that “developmental psychologists should find room for behavioral genetics” as recently as 1994 (McGue 1994). Two volumes edited by Grigorenko and Sternberg in the late 1990s represent the accumulated state of knowledge at that time (Grigorenko and Sternberg 1997; Sternberg and Grigorenko 2001). The volumes can be considered a matched set, with one focusing on the impact of family environment on intelligence while acknowledging the role of genetics (Grigorenko and Sternberg 2001) and the other attempting to establish that the field has moved beyond the overly simplistic nature vs. nurture controversy with regard to intellectual functioning (Sternberg and Grigorenko 1997). Scarr (1997) wrote of reconciliation between behavioral genetic and socialization theories; but, in the same volume Bidell and Fischer (1997) argued that the basic techniques of behavioral genetics are flawed. Hunt (1997) declared that he did not want to hear the phrase “nature vs. nurture controversy” ever again, while proposing that the argument was more properly political rather than scientific.

Science moves swiftly and we believe that the 15 years intervening since the Sternberg and Grigorenko (1997) volume has brought many changes, both in the field of behavioral genetics of cognition and in its acceptance by scientists generally. In his chapter discussing unresolved questions in the behavioral genetics of intelligence at that time, Waldman (1997) listed: (a) developmental behavioral genetics, (b) gene by environment interaction and correlation, (c) behavior genetics as a tool for examining the construct validity of intelligence, and (d) behavior genetics as a tool for examining causal influences on intelligence. Significant advances in the last decade on all four fronts merit collection in a new volume dedicated to summarizing the current state of the art in behavioral genetic investigations of cognition across the lifespan. Two of the most significant advances in the field guide the structure of the current volume. First, developmental behavioral genetics forms the basic structure of the book, which is divided into sections on childhood and adolescence, middle adulthood, and aging. Recent advances in both collection and statistical modeling of twin data, particularly longitudinal twin data, make this an especially advantageous moment to produce a work that presents a collection of the groundbreaking research on cognitive abilities across the lifespan. Second, two chapters focus specifically on investigations of gene by environment interplay in childhood (Chap. 2) and adulthood (Chap. 6). Increasing sophistication in statistical modeling and molecular genetic methods combine to allow for nuanced investigations of gene by environment correlation and interaction.

The current volume is presented as a survey of the current research in the field of behavior genetics of cognition. This volume presents an overview of the current state of quantitative and molecular genetic investigations into the many facets of cognitive performance and functioning across the lifespan. In the past, it may have been easier to identify distinct fields of study or approaches within behavioral
Preface

In recent decades, the field of behavior genetics has advanced significantly, particularly in our understanding of the genetic and environmental influences on cognitive development and aging. Advances in technology, such as neuroimaging, have provided new insights into the brain's role in cognitive processes. At the same time, the interplay between biology and environment has become more evident, highlighting the complex nature of cognitive function across the lifespan.

The chapters in this volume reflect these advances and aim to capture the current state of research in behavior genetics. The editors have organized the chapters into three parts, each focusing on a different stage of the lifespan: childhood, adulthood, and contributions from biological and neurobiological approaches.

Part I, focusing on childhood, introduces the history of conceptions of intelligence and provides an overview of normative intellectual development. It also discusses the role of genetic and environmental factors in atypical intellectual development.

Part II, dedicated to adulthood, explores midlife and the aging process. It discusses how genetic and environmental factors influence cognitive function and how these factors change over time.

Part III, addressing biological and neurobiological contributions, reviews the impact of recent neuroimaging techniques on our understanding of brain morphology and function.

Each chapter can be read independently but also works together to present a comprehensive view of the field of behavior genetics of cognition across the lifespan. The editors have ensured that the chapters are not only self-contained but also integrated, reflecting the complex nature of cognitive development and aging.

We hope that this volume will serve as a valuable resource for researchers, students, and professionals interested in the complex interplay between genetics, environment, and cognitive function.
of cognition across the lifespan. We identify the issues raised by Waldman that are still in need of attention or resolution and identify new directions that we feel the field is prepared to explore.

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References


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