Intelligence in Context

The Cultural and Historical Foundations of Human Intelligence

Edited by
Robert J. Sternberg · David D. Preiss

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Preface

Intelligence often is thought of as represented by a score on some kind of an intelligence test: a verbal one, a nonverbal one, or perhaps some mixture of the two. The tests yield a score, which may or may not have an impact on decisions that experts or bureaucrats take about an individual's life. The test can provide or restrict educational opportunities, can provide access to special treatments or interventions, and, in some extreme cases, save or cost a person's life if used as a part of a trial for which the death penalty is a result. During most of the twentieth century, intelligence testing played a substantial role in shaping not only our educational institutions but also our society in general. Today, intelligence tests are still widely used, but that use is not exempt from intense debate because of the long-standing differences in test performance between individuals from different socioeconomic, cultural, and ethnic backgrounds.

Many researchers in the field of intelligence look beyond IQ tests in various ways to understand and measure intelligence. Although there are many ways of looking beyond, one of the most important ones is to look to intelligence as it occurs in its natural contexts, including not only the individuals and groups but also the cognitive tools and technologies they use when performing different tasks (Preiss & Sternberg, 2005). John Berry (1974), one of the contributors to this book, was one of the earliest to recognize that intelligence can vary as a function of contextual demands. Michael Cole and his collaborators also have long taken this position (Laboratory of Comparative Human Cognition, 1982), as have many others since then (e.g., Mpofu, 2004; Rogoff, 2003; Scribner, 1984; Serpell, 1974; see essays in Sternberg & Preiss; 2005, and a review in Sternberg, 2020).

As you will discover when you read this book, many of the authors believe that a contextual approach to intelligence is more important than ever. IQ has proven inadequate for solving many, perhaps any of the serious problems the world faces today. And some of these problems, such as climate change, are potentially catastrophic. The name given to the Epoch undergoing this possible eventual catastrophe, the Anthropocene, makes clear that many of the issues that we face today are a result of not only our activities but also our abilities, including those comprised by the construct of intelligence. In addition to understanding the relation of intelligence to its context, it is important to understand how historical changes impact intelligence research: They affect not only our definitions of intelligence and of intelligence assessment but also the nature of the abilities themselves.

The book opens with this brief introduction and then is divided into seven parts.

In Part I, *Intelligence and Cultural Evolution*, researchers consider how cultural evolution shapes intelligence and how intelligence, in turn, is shaped by cultural evolution. This part consists of two chapters: "Intelligence as Ecological and Cultural Adaptation," by John W. Berry, and "Adaptive Intelligence and Cultural Evolution," by Chi-yue Chiu, Hiu-sze Chan, Sau-lai Lee, and Jennifer Yuk-Yue Tong.

Berry advances an ecocultural framework, which suggests that intelligence favors adaptation in multiple and different ways across cultures. This framework rests on two principles: (i) psychological processes are largely universally shared, and (ii) these processes are variably developed historically and ontogenetically. The author indicates that, for understanding intelligence, it is therefore necessary to know the challenges people face in their own ecosystems. Chiu and collaborators link adaptive intelligence to cultural evolution theories and suggest that adaptive intelligence is supported by individual and interpersonal capacities. These capacities have evolved and are evolving to support adaptation in concrete physical, socioeconomic, and social ecologies. The authors propose a conceptual framework for understanding, measuring, and developing a psychological system of adaptive intelligence.

Part II deals with *Culture and Society in the History of Research on Human Intelligence.* There are three chapters: "A Brief History of IQ Testing: Fixed vs. Malleable Intelligence," by Alan S. Kaufman, Dowon Choi, Hansika Kapoor, and James C. Kaufman; "The Idea of a Peculiarly Female Intelligence: A Brief History of Bias Masked as Science," by Gerd Gigerenzer; and "Intelligence and Wisdom in Chinese Intellectual History and in Modern-Day Taiwan," by Shih-ying Yang, Kimberly Y. H. Chang, and Shin-yi Huang.

Kaufman and his collaborators review the history of IQ test development. They assess how different scholars in the history of the field have considered the malleability of intelligence. Specifically, they summarize the views of Binet, Terman, Wechsler, and others on both basic and applied topics related to the definition and interpretation of intelligence and its measurement. Next, Gigerenzer identifies three approaches developed by men to a *peculiarly female intelligence* in order to explain and justify their own superior social position. He summarizes historical approaches as well as other approaches originating from modern research on intelligence and related fields. Closing this section, Yang and collaborators explore the concepts of intelligence and wisdom in Chinese intellectual history and in modern-day Taiwan, showing that, in Taiwan, the Chinese term for intelligence is often used interchangeably with that for wisdom. Then, they trace the evolving concepts of wisdom and intelligence through Chinese intellectual history and present a pilot study exploring perceived differences between wisdom and intelligence in Taiwan today.

Part III focuses on *Socio-cultural Influences in Human Intelligence.* It comprises three chapters: "The Status of Intelligence as a Panhuman Construct in Cross-Cultural Psychology," by Johnny R. J. Fontaine and Ype H. Poortinga; "Cultural intelligence: From Intelligence in Context and across Cultures to Intercultural Contexts," by Kok Yee Ng, Soon Ang, and Thomas Rockstuhl; and "Cultural Change in Africa under the Pressure of HIV/AIDS: The Role of Natively Developed Intelligence," by Mei Tan and Elena L. Grigorenko.

Fontaine and Poortinga summarize the early history of intelligence testing in cross-cultural contexts and present examples of studies that have produced credible findings about effects of economic and social conditions on intellectual performance. Second, they argue that the distinction between credible and noncredible approaches in cross-cultural research on human intelligence centers on a differentiated approach to psychometric equivalence. Third, they discuss various approaches to the assessment of intelligence, in terms of the level of equivalence that can be achieved, and the consequent prospect for cross-cultural comparison. Kok Yee Ng, Soon Ang, and Thomas Rockstuhl take the view that intelligence and context are deeply intertwined. They show how three different streams of intelligence research emerge from different conceptualizations of context: (1) a narrow focus on intelligence in context; (2) an ethnological approach focused on intelligence across cultures; and (3) an integrative approach, which they name "cultural intelligence." The last approach studies the capability to function effectively in the specific context of intercultural interactions. The authors discuss implications and future research directions in the Anthropocene epoch. Tan and Grigorenko discuss culturally shaped components of intelligence playing a relevant role in the survival and well-being of individuals affected by HIV/AIDS in sub-Saharan Africa. They focus specifically on cognition relevant to social responsibility and social connectivity. They then illustrate how such skills have been instrumental in individuals' adaptation, with a focus on the accommodation of AIDS orphans within African kinship systems, and the transformation of African conceptions of time to support habits of medication adherence.

Part IV deals with *Context, Assessment, and Intellectual Performance.* It has two chapters: "Taking an Intelligence Test: Does the Context Matter?" by Adrian Furnham and "A Contextual Approach to Research on Intelligence and Complex Task Performance," by David Z. Hambrick.

Furnham makes a distinction between the academic view and the lay understanding of intelligence, considers issues about the perception and accuracy of intelligence tests, and, in contrast with typical other means of assessment, looks at other everyday tests and markers of intelligence and what they mean. He concludes that most people take a wider view of intelligence and are skeptical about tests because their face validity seems not to coincide with people's understanding of what intelligence means. Hambrick argues that although scores on tests of standardized tests of intelligence meaningfully predict performance in complex real-world tasks, research on intelligence has been conducted in a largely acontextual fashion. He focuses on the interplay between intelligence, domain knowledge, and the environment in complex task performance and sketches out a contextual view of intelligence

Part V covers *Social Issues and the Science of Human Intelligence.* It consists of three chapters: "Mindsets of Intelligence: Their Development, Consequences, and Relation to Group-based Inequality," by Lin Bian; "Re-Envisioning Intelligence in Cultural Context," by Lisa Suzuki, Taymy Josefa Caso, and Aysegul Yucel; and "Challenges for Intelligence Today: Combatting Misinformation and Fake News," by Stephen J. Ceci and Wendy M. Williams.

Bian provides a selective review of implicit theories of intelligence at both the individual and the organizational levels. She discusses the acquisition of these beliefs and their impacts in people's behavior. She comments on people's stereotypes about intelligence based on gender or race, and summarizes evidence showing how a fixed organizational mindset detrimentally impacts individuals of negatively stereotyped groups. Suzuki and collaborators propose that traditional definitions of intelligence are limited in their cultural adaptability. The authors claim that measures must be inclusive of various forms of intelligence, including those advanced by theories of social, emotional, and cultural intelligences. For the authors, intelligence can no longer be defined by a single score but rather must be based on profiles of behavior and outcomes that takes into consideration flexibility, adaptability, and survival. Ceci and Williams discuss how intelligence today must address how people identify and resist misinformation. They propose that current conceptions of intelligence should incorporate how people reason in today's information-rich era, which requires us all to distinguish trustworthy information from fake news. They indicate that the evidence points to the importance of assuming an "openly active method of thinking" to identify and resist misinformation. They conclude by discussing the relationship between this mode of thinking and intelligence as it is usually defined.

Part VI encompasses thoughts on *The Future of the Science of Human Intelligence and Its Implications for Society.* It consists of two chapters: "Human intelligence in the Time of the Anthropocene," by David D. Preiss, and "Time Bomb: How the Western Conception of Intelligence Is Taking Down Humanity," by Robert J. Sternberg.

Sternberg proposes that humans are on a species-suicidal course and that the conventional notion of intelligence has led us to set a time bomb for our own existence. He argues that serious problems in the world will not be solved by conventional education or by selecting students with the highest IQs. He proposes that we need a conception of intelligence in instruction and assessment that considers the kinds of problems people need to solve in order to ensure their survival and that of many other species. This requires focusing on creative, practical, and wisdom-based abilities. Preiss discusses how the transformations we have experienced during the Anthropocene signal the need to more deeply consider the role of context in our thinking of intelligence. Next, he discusses how the cultural evolution of our symbolic abilities is key to understand the properties of modern-day human intelligence. Then, he comments on how the invention of the theory of general intelligence was marked by a lack of consideration of the role of context, notwithstanding the fact that the British founders of the field were working in the midst of the great transformation provoked by the Industrial Revolution. Finally, he concludes by discussing how intelligence research should be conducted to address the demands of the Anthropocene.

Finally, Part VII, *Conclusion,* involves just a single chapter: "Conclusion: Intelligence Does Not Inhere within the Individual but Rather in Person x Task x Situation Interactions," by the editors.

As a whole, this book makes a compelling case for the integration of contextual perspectives in human intelligence research. It includes chapters dealing with the relation between intelligence and natural and cultural evolution, the role of contextual variables in intelligence, the evolution of the concept of intelligence across time, the status of human intelligence in the Anthropocene, and contemporary social issues and intelligence. The book is written for those in the field of intelligence, but also for others who are interested in intelligence and thinking about it beyond the narrow confines of IQ-based and other similar psychometrically based concepts. We believe that the book will also be instrumental to fostering academic dialogue between psychologists and scholars working in other social sciences on issues related to the cultural, social, and contextual determinants of human ability.

This book is not focused on decomposing environmental and hereditary influences in human intelligence but rather on understanding how culture and society impact human intelligence and our understanding of human ability. Additionally, this book can be seen as a companion book to one we edited roughly fifteen years ago that focused on the way tools and technologies both define and amplify human intelligence (Sternberg & Preiss, 2005). That book also made a case for the consideration of contextual variables in our understanding of human intelligence.

We thank Palgrave Macmillan Publishers and our editors there for their helpful assistant in bringing this book into reality. The work of David Preiss in this book was supported by grant FONDECYT No. 1181095. He expresses his gratitude to the *Agencia Nacional de Investigación y Desarrollo*, ANID. We dedicate this book to two giants in the field of context and intelligence, the late Urie Bronfenbreneer and Michael Cole.

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John W. Berry is Professor Emeritus of Psychology at Queen's University, Canada. He graduated (BA) from Sir George Williams University in 1963, and from the University of Edinburgh (PhD, 1966). He received honorary doctorates from the University of Athens and Université de Geneve (in 2001). He is a fellow of numerous academic societies (IACCP, IAAP, IAIR, CPA) and the Royal Society of Canada. He has published over 40 books and over 300 articles and chapters in the areas of cross-cultural, intercultural, social and cognitive psychology with various colleagues.

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Adrian Furnham was educated at the London School of Economics where he obtained a distinction in an MSc Econ. and at Oxford University where he completed a doctorate (D.Phil) in 1981. He has subsequently received D.Sc (1991) and D.Litt (1995) degrees. Previously a lecturer in Psychology at Pembroke College, Oxford, he was Professor of Psychology at University College London from 1992 to 2018. He is currently at the Norwegian School of Management. He has written over 1300 scientific papers and 95 books

Gerd Gigerenzer is a member of the American Academy of Arts and Sciences, the American Philosophical Society, and the German Academy of Sciences. His many awards include the AAAS Prize for Behavioral Science Research, and his books have been translated into more than 20 languages. He has been distinguished as one of the top-100 Global Thought Leaders worldwide.

Elena L. Grigorenko received her PhD in general (cognitive) psychology from Moscow State University, Russia; her PhD in developmental psychology and genetics from Yale University, USA; and her re-specialization in clinical (forensic) psychology from Fielding University, USA. Currently, Grigorenko is affiliated with five universities: Baylor College of Medicine, University of Houston, and Yale University in the USA, and Sirius University of Science and Technology and Moscow State University of Psychology and Education in Russia. Grigorenko has published more than 500 peer-reviewed articles, book chapters, and books. She has received multiple professional awards for her work and obtained funding for her research from numerous federal and private sponsoring organizations in the USA and other countries.

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Alan S. Kaufman has been Clinical Professor of Psychology at Yale's Child Study Center since 1997. He is the author of the landmark 1979 Intelligent Testing with the WISC-R; his books on clinical assessment have been influential for more than a generation. His intelligence and achievement tests (KABC-II NU, KTEA-3, KBIT-2), developed with Nadeen Kaufman, are widely used.

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Robert J. Sternberg is Professor of Psychology at Cornell University and Honorary Professor of Psychology at the University of Heidelberg, Germany. His PhD is from Stanford University and he holds 13 honorary doctorates. He is the past winner of the Grawemeyer Award in Psychology and the James and Cattell Awards from APS. He has been cited over 211,000 times with an h index of 222.

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Introduction

Robert J. Sternberg

Intelligence is often viewed as a fixed entity in the sense that it is what it is, regardless of time or place. In particular, a long-standing view is that it may be viewed as general ability plus more (Spearman, 1927; Carroll, 1993; McGrew, 2005). Or it may be viewed as operationalizable as an IQ (Boring, 1923; Macintosh, 2011).

As a child, I used to read science-fiction books and watch science-fiction movies about alien invasions of the Earth. Examples were *War of the Worlds, Invasion of the Body Snatchers, Invaders from Mars, Earth vs. the Flying Saucers,* and countless others. The basic plot was always about the same. Aliens invade Earth. The Earth becomes aware, late in the game, that it is being invaded. People, usually all over the world, unite to repel

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the invaders. The Earthlings succeed. But it is not at all clear that there won't be another alien invasion sometime in the future.

There was one basic assumption in all the movies—that the people of Earth would unite to repel the invaders. Even countries that were deeply antagonistic to each other, such as the United States and the Soviet Union, would have to fight their common enemy. But today, can one really imagine the United States working with Russia, or China, for that matter, to repel an extraterrestrial invasion? Worse, can one imagine the United States itself unifying enough to fight such an invasion?

We do not need to speculate on the answer. We already know it because we had a worldwide invasion, not by aliens, exactly, but by the novel coronavirus, the cause of COVID-19. The world failed miserably. As I write, India just had close to 400,000 *reported* new cases of COVID-19 in one day (https://www.nytimes.com/interactive/2020/world/asia/india-coronavirus-cases.html).

This figure has been typical of the last week. The United States, my own country, had close to 33 million cases and almost 600,000 deaths (https://www.google.com/search?q=how+many+new+cases+of+covid-19+has+the+US+had%3F&client=firefox-b-1-d&sxsrf=ALeKk00wlRiSPNOAaLBDwD1VeSvlp_iwmg%3A1620425620685&ei=lLuVYOKtKcKqtQaE5rKwCA&oq=how+many+new+cases+of+covid-19+has+the+US+had%3F&gs_lcp=Cgdnd3Mtd2l6EAMyCAghEBYQHRAeMggIIRAWEB0QHjoHCCMQsAMQJzoHCAAQRxCwAzoHCCMQsAIQJ1D1Jlj0WGDkW2gBcAJ4AIABtwGIAZoTkgEEMjEuNZgBAKABAaoBB2d3cy13aXrIAQnAAQE&sclient=gws-wiz&ved=0ahUKEwjix4Xsy7jwAhVCVc0KHQSzDIYQ4dUDCA0&uact=5). A study published in *The Lancet* study found that an incredible 40% of US deaths were preventable (Woolhandler et al., 2021) had it not been for the bungling of the response by the U.S. federal government. Meanwhile, in 2020 and then in 2021, during the scourge of the lethal delta variant of COVID-19, much of the United States decided to make a public issue an ideological issue, with people not getting vaccinated, not wearing masks, and not socially distancing to show their ideological affiliation. Although Democratic-governed states initially had higher rates of COVID-19, by May 2020 the pattern reversed, and the reversal held up (https://www.jhsph.edu/news/news-releases/2021/as-cases-spread-across-us-last-year-pattern-emerged-suggesting-link-between-governors-party-affiliation-and-covid-19-case-and-death-numbers.html). The difference could not be accounted for by differential health. Rather, the Republican-governed states were less observant of mask-wearing, social distancing, and related precautions, and then were less likely to achieve high rates of vaccination (Bynum, 2021). After 3.26 million deaths worldwide as of May 7, 2021 (https://www.google.com/search?client=firefox-b-1-d&q=how+many+deaths+due+to+covid-19), it is probably fair to say that the "aliens" were, if not winning, doing one hell of a job. If they were humans, we all might not do much better. As David Brooks (2021) pointed out, it hardly seems possible that today's America could have defeated the enemy in World War II. That is how disunified the country has become. The world needs intelligence in context—to solve real problems—not just intelligence to solve test-like problems whose nature if fundamentally different from that of real-world problems.

What does all this have to do with intelligence in context? Let's assume that intelligence, at some level, constitutes adaptation to the environment, as it was originally defined (Binet & Simon, 1916; "Intelligence and its measurement," 1921; Wechsler, 1940). Somehow, the original definition of intelligence as adaptation has been trivialized to refer to performance on tests of IQ or general intelligence. The degradation of the concept is, in some ways, breathtaking. The world faces serious and species-threatening problems such as global climate change, pandemics, and weapons of mass destruction; yet educators are worried not so much about people's ability and preparation to solve these problems, but rather their ability to solve number-series and reading-comprehension problems on passages of no consequences to anyone. That will not prepare students for a world in which their intelligence will be manifested, and in which the world will change for the better, only if the students learn to effectively use their intelligence to solve problems in the real-world contexts in which those problems present themselves.

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Part I

Intelligence and Cultural Evolution

2

Intelligence as Ecological and Cultural Adaptation

John W. Berry

Introduction. What Is Intelligence?

This chapter begins by considering the notion of "intelligence" as situated within ecological and cultural contexts, and then presents an *ecocultural framework* that links these contextual variables to the development and display of individual behaviors. The second part of the chapter illustrates these variables and relationships among them with empirical research in two domains: indigenous cognition and cognitive style. It ends with a consideration of the implications of these conceptualizations and empirical findings for the present and future of human life in the Anthropocene Era.

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In my view, there is a need to understand the concept of "intelligence" in the contexts within which it develops and is expressed. My first articulations of this view were in two papers in the early 1970s. These were titled "Radical cultural relativism and the concept of intelligence" and "Differentiation across cultures: Cognitive style and affective style". In the first, I proposed that we should "wipe the slate clean, and search for the possibility of qualitatively different 'intelligences', developing in differing cultural contexts" (1972, p. 79). In the second paper, I proposed that the cognitive aspects of human functioning (captured by the notion of "cognitive style") needed to be supplemented by the socio-emotional aspects (captured by the notion of "affective style", p. 170).

In both papers, I argued that the "ecological demands" for living successfully in a particular habitat, and the "cultural aids" that promote adaptive behavioral development, needed to be studied and understood before any conceptualization or assessment of individual behavior (especially "intelligence") could be undertaken. An analysis of these ecological and cultural features of the context within which a population lives is first carried out using ethnographic methods and then serves as a basis for the conceptualization and assessment of the behaviors with psychological methods that permit survival across and within generations.

In my first studies, these cognitive and social features were identified during fieldwork, which was carried out in the 1960s in Sierra Leone and the Canadian Arctic (Berry, 1966, 1967). Initially, they were considered to be discrete behaviors that are adaptive to specific local demands. Later, it became apparent that they were not discrete, but rather they formed a pattern of behaviors (Berry, 1983), one that had an affinity with the concept of *psychological differentiation* developed by Witkin et al. (1962; Witkin & Berry, 1975). These behaviors and the patterns that they make may be seen as precursors to the later interests in cross-cultural psychology in the dimensions that contrast the analytic/holistic thinking, individualism/collectivism, and the independent/interdependent ways that people deal with their physical and social worlds (e.g., Berry, 1994; Markus & Kitayama, 1991; Triandis, 1995).

These two early papers contain the core of my ideas on human intelligence: It is a set of cognitive and social capacities and abilities that are adaptive to context; they are organized into patterns that serve societies over time and individuals during their lifetimes, in their attempts to live successfully. This view has become widely accepted in the literature (e.g., Sternberg, 2019). These contexts are the local ecological and cultural habitat, which are both constantly changing; they are also the external influences from contact with other cultures that bring about further changes and challenges. My *ecocultural* perspective on human behavior has evolved from these core ideas (Berry, 1975, 1976, 1980, 1983, 1987, 1994, 1995, 2004, 2018).

All concepts have cultural roots, including the concept of *intelligence* (Sternberg, 2007). The concept of culture is used to describe the characteristic features of a society that are acquired and shared by its individual members; what do they have in common, and what distinguishes them from other societies? These features can be material (such as technology and physical structures), social (such as political and economic institutions), and symbolic (such as values. myths, and religious beliefs). These shared features of the population provide the basis for other common aspects, such as their goals and their motivations to achieve them. The concept of "intelligence" is just one feature of these shared cultural values and goals. It incorporates the important qualities (the underlying processes and overt behaviors) that are considered to be essential for survival and are to be inculcated in individuals and to be developed widely in the population.

Both individuals and groups are needed for the survival of the human species: individuals cannot survive alone; nor can groups survive without individuals procreating. Given this joint requirement, Aberle et al. (1950) have proposed nine functional prerequisites of society that are required to maintain and operate a successful society, and hence their survival as a group, and as individuals. One of these nine functions is having a "shared cognitive orientation", which comprises the multiplicity of cognitive capacities (abilities) that are essential for societal survival. Two other functions are fundamentally social: the need for socialization into the society and the regulation of affective expression among members. Together, these functional prerequisites serve as a foundation for the cognitive and social development of individual members.

The field of cross-cultural psychology (e.g., Berry et al., 2011) considers that all human behaviors are shaped by the cultural contexts in which they have developed and are expressed in daily life. That is, individual behaviors are viewed as long-term adaptations to living in a culture through the processes of development and enculturation. One background to this basic principle of individual adaptation to cultural context is that cultures are themselves situated in broader *ecological* contexts; features of cultures are fundamentally shaped by the supporting and constraining features of the physical habitat in which they have evolved. In addition, the new *sociopolitical* contexts are introduced by contact with other cultures. That is, cultural features of the society, as well as individual behaviors, are considered to be attempts to improve the "fit" among individuals, societies, and their habitats. This sequence of adaptations is at the core of my ecocultural perspective (Berry, 2018).

This ecocultural perspective is based on two principles: (i) psychological processes are *universal*, and they are shared by all cultural populations, and (ii) these processes become variably developed and expressed in behaviors during the process of *adaptation* over time (historically) and during the individual's lifetime (ontogenetically). This perspective applies to intelligence as much as to any other feature of human psychology.

The principle of universal psychological processes is rooted in our shared biology; all human beings have common life systems made up of our physical structure, physiology, and neural and hormonal functions. These functions provide the basis for operating all our domains of behaviors: sensation, perception, cognition, emotions, personality, motivations, and social actions. Without these underlying commonalities, we could not interact effectively among individuals within societies, or across groups between societies. Equally important is that, without these commonalities, comparison across individuals, groups, and cultures would not be possible, since the act of comparison requires some underlying similarity.

The second principle is rooted in the existence of the obvious surface variations in behaviors among individuals in any population; this behavioral variation may be viewed as a set of adaptations to ecological and cultural context. If such behavioral variation can be linked systematically to variations in life conditions and experiences of individuals, then it is possible to conclude that such behavioral variation is the consequence of the need to develop the capacities that are required to survive and thrive in these habitats.

I conclude that intelligence is the complex *cognitive and social capacity to adapt successfully to life conditions*, including those that have been experienced during the course of development, and to the changing conditions that are now being experienced. Since these conditions vary widely, a cultural group's conception of what intelligence is, and a person's own developed intelligence, will also vary widely.

Differences from the Conventional View of Intelligence

As described above, my view is that "intelligence" is highly variable across cultures and individuals, rather than being a single quality. It is certainly not something that has been conceptualized or assessed adequately by psychologists in any single society. It varies by ecological context, by cultural group, and by individuals; only the last feature (individual differences) has some correspondence with the conventional view of intelligence. To explicate these ecological and cultural variations, I now turn to a summary of the ecocultural perspective on the development and display of behavior.

Ecocultural Perspective

As noted above, the ecocultural perspective considers that all group and individual features of human populations can only be understood when viewed as being situated in their contexts. In the first step, the *ecological* approach examines phenomena in their natural contexts (habitats) and attempts to identify relationships between cultural and behavioral phenomena and these ecological contexts. In the second step, the *cultural* approach examines individual behaviors in the cultural contexts in which they develop and are displayed. When these examinations are carried out comparatively, the *cross-cultural* approach is the third step. Essential to understanding all these steps are the concepts of *interaction* and *adaptation.* Interaction implies reciprocal relationships among elements in the system; adaptation implies that changes take place that may (or may not) increase their mutual fit or compatibility within the system.

In addition to this ecology → culture → behavior line of thinking, another line in the ecocultural framework originates from contact with other cultures. This second external source of influence links the *sociopolitical* context that brings about contact with other cultures, which in turn shapes both the original ecological and cultural features of the group and then the behavior of individuals in the group. In this case, there are both interactions among peoples of diverse cultural backgrounds and mutual adaptations to intercultural contact. This second line of research examines the impact on cultures and individuals from contact with outside cultures; it has been advancing greatly in recent years (Sam & Berry, 2016). This impact includes new challenges that may modify and extend the way intelligence is conceived, developed, and expressed.

By combining the ecological and sociopolitical sources of influence on how groups and individuals develop, interact, and adapt to change, the ecocultural approach to understanding human behavior is generated. Its core claims are that cultural and biological features of human populations interact with, and are adaptive to, both the ecological and sociopolitical contexts in which they develop and live, and that the development and display of individual human behavior are adaptive to these contexts.

To operationalize this ecocultural perspective, an ecocultural research framework was developed, starting in the 1960s (Berry, 1966). This framework has evolved through a series of conceptual elaborations and empirical studies devoted to understanding similarities and differences in perceptual as well as cognitive and social behaviors in relation to their ecological, cultural, and intercultural contexts (Berry, 1976; Berry et al., 1986; Mishra et al., 1996; Georgas et al., 2006; Mishra & Berry, 2017). The ecocultural approach has also been used as an organizing framework in textbooks that seeks to integrate the vast field of cross-cultural psychology (e.g., Berry et al., 2011).

In more detail, the ecocultural framework (see Fig. 2.1) seeks to account for human psychological diversity (both group and individual similarities and differences) by considering the two fundamental sources of influence noted above: *ecological* (within the habitat) and *sociopolitical* (from outside the habitat). In adaptation to these contexts, two features of human populations (*cultural* and *biological* characteristics) become established in the group. These population variables are then transmitted to individuals

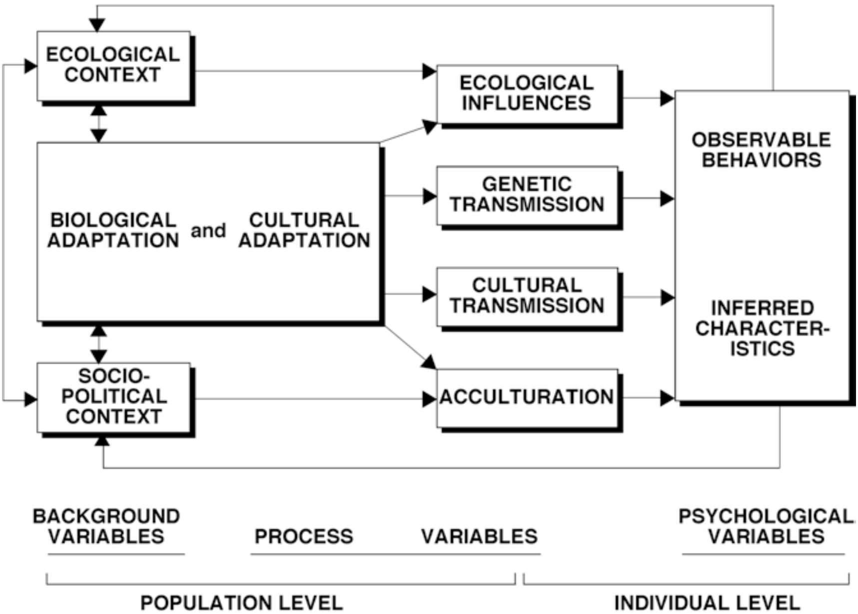

Fig. 2.1 The ecocultural framework (Berry, 1975, 1976, 1980, 1983, 1987, 1994, 1995, 2004, 2018)

by various *transmission* variables such as *enculturation, socialization, genetics*, and *acculturation*. The outcomes of these exogenous variables impacting cultural and biological adaptations result in the development and shaping of *psychological variables (individual behaviors)*. These behaviors can be directly observed; and from these observations, we can make inferences to the presence of underlying psychological characteristics (such as abilities and traits).

This ecocultural framework provides a broad structure within which to examine the development and expression of similarities and differences in human psychological functioning (both at individual and at group levels). The framework considers human diversity (both cultural and psychological) to be a set of collective and individual adaptations to context. Within this general perspective, it views cultures as evolving adaptations to ecological and sociopolitical influences and psychological characteristics in a population as adaptive to their cultural context as well as to the broader ecological and sociopolitical influences. The ecocultural perspective argues that together ecological and sociopolitical influences can be held to account for behavioral development and expression. Note that while the arrows linking components within the framework move from left to right (from exogenous contexts to behavior), the relationships are usually interactive, with mutual influence changing both elements in the relationship. For example, human behavior impacts the habitat of the group, and contact between groups alters the cultural characteristics of both groups. The upper and lower arrows that feed back to the exogenous contexts are intended to signify these mutual relationships within the framework.

The linking of ecology to cultural adaptation has a long history in anthropology (Feldman, 1975) and psychology (Bronnfenbrenner, 1989; Jahoda, 1995; Kardiner & Linton, 1939; Whiting, 1977). These links attempt to situate human social and behavioral phenomena in their natural contexts. Linking ecology to biology to culture and then to behavior has a similarly long history, beginning with Darwin and Spencer (see Keller et al., 2002, for essays on how this fits into cross-cultural psychology). The field of evolutionary psychology (Cosmides & Tooby, 2013; Tooby & Cosmides, 2015) has served as reminder to social scientists that there are also long-term adaptations to habitat that have both biological and cultural consequences, and then onto shaping individual behaviors.

The linking of external contact to the cultures, biology, and behaviors of a society is shown at the lower level of the model stemming from the sociopolitical input. These contacts have come about as a result of exploration and colonization of Indigenous peoples, by enslavement and by the movements of refugees and immigrants. The features of a culture and the behaviors of individuals within them are both transformed by these external influences. This means that individuals must now adapt to more than one cultural context. When many cultural contexts are involved (as in situations of multiple culture contacts over years), psychological phenomena can be viewed as attempts to deal simultaneously with, and adapt to two cultures. The arrow in Fig. 2.1 connecting the two main exogenous variables in the framework (ecological and sociopolitical contexts) illustrates that they are not independent of each other. This is because of two factors. First, contact between cultures is influenced by the habitats of both the source and the destination countries. Some locales are ecologically degraded, from which people flee; and some are attractive for colonization and settlement. The presence of resources (such as minerals, water, and arable land for agriculture) have influenced where people have invaded, migrated, and settled. Second, the impact of colonization and settlement on resident populations has been variable: Those with highly structured political, social, and military organizations are more able to resist occupation and domination. Related to this is some psychological evidence (e.g., Berry, 1976) showing that hunter/gatherers (which are usually smaller-scale societies with limited political structures to deal with the demands of invaders) have been more negatively impacted by acculturation pressures than have been more politically structured societies. Thus, we can claim that these two major inputs are related to each other and interact in ways that produce a complex pattern and flow across the ecocultural framework.

The ecological and sociopolitical lines of influence have equal conceptual status as factors in the development and display of human behavior. The actual degree of influence of each factor is variable across settings, populations, and individuals. The inclusion of the sociopolitical line in the ecocultural framework sets the stage for a more detailed examination of the changes in the conceptualization of intelligence. Although these various components have been proposed as a way to understand group and individual human behavior in their natural contexts, I was the first to assemble all these components into a systematic framework (Berry, 1975).

Changes in Intelligence

Because intelligence is considered to be adaptive to ecological and cultural contexts, as these contexts change so also will change the cultural meanings of intelligence and the development and expression of individual intelligence.

All these changes pose challenges that require new ways of conceptualizing and operationalizing how we view intelligence. For example, *ecological* changes have brought about an increasing numbers of hurricanes and fires; this requires changing the way we understand and deal with the interactions between human behavior and our habitats. *Cultural* changes taking place over time (both over generations and in a person's lifetime) also require new abilities and forms of intelligence. For example, the rise of use of mass media and the internet have changed the forms of literacy and communication skills. *Sociopolitical* impacts also bring about challenges, through migration, colonization, and globalization. For example, there can be a need to acquire new skills to succeed in new economic activities, and the need to acquire new ways of learning due to the imposition of formal schooling on children.

All these sources of change require continual reconceptualization and assessment of intelligence.

Assessment of Intelligence

The capacities that make up intelligence need to be studied and assessed in ways that capture the intelligence that is conceptualized and that actually exists in a group and among individuals. This obvious fact may be illustrated by the metaphor of Sir Arthur Eddington's net (1938). In his essays on the philosophy of science, he argued that the instrument used determines the data collected.

He argued that the ichthyologist can catch fish only in a net that is appropriate to catch that fish:

> Let us suppose that an ichthyologist is exploring the life of the ocean. He casts a net into the water and brings up a fishy assortment. Surveying his catch, he proceeds in the usual manner of a scientist to systematise what it reveals. He arrives at two generalisations: No sea-creature is less than two inches long. (2) All sea-creatures have gills. These are both true of his catch, and he assumes tentatively that they will remain true however often he repeats it… In applying this analogy, the catch stands for the body of knowledge which constitutes physical science, and the net for the sensory and intellectual equipment which we use in obtaining it. An onlooker may object that the first generalisation is wrong. 'There are plenty of sea-creatures under two inches long, only your net is not adapted to catch them.' The icthyologist dismisses this objection contemptuously. 'Anything

uncatchable by my net is *ipso facto* outside the scope of icthyological knowledge. In short, what my net can't catch isn't fish'.

By extension, if the concept and the measure of intelligence are inappropriate for the intelligence being sought, then the "fish" will escape your capture. This illustrates the oft-repeated claim that "intelligence is what my intelligence test measures" (see criticisms of this tautology by Warne, 2020).

Many books have been devoted to examining the relationship between culture and cognition (e.g., Berry & Dasen, 1974/2019; Rogoff, 2003), as well as review articles written from many different perspectives (e.g., Cole & Cigagas, 2010). Rather than attempt to review these, I now report on two culturally appropriate approaches to examining the meaning and assessment of intelligence in its ecocultural contexts: indigenous cognition and cognitive styles.

One insight giving rise to both of these approaches was articulated by George Ferguson (1956, p. 121): "Cultural factors prescribe what shall be learned and at what age; consequently different cultural environments lead to the development of different patterns of ability". Thus, we should expect that different abilities will be emphasized, promoted, and developed in different cultures, and that these will be organized into some more general functional arrangement (Irvine & Berry, 1988). This perspective is relevant to both the indigenous and styles approaches to intelligence.

Indigenous Psychologies

The first culturally appropriate approach to the assessment of intelligence is rooted in the field of *indigenous psychology*. This perspective is part of a larger movement in cross-cultural psychology that seeks to discover the meaning and expression of behaviors from the point of view of people in a specific culture (Allwood, 2020; Allwood & Berry, 2006; Kim & Berry, 1993). Part of this enterprise is the interest in the field of indigenous cognition (Berry et al., 1988).

The examination of the cognitive beliefs and goals, and activities of populations, has now been studied in many cultural groups (Dasen, 1984; Sinha, 1983; Sternberg et al., 2001; Wober, 1974). The overall approach to indigenous cognition has been summarized by Berry (1987), and a theoretical framework has been articulated by Irvine and Berry (Irvine & Berry, 1988/2018). To illustrate this way of understanding intelligence from the indigenous point of view, I present one study (Berry & Bennett, 1992) among the Cree people of Northern Canada.

The Cree are traditionally a hunting and gathering society, who are now transitioning to a more urban and schooled society. The community educational council had sought an answer to the question: "Toward what goals should we be educating our children?" They knew that the Eurocanadian educational system was not working well for them and wanted to consider a Cree alternative.

In this study, both ethnographic and psychometric procedures were used to uncover what the Cree understand by notions such as "intelligent", "smart", "clever", "able", and "competent". The first stage was to elicit Cree concepts for these and similar terms, and to seek both linguistic and contextual elaborations of them. We collected a list of 20 words dealing with cognitive competence through a series of very loosely structured interviews conducted with key informants in the Cree community of Big Trout Lake. This part of the research was broadly ethnographic.

After eliciting these Cree terms, the words were written out in the Cree syllabic script on cards. The cards were given to 60 participants, all of whom were able to read the syllabic cards. They were asked to sort the cards into piles on the basis of similarity of meaning of the terms. Multidimensional scaling revealed two dimensions (see Fig. 2.2). The horizontal axis may be seen as having a positive value on the right, and a negative one on the left. The vertical axis is less clear; however, it appears to involve openness at the top and toughness at the bottom.

As shown in Fig. 2.2, there was a cluster of words that are positive and sensitive, including the words rendered in English as "wise", "respects", "respectful", "listens", "pays attention", "thinks hard", and "thinks carefully". This cluster constitutes the core meaning of competence among the Cree. It is also an example of the "pattern" of abilities proposed by

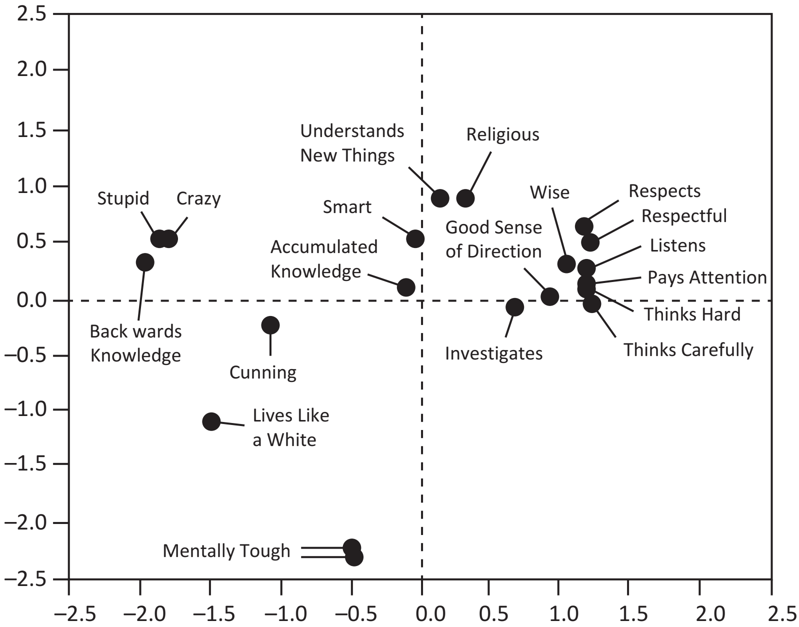

Fig. 2.2 Multidimensional scaling of Cree concepts of competence (Berry & Bennett, 1992)

Ferguson (1956) and also constitutes a cognitive style as will be discussed in the next section.

Some of these core terms are essentially cognitive (e.g., "attention" and "thinks"), while others are social (e.g., "respects"). The core idea of respect centers around knowledge of, and personal engagement with, people, animals, objects (both human-made and natural), the Creator, and the land. Such respect for others in one's environment is a central value among many hunting and gathering peoples. The word most directly opposite the core cluster, the word which is therefore most distant from it on both dimensions (i.e., negative and insensitive), is rendered as "lives like a white", in the sense of behaving, thinking, and comporting oneself like a non-Cree person!

It should be clear from this study that it would be very difficult to assess the Cree meaning of intelligence with standard IQ tests. Moreover, if intelligence were measured with a test developed by the Cree, it would be difficult to make comparisons between scores on this Cree test and scores obtained by Western groups on their tests. A study like this one leaves us with the question: How would it be possible to decide whether the Cree are more or less intelligent than some other cultural group (particularly urban, Western societies), when their vision of the competent person is so different?

Cognitive Styles

The second alternative way to conceptualize and assess "intelligence" has been in relation to the concept of cognitive styles. I consider that the pattern of abilities suggested by Ferguson (1956) may be seen as akin to the notion of cognitive styles, which have been defined as "one's preferred way of processing information and dealing with tasks" (Zhang & Sternberg, 2006, p. 3). These styles serve as ways of organizing and using cognitive information that allow a cultural group and its members to deal effectively with problems encountered in daily living. Interest in cognitive styles has varied over the past few decades (Sternberg & Grigorenko, 1997), but has become the focus of more attention recently (e.g., Dasen & Mishra, 2010; Lacko et al., 2020; Stevenson & Deary, 2006). In some of these studies, the interest is in the practical use of these styles in geographic navigation, as was the original interest in Inuit navigation (Berry, 1966).

I use the concept because it provides a value-free way to view individual and group differences in cognitive activity. When combined with an ecocultural approach, a less controversial, more value neutral, position is facilitated (Dasen Berry & Witkin, 1979). This is because cognitive styles view cognitive performances in relation to the adaptive needs of living in a particular context, rather than them being evaluated against some external cognitive criterion.

The most influential conceptualization of cognitive style has been that of Witkin (Witkin et al., 1962), who developed the dimension of the field-dependent/field-independent (FDI) cognitive style. This style is referred to by Witkin et al. (1979, p. 1138) as "extent of autonomous functioning". The notion of cognitive style itself refers to a self-consistent manner of dealing with features of the physical and social environment.

In the case of FDI, the construct refers to the extent to which an individual typically relies upon or accepts the physical or social environment as a given, in contrast to working on it, for example by analyzing or restructuring it. As the name suggests, those who tend to accept or rely upon the external environment are relatively more field-dependent, while those who tend to work on it are relatively more field-independent.

The construct is a dimension, the poles of which are defined by the two terms; individuals have a characteristic "place" on this dimension, reflecting their usual degree of independence from the external environment. However, individuals are not "fixed" into their usual place. At one end of the FDI dimension are those (the relatively field-independent) who rely on bodily cues within themselves, and are generally less oriented toward social engagement with others; at the other end are those (the relatively field-dependent) who rely more on external cues, and are more socially oriented and competent. As for any psychological dimension, few individuals fall at the extreme ends; most fall in the broad middle range of the dimension. Examples of measures of FDI are the original Embedded Figures Test and the Portable Rod and Frame Test.

Studies over the past 50 years (reviewed by Mishra & Berry, 2017) have provided a set of ecological and cultural concepts (ecological demands, subsistence strategies, societal size, social conformity, and personal connectedness) that reveal a fairly consistent set of relationships between the basic contexts in which people live and the cognitive styles that they need to carry out their lives. These adaptive variations in cognitive and social qualities vary in a way that undermines any possibility of a claim that there is only one way of "being intelligent".

Our recent research with the FID cognitive style (Mishra & Berry, 2017) was carried out both internationally across countries and across samples of Adivasi (Indigenous) children in India. The ecocultural framework was used to guide the international research (in Canada, China, Ghana, and India) among adults who are engaged in hunting, agriculture, and industrial activities, and also among Adivasi children (who also varied in economic base across hunting-gathering, agricultural, and wage employment groups).

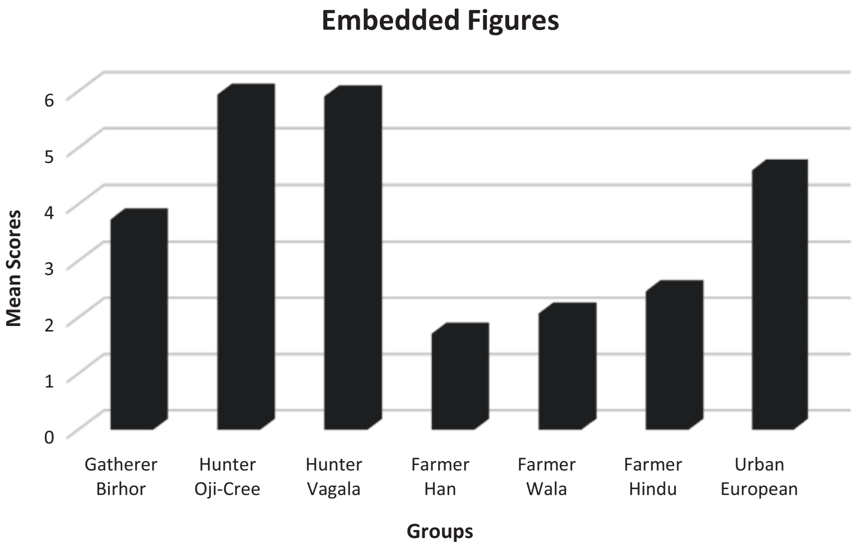

Fig. 2.3 Means of international sample adult performance on Embedded Figures Test by ecocultural context of subsistence groups (Mishra & Berry, 2017, Fig. 6.1)

International Study Across Societies

Across countries, we sampled adults: Birhor hunters/gatherers in India; Oji-Cree hunters in Northern Canada; Vagala hunters in Ghana; Han farmers in China; Wala farmers in Ghana; Hindu farmers in India; and urban European-origin residents of a mid-sized city in Canada. Results were much as expected: mean scores on the EFT varied across the ecocultural range, with highest scores in the hunting and urban samples, and lower scores in the agricultural samples; the gatherers were in between (see Fig. 2.3).

Adivasi Children Study in India

The Adivasi study had samples with four different ecological adaptations: hunting-gathering, dry agriculture, irrigation agriculture, and industrial wage-earning groups. Two group variables were examined: *societal size* was assessed by a number of indicators (e.g., population density and political stratification); and *social conformity* was assessed by indicators such as the presence of hereditary hierarchical distinctions, child socialization for compliance, and role social obligations to others in the group. In addition to examining the distribution of societies on these two cultural dimensions, we assessed individuals within them on the social dimension of *personal connectedness.* The FID cognitive style was assessed by the Story-Pictorial Embedded Figures Test (SPEFT, Sinha, 1983).

We expected that the cultural variable of societal size would be low in hunting-gathering societies and increase through agricultural societies to a high in urban-industrial societies. We also expected that social conformity would be low in hunting-gathering and urban-industrial samples and higher in agricultural samples. With respect to cognitive style, we expected that the FID cognitive style would be relatively higher in the hunting-gathering and the urban samples than in the agricultural samples. We examined the relationships among all these cultural and individual-level variables to see if the cultural variables are related to the ecological ones, and if individual performance on the cognitive style task is related to their ecocultural contexts.

Our results for the two cultural dimensions show relationships with the four subsistence strategies as expected. On the measure of societal size, there is a progressive increase from hunting-gathering to wage employment samples, through the two agricultural samples. The relationship of social conformity with subsistence strategies is curvilinear: low in hunting and wage employment but high in the two agricultural groups. It is clear that a group's subsistence activities do relate in important ways to their cultural features and cognitive characteristics. These results generally support the hypothesis regarding the existence of cultural dimensions of societal size and social conformity and their linkages with the subsistence economy of groups.

The results for the social behavior variables of population-level social connectedness and individual-level personal connectedness show variations across the samples as expected: there are lower social engagements both among members in the group and in personal involvement of individuals, in the hunter-gatherer and the urban wage-earner samples; in

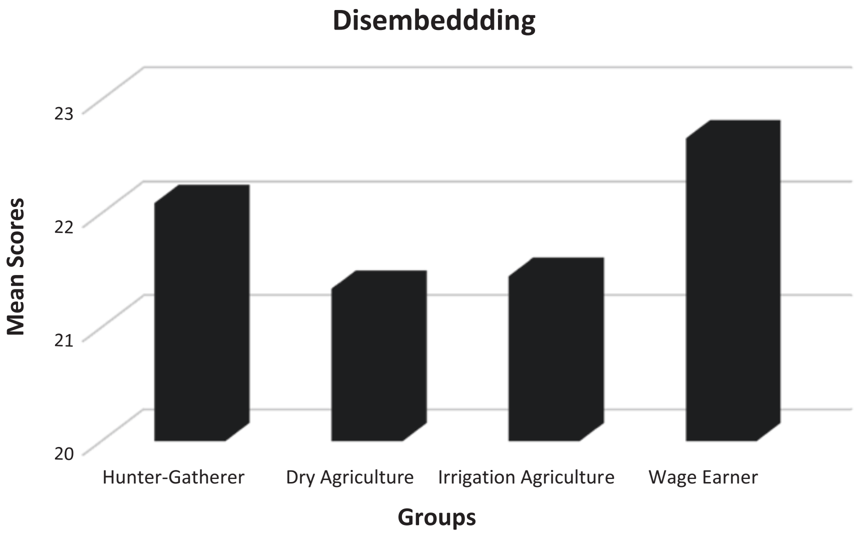

Fig. 2.4 Means of performance on Story Pictorial Embedded Figures Test (SPEFT) by Adivasi children's ecocultural context of subsistence groups (Mishra & Berry, 2017, Fig. 7.4)

contrast, there is much higher connectedness in both agricultural samples. This pattern fits the expectations from the ecocultural framework. Together with the group-level findings for societal size and social conformity, these individual connectedness findings provide a comprehensive picture of the variations in the social behaviors that correspond to variations in the subsistence strategies of these ecological adaptations.

The results for the FID cognitive style (Story-Pictorial Embedded Figures Test) showed the predicted co-variation of ecocultural context with cognitive style in the Adivasi samples (see Fig. 2.4). The pattern is consistent with the prediction that hunter-gatherers would have high disembedding scores, approaching those in the urban schooled sample; in contrast, the scores of the two agricultural samples were lower. This pattern confirms the overall finding in the literature, and in our international study, that the ecological and cultural features of a population provide variable contexts for the cognitive and social development of children, and that they persist into adulthood. In short, individuals attain a form of "intelligence" that permits them to live successfully in their particular habitats.

By conceptualizing and assessing the social variables at both the cultural group and individual levels, we can make the connection between ecological, cultural, and individual findings, and further to the cognitive-style findings. Establishing these kinds of systematic connections avoids the problem that is common in some current research (e.g., English & Geeraert, 2020) where the ecological context is described (e.g., wheat vs. rice agriculture communities in China) and then related to individual behaviors. However, the intervening cultural, social, and individual features of the populations were not actually measured, leaving them only as inferred mediating variables.

All together, these findings lend support to the earlier (Berry, 1974) proposal for the existence of both a cognitive style and a socio-affective style that vary according to different adaptations across the ecocultural range and sociopolitical conditions. Moreover, they are in keeping with my assertion (Berry, 1972) that these systematic patterns constitute differences in ways of being "intelligent" that allow for successful adaptation in different habitats.

Implications for the Anthropocene Epoch

Given the roots of my views on intelligence in the ecological perspective, it is clear that the focus on the long-term adaptation of cultures and individuals to their habitats can be incorporated into discussions of the Anthropocene, and its way of understanding how human life has come to be interacting with the natural world. The Anthropocene Epoch can be defined not only as the period in history in which human activity has altered this natural world, but one in which it has done so in mainly negative ways, and with mostly disastrous outcomes.

The main life challenge confronting human beings is how to engage the natural world in our quest to live successfully in it (Aberle et al., 1950). We can approach this issue with the help of the classic psychoanalytic strategies for dealing with such challenges that were proposed by Horney (1945). She conceptualized these strategies as: moving with them, moving toward them, moving away from them, moving against them, and moving under them. Following this sequence, these strategies result in mutual adaptation (moving *with* the challenge, to accommodate them), changes to the self (moving *toward*, to accept and become more like the source of the challenge), withdrawal (moving *away*) from or disregarding the challenge, attempting to dominate and change the source of the challenge (moving *against*), and succumbing to (going under) the challenge. In my view, the Anthropocene has seen the predominant use of moving against the natural world, attempting to change it and to use it for our advantage.

However, the other strategies have been manifest in a few specific domains. For example, in the case of migrants they move away (emigration) and move toward (immigration). They sometimes move against (confront) the new society in response to being subjected to invasion and discrimination; and sometimes they succumb to the difficulties encountered in the migration experience (going under).

The acculturation strategies framework proposed for immigrants (Berry, 1980, 2005) mirrors these more general life strategies. The original chapter in 1980 was titled "Acculturation as varieties of adaptation" in order to make an explicit link between these general adaptation strategies and the various way that immigrants can deal with the challenges of living in two or more cultures. These strategies are based on the intersection of peoples' orientations to two issues: the degree to which they want to maintain their heritage cultures and the degree to which they wish to participate in the larger society within which they now live. These are: *Integration* (retaining the heritage culture and identity, while participating in the new society; *with*); *Assimilation* (giving up the heritage culture and becoming absorbed in the new society; *toward*); *Separation* (maintaining the heritage culture while disengaging from the new society; *away* or *against*); and *Marginalization* (giving up the heritage culture, while also not being engaged in the new society; *under*).

With respect to the main issue of how human beings deal with the natural world, these same strategies may be observed. They appear to vary across the range of economic subsistence practices that were examined in the previous section: gathering, hunting, dry agriculture, irrigation agriculture, and industrial practices. The first two economic practices are largely *living with* the habitat, while the last is essentially one of *domination over* it; agriculture falls somewhere in between, with a combination of stewardship and exploitation. They also appear to be useful ways to understand the ways in which groups and individuals deal with the cultural and economic changes being introduced from outside their cultures. These variations have implications for other domains, such as climate change and pollution, food security and water quality, and possibly the emergence of pandemic disease.

In conclusion, I believe that we can learn from other cultural groups that have engaged, and continue to engage, the natural world by using these various strategies. Ways of living *with* natural habitats have survived in indigenous populations in many parts of the world, and have resulted in minimal conflicts with the inanimate and animate resources present in the ecosystem. However, living *against* (or especially *over*) the natural world has brought us to our present crisis. Taking lessons from other cultures, especially indigenous cultures, about how to achieve a balance in our relationships with the natural world, through observation, listening, reflection, and respect may serve us well as we continue to try to live in the Anthropocene.

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3

Adaptive Intelligence and Cultural Evolution

Chi-yue Chiu, Hiu-sze Chan, Sau-lai Lee, and Jennifer Yuk-Yue Tong

Adaptive Intelligence and Cultural Evolution

> People shoot themselves, or take poison, or jump off a cliff. But suicide does not have to be individual and it does not have to be quick. If people, collectively, destroy the water they drink, the air they breathe, the climate in which they live, they are doing collectively and slowly what a person may do individually and quickly. The ultimate effect is the same … Humans seem to be much better at seeing short-term consequences for individuals than long-term consequences for either individuals or collectivities. They avoid thinking sufficiently about the long-term future. But that is a flaw in their intelligence: To be adaptively intelligent, one must look not only at the short-term, but also at the long-term, as illustrated by the tragedy of the commons.
>
> —Sternberg (2021, p. 6)

Chapter prepared for *Intelligence in Context: The Cultural and Historical Foundations of Human Intelligence*, edited by Robert J. Sternberg and David D. Preiss

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As the volume of big data multiplies, data scientists start to rethink what artificial intelligence is. A machine can be trained to convert inputs into insights to enable action. However, does it always deliver the most context-relevant output whenever required? How can we render artificial intelligence actually intelligent? Can this be achieved without human involvement (Joshi, 2019)? Whereas most intellectual capacities captured by conventional IQ tests can be replaced by "intelligent" machines, adaptive intelligence—the ability to deliver contextually relevant outputs for the survival and sustainable development of humans and the world they inhabit—may be a uniquely human ability.

Detailed expositions of the nature, measurement and training of adaptive intelligence can be found in Sternberg (2021). In this chapter, we attempt to further enrich the theoretical construct of adaptive intelligence by connecting it to cultural evolution theories. We also consider some abilities and processes that may support the development of adaptive intelligence, and discuss issues related to the measurement of adaptive intelligence.

In the first part of the present chapter, we will link adaptive intelligence to cultural evolution theories (e.g., Creanza et al., 2017; Forgarty and Kandler, 2020). We propose that adaptive intelligence is supported by a concatenation of mutually reinforcing individual and interpersonal capacities. These capacities have evolved and are evolving to support adaptation of human populations to the environment and its changes. Furthermore, adaptive intelligence is solution-oriented; it enables human groups to identify/create and implement optimally adaptive strategies to meet challenges in concrete physical, socioeconomic and social ecologies. Based on these ideas, in the second part of the chapter, we propose a conceptual framework for understanding, measuring and developing a psychological system of adaptive intelligence.

Adaptive Intelligence: What Is It, and Why?

Intelligence has been defined narrowly as "what IQ test measures" (Boring, 1923). For over a century, the view that intelligence is a context-free positive manifold (i.e., an intrapersonal entity associated with many important achievement and life outcomes) has been a heavily promoted idea in intelligence research and popular culture. Many intelligence researchers still believe that individual differences in intelligence can be captured by the shared variance of a test battery that is statistically associated with cognitive performance (e.g., performance in memory, spatial-linguistic tasks) and life outcomes (e.g., school success; see Van de Mass et al., 2014).

Nonetheless, there are alternatives to this conventional view of intelligence. For example, instead of regarding intelligence as a context-free positive manifold, the functional view of human intelligence treats intelligence as a concatenation of mutually reinforcing context-responsive capacities that enable and support individuals' goal-directed behaviors (Sternberg and Salter, 1982). This perspective can be traced back to David Wechsler (1944), who defined intelligence as "the aggregate or global capacity of the individual to act purposefully, to think rationally, and to deal effectively with his [*sic*] environment" (p. 3).

Adaptive intelligence (Sternberg, 2019) is a conceptual hybrid of the functional view of intelligence and a broad cultural evolutionary perspective (see Alvard, 2003). Adaptive intelligence extends the functional view of intelligence by featuring collective adaptation as a hallmark of human intelligence. According to this view, any thought and behavior labeled as adaptively intelligent must contribute to the perpetuation of human populations instead of being destructive to this perpetuation (Sternberg, 2019).

Cultural Evolution

Cultural evolution is the study of how culture drives human evolution. Like biological evolution, cultural evolution can drive human adaptation. Moreover, cultural evolution can override the adaptive effect of biological evolution. To understand the cultural evolutionary perspective, consider the example offered by Richerson and Boyd (2005). Many plants contain toxic substances. Through natural selection, the *TAS2R* gene family and the bitter taste receptors on the tongue that could bind to toxic chemicals were evolved. Animals developed taste aversions to bitter plants; they use the bitter taste of these plants as a signal that they are inedible. However, humans can override these taste aversions when they learn from others that certain plants (e.g., *Coptis chinensis* used in Chinese medicine) with an aversive bitter taste have medicinal value. Although our sensory physiology has not changed (eating these plants still leaves a bitter taste in the mouth), the cultural belief in these plants' medicinal value increases the likelihood of their consumption in the population.

Three important questions cultural evolution theories attempt to address are also at the heart of the theory of adaptive intelligence. First, why do human actions often seem to be mildly (or sometimes wildly) dysfunctional and sometimes lead to colossal catastrophes? According to Heylighen (1992), natural selection favors individuals who can produce many copies or replicas of themselves (survival of the fitness). That is, individuals are biologically prepared to use scarce resources to the limit to produce a maximum of copies. This explains the tragedy of the commons: Competition between self-interested individuals causes rapid depletion of shared resources (e.g., clean water and air) and ultimately threatens the survival of all species.

Second, how did cooperation evolve in human populations to regulate dysfunctional behaviors and prevent colossal catastrophes? To answer this question, Tomasello et al. (2012) have put forward *the interdependence hypothesis*. According to this hypothesis, there were two steps in the evolution of human cooperation. First, interdependence in collaborative foraging required individuals to have a direct interest of their partners. Individuals developed new motivations and skills that support cooperation. Next, these motivations and skills were scaled up to group life; cultural conventions, norms and institutions that supported cooperation were evolved.

Finally, what are the characteristics of a human psychology that is uniquely adapted to complex culture. Tomasello (2016) believes that in the first step of the evolution of cooperation, humans began to "form with one joint goal toward mutually beneficial ends, structured by joint attention." They also "recognized simultaneously different individual roles in the collaborative activity and different individual perspectives on their joint focus of attention" (p. 62). It is the evolution of these characteristics, collectively known as *joint intentionality*, that allowed humans to engage in cooperative collaboration.

Adaptive Intelligence and the Multilevel Selection Problem

Cultural evolution theories explain why we need adaptive intelligence to escape from the tragedy of the commons. Neoliberalism asserts that to optimize the collective interest of the society, all individuals in the society should always be able to freely and rationally choose any available options to maximize their self-interests. However, this neoliberal assumption does not always hold (see Bettache and Chiu, 2019). Consider a mixed motive social dilemma game in which a group of players make bids anonymously to decide how much timber to harvest from a self-replenishing forest. In this game, selfish choices would almost always benefit the individuals at the expense of the group's long-term interest (Sheldon and McGregor, 2000).

This example illustrates the problem of *multilevel selection*: Evolution takes place at multiple levels simultaneously. More importantly, selfish choices that almost always benefit the individuals can place the group's long-term interest at risk (Campbell, 1990; Chiu et al., 2010). Enron's failure, a prelude to the financial market meltdown in 2008, ensued from financial engineers' proneness to privately profit from competition at the expense of the economy's financial health. As Turchin (2016) puts it, "It is cooperation that underlies the ability of human groups and whole societies to achieve their shared goals… But what Skilling [Enron's CEO] did at Enron was to foster within-group competition, which bred mutual distrust and back-stabbing (if not throat-stomping). In other words, Skilling completely destroyed any willingness among his employees to cooperate—not with each other, not with their bosses, not with the company itself. And after that, collapse was inevitable" (p. 47).

Unlike a collection of competitive selfish maximizers, a group that possesses cooperative characteristics would flourish, although the advantage of cooperation may not be apparent at the individual level. A lesson we learn from the COVID-19 pandemic is that citizens in societies with strict cooperative norms are prepared to voluntarily adopt social distancing and contact tracing practices. These practices protect public health, although they entail self-imposed restrictions on personal freedom. As a consequence, these societies had lower infection and mortality rates (Gelfand et al., 2021).

Harmonization of personal and collective interests requires social processes that (a) incentivize cooperative behaviors, (b) enable early detection of free riders (people or organizations who privatize profits and externalize losses) and (c) support formation of coalitions to sanction selfish maximization (Sheldon et al., 2000). It also requires psychological processes and abilities that support *co-opetition*, the act of cooperating with competitors to achieve a common goal (Brandenburger and Nalebuff, 1996). We shall explore some of these processes and strategies later in the present chapter.

Context-Responsiveness in Behavioral Expressions of Adaptive Intelligence

Cultural evolution theories also help to illustrate several important aspects of adaptive intelligence. First, according to Tomasello (2016), the thinking processes that enable human adaptation to dynamic changes in the environment is a self-regulating thinking system that can process, store and evaluate environmental information and utilize it to realize individuals' goals by flexibly adjusting behavioral strategies to (sometimes novel) situations occurring in its dynamically changing habitat.

Second, adaptive intelligence underscores the interdependence of behaviors and their environments. Consistent with this emphasis, cultural evolution theories assert that, generally speaking, environmental affordances and constraints exert selection pressure on behavioral preferences, although the selection pressure does not rigidly determine behavioral choices (Alvard, 2003). For example, external threats and competition with out-groups increase the preferences for belonging to a large group and hierarchical social organizations (Turchin, 2016).

Furthermore, cultural evolution theories also highlight the cultural and temporal variations in humans' responses to different environments and environmental changes. For example, ancient droughts in Arabia during the Dark Millennium (from approximately 5900 to 5300 years ago) led to marked regional differences in technological, economic and cultural responses. In southeastern Arabia, where there were less extensive aquifers, the droughts led to widespread depopulation of the interior settlements and a shift to coastal occupations. In contrast, in northern Arabia, there were large and shallow aquifers. To survive the climate shifts, the inhabitants developed new technology to capture runoff through construction of landscape features and excavation of wells. These technological changes enabled the onset of oasis agriculture (Petraglia et al., 2020).

The extent to which a certain behavioral strategy is adaptively intelligent depends on the context; a type of behavior that is adaptive in one cultural context might not be adaptive in another (Sternberg, 2019). As an example, consider growth mindset, the belief that one can raise one's level of intelligence by mobilizing effective effort. This belief has been shown to enhance resilience in the face of achievement setbacks (Hong et al., 1999) and consequently increase academic performance (OECD, 2021). However, the beneficial effects of the growth mindset are significantly attenuated in societies with lower academic mobility, operationalized as the percentage of children from low-education households to graduate from tertiary education (Jia et al., 2021). Across 30 countries, depending on the academic subject (math, science and reading literacy), the gain in academic performance from exhibiting the growth mindset was reduced by 42% to 45% from a country with high academic mobility to one with low academic ability. Inducing the perception of low academic mobility in a controlled experiment also attenuated the positive effects of growth mindset interventions on learning motivation. In low mobility societies, students do not feel that improvement in academic performance will increase the likelihood of rising to a higher social and economic position. Even if they believe that they can raise their ability, they may not be motivated to invest in academic pursuits.

In a stable environment, there is no demand for adjusting the self or altering the environment. Status quo maintenance is the optimal adaptation strategy under these circumstances. However, when a massive change in the environment occurs, adaptation to the novel environment becomes necessary. The inhabitants of a society can adapt to the new environment in two ways: (a) *Self-adjustment*: the inhabitants adjust their behavioral preferences to the new exigencies of the environment; and (b) *Environment reshaping*: inhabitants take agentic, innovative actions to reshape the environment (Forgarty and Kandler, 2020). Table 3.1 shows the major

Table 3.1 Four patterns of adaptive responses to the environment

		Self-adjustment	
		Not preferred or permissible	Permissible and preferred
Environment reshaping	Not preferred or permissible	Migration or environment selection	Standing variations of existing preferences
	Permissible and preferred	Niche construction; De novo innovation	Person-environment co-evolution

patterns of responses to environmental changes, depending on whether self-adjustment and environment reshaping are permissible or preferred. *Migration (environment selection) is* likely to occur when both self-adjustment and environment reshaping are not preferred or permissible. For example, *the inhabitants in* southeastern Arabia migrated to the coastal areas in response to the droughts in the Dark Millennium (Petraglia et al., 2020. *Standing variations* are likely to occur when only self-adjustment is preferred or permissible. Self-adjustment is preferred and tends to spread in societies with immutable structures and norms. In these societies, individuals can achieve their personal goals only by navigating the fixed structures and norms (Su et al., 1999). People in these societies tend to imitate behaviors exhibited by the majority of the population (Leung et al., 2014). The *conformist bias* is likely to prevail in these societies; the probability of adopting a more common cultural variant in a population exceeds its frequency (Denton et al., 2020). *Niche construction* and *de novo innovation* are likely to occur when only environment reshaping is preferred or permissible. Environment reshaping is preferred and tends to spread in an environment with mutable structures and norms. In these societies, individuals prefer to change the environment instead of the self to achieve their personal goals (Su et al., 1999). The inhabitants are interested in the exploration of novel practices. They also tend to display the *anti-conformist bias*; the probability of adopting a more novel cultural variant in a population exceeds its frequency (Denton et al., 2020). Finally, *person-environment co-evolution* tends to occur when both self-adjustment and environment reshaping are preferred or permissible.

COVID-19 is a catastrophic environmental shift that requires a coping response. Survival of human groups depends on their ability to meet the new environmental challenges; status quo maintenance is no longer an option. Before effective pharmaceutical interventions (e.g., vaccination) were found, societies needed to rely on non-pharmaceutical preventive measures (e.g., lockdowns, social distancing and mask use) to contain spread of the virus. To some extent, effectiveness in implementing these non-pharmaceutical measures depended on government efficiency. However, to a critical extent, it also depended on citizens' willingness to comply with the government policies, and to give up some personal freedoms and regulate their own behaviors for a common good.

Voluntary adoption of non-pharmaceutical measures would more likely occur in societies that already have strict cooperative norms. In these societies, most citizens would adopt the measures willingly once they recognized that mask use, social distancing and other non-pharmaceutical practices were a part of the prevailing cooperative norms. In contrast, in neoliberal societies that prioritize unbridled expression of individual freedom, government-imposed non-pharmaceutical prevention policies might meet disapproval and even resistance from a sizeable proportion of the population (Mair, 2020). Consistent with these contentions, there is research evidence that before COVID-19 vaccines were available, the cumulative percentages of confirmed cases and deaths were lower in tight countries (countries with strict norms) than in loose countries (countries that tolerate rule-breaking; Gelfand et al., 2021), and in collectivist countries (countries that prioritize attainment of group goals) than in individualist countries (countries that prioritize attainment of personal goals; Lu et al., 2021). The same relationship was found when data from 3141 counties of 50 US states were analyzed and when controlling for a host of variables (including GDP per capita, stringency of the non-pharmaceutical preventive measures and government efficiency).

In a recent study, we analyzed the rates of vaccination (a pharmaceutical preventive measure) across 43 countries since COVID-19 vaccines were available in these countries. Latent profile analysis results show that these countries can be classified into loose-individualist or tight-collectivist countries based available measures of cultural tightness, individualism and power distance (see Chiu et al., 2015). These two types of societies show markedly different responses to the non-pharmaceutical and the pharmaceutical preventive measures. We will illustrate these differences with the data from Hong Kong (a tight-collectivist society) and Canada (a loose-individualist society), although the pattern holds generally for other tight-collectivist and loose-individualist societies. These results remain significant when controlling for GDP per capita, stringency of the non-pharmaceutical preventive measures and government efficiency.

Figure 3.1 shows the patterns of responses to the pandemic prevention measures in Hong Kong and Canada from March 2020 to July 2021. The black vertical line marks the date when vaccines started to be available in the society. The upper panel displays the daily rates of new confirmed cases and COVID-related deaths. The lower panel shows the stringency of government-imposed non-pharmaceutical preventive measures and

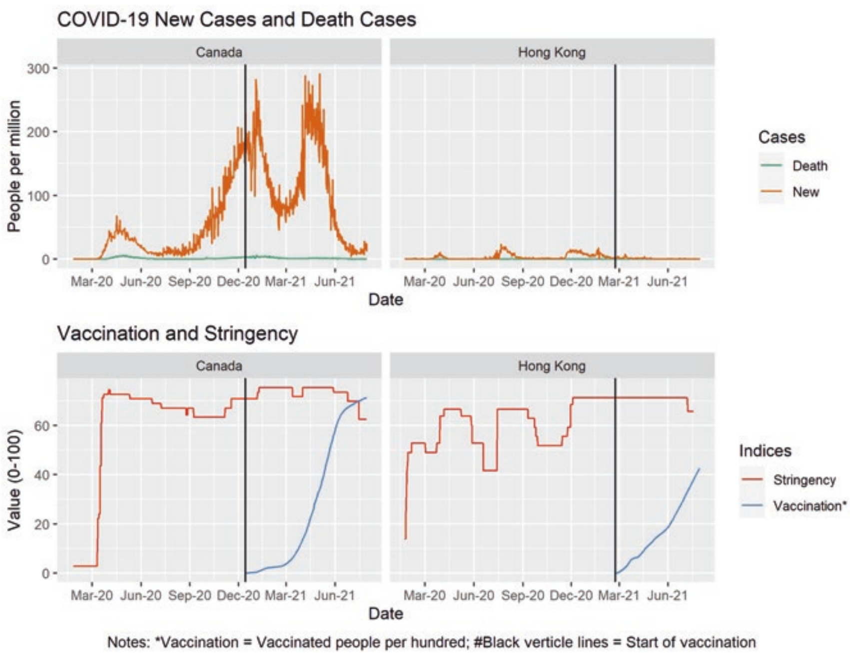

Fig. 3.1 The responses of Canada and Hong Kong to COVID-19 from March 2020 to July 2021

the rates of vaccination (percentage of vaccinated people in the population). Hong Kong, a tight-collectivist society, had lower rates of confirmed cases and deaths before vaccines were available in March 2021, compared with Canada, a loose-individualist society. These cultural differences were not attributable to differential strictness in government-imposed pandemic policies, because these policies were more stringent in Canada than in Hong Kong most of the time.

Innovations that directly address a massive environmental threat can reverse the relative fitness of different cultural preferences. Consider the example of cultural tightness and coping with COVID-19 again. In a tight society, people are expected to follow strict norms to avoid social sanction or reputation loss. In contrast, in a loose society, people are expected to pursue personal goals to maximize personal gains. Thus, whereas a tight culture prioritizes loss prevention, a loose culture promotes aspirations for gains (Li et al., 2017). In Hong Kong, given the low infection rate, there was not much to gain from vaccination. However, potential side effects of vaccination could fuel the chronic prevention anxiety in the city. Accordingly, in Hong Kong, the motivation to be vaccinated is relatively weak, as is evident in the slow increase of its vaccination rate. In contrast, in Canada, the high infection rate and the prospect of regaining personal freedoms through vaccination had accelerated the country's vaccination rate. Achievement of herd immunity had at least temporarily stopped the spread of the pandemic in July 2021.

The rapid spread of new variants of the COVID-19 virus in August 2021 represents another massive environmental shift, which may trigger another cycle of adaptive responses, and the relative fitness of tight versus loose cultures may change again. Person-environment co-evolution may become a long-term solution to win the war against COVID-19. Environmental threats posed by the pandemic may pressurize individuals to temper selfish maximization of personal freedoms with communal values, and at the same time incentivize innovations that will help create a new, nonthreatening environment for humankind. Adaptive intelligence will have a key role to play in this person-environment co-evolution.

Abilities and Processes that Support Adaptive Intelligence

Despite the presence of spatiotemporal variations in the behavioral expressions of adaptive intelligence, certain abilities and processes may foster cultural adaptation to the environment and its changes in all populations (Sternberg, 2019, 2021). These abilities and processes may strengthen people's adaptive intelligence.

As discussed in the previous sections, adaptive intelligence prioritizes agility in encoding nuanced meanings of situations and use them to navigate shifting environmental demands and the capacity for co-opetition. Table 3.2 presents some cognitive abilities and processes in four domains of intellectual performance that we propose to be relevant to these two proclivities. The four domains are attention, memory, problem-solving and innovation (or niche construction). For each domain, we sample one process/ability that fosters environmental information processing and one that promotes cooperation and collaboration.

Attention

In the Wechsler Intelligence Scale for Children (Wechsler, 2014), the Freedom from Distractibility Index is derived from the sum of the scores of the arithmetic and digit span tests. This index treats attention to

Table 3.2 Some abilities or processes that support the development of adaptive intelligence

Cognitive domain	Adaptively intelligent abilities or processes
Attention	Discriminative facility Shared and coordinated attention
Memory	Meta-memory of what is currently available in external memory devices; Efficiency in retrieving information from external memory stores; Transactive memory system
Problem-solving	Practical intelligence; Wisdom
Niche construction	Foresight Creativity

nuanced environmental information and its adaptive significance as distractors. In contrast, adaptive intelligence regards attention to nuanced situational information as a valuable cognitive facility. *Discriminative facility* refers to an individual's sensitivity to subtle cues about the psychological meanings of a situation. It is assessed by an individual's readiness to attend to nuanced psychological meanings of a situation and to discern situation-appropriate behavior across a variety of novel stressful situations (Chiu et al., 1995). This ability has been shown to predict adaptation to stressful life changes and better quality of interpersonal experiences (Cheng et al., 2001; Cheng et al., 2014).

S*hared and coordinated attention* is another attention process that supports adaptive intelligence. Tomasello et al. (2007) have proposed the *cooperative eye hypothesis*. According to this hypothesis, unlike other primates, human eyes have a distinct color contrast between the white sclera, the colored iris and the dark pupil. This distinctive and visible characteristic of the human eye was evolved to permit humans to follow the eye gaze of their collocutors or coworkers effortlessly in interpersonal interactions. A subset of neurons in the lateral intraparietal (LIP) area has been identified to mediate gaze following and shared attention (Shepherd et al., 2009). These neurons fire both when a macaque looks at a certain object and when the macaque notices that another macaque is looking at the same object. Gaze following, an evolved biological trait, fosters the development of shared and coordinated attention and cooperation, which in turn enable rapid cultural evolution.

Building on this idea, Shteynberg (2015) observes that the potential for attending to the environment with others has grown considerably with the emergence of mass media technologies, which allow for shared attention in the absence of physical copresence. There is also research evidence that sharing attention with others to a certain object *X* increases the amount of cognitive resources committed to processing *X*, improves individuals' memory of *X*, intensifies feelings about *X*, increases the motivation to interact with *X* and enhances behavioral learning from the interactions with *X*.

Memory

Environmental change has altered the relative adaptive value of different memory skills. For example, advances in information technology have created the *Google effect*; when people are expected to have future access to information, they tend to remember where to access it instead of recalling the information itself (Sparrow et al., 2011). Almost all information we need is stored externally, which is retrievable literally with a touch of a finger. As a consequence, meta-memory of what is available in external memory stores (e.g., iCloud) and efficiency in retrieving information from external memory devices have become more useful than retention and recall of the learned materials in the human brain.

Memory is externalized in interpersonal networks as well. *Transactive memory system* refers to a socially externalized memory system through which a collection of interconnected individuals collectively encodes, stores and retrieves knowledge (Wegner, 1987). A *transactive memory system* is a shared store of knowledge that consists of (a) the knowledge encoded into each individual's memory and (b) meta-memory containing information about the different networked individuals' domains of expertise (e.g., knowledge of what other people in my network know; Wegner, 1995). Like other externalized memory systems, the transactive memory system enables members of the social network to be aware of what information is available for use within the network. Research has shown that transactive memory systems can catalyze cooperative interdependence in teams and foster innovation (Zhang et al., 2007). Transactive memory systems also improve close relationships (Wegner et al., 1991).

Problem-Solving

Adaptive intelligence is solution-oriented. It was evolved to solve adaptation problems. The solution orientation of adaptive intelligence is also recognized in the concept of *practical intelligence*, one of the three components of human intelligence in Sternberg's triarchic theory of intelligence (Sternberg, 1985). Practical intelligence is the ability to apply one's intelligence to navigate the environment even in unfamiliar circumstances and solve problems in everyday situations. Practical intelligence requires adaptation to, shaping of and selection of new environments (Wagner and Sternberg, 1985).

Wisdom is a variant of practical intelligence (Sternberg, 2000); it involves the use of one's intellectual abilities under the guidance of positive ethical values toward the achievement of a common good. Grossmann et al. (2013) assessed wisdom by the degree to which people use various pragmatic schemas to deal with social conflicts and found significant associations between wise reasoning and greater life satisfaction, less negative affect, better social relationships, less depressive rumination, more positive versus negative words used in speech and greater longevity. These associations remained significant when controlling for socioeconomic factors, verbal abilities and several personality traits. In contrast, intelligence as measured by conventional intelligence tests was unrelated to these well-being outcomes.

Innovation or Niche Construction

Niche construction refers to the modification of the environment to enhance the selective advantages of a population (Laland et al., 2016). Thus far, we have focused largely on the intellectual abilities and processes that support cooperation and adjustment of the self to the environment. When faced with large environment shifts, adaptation may require renovation of the existing environment and creation of a new environment. Both renovation and innovation take time. Inevitably, there will be a time lag before renovations or innovations are available to address newly emerged environmental threats. For example, in the case of COVID-19, hundreds of millions were infected and millions of lives were lost before vaccines were available to contain the spread of the virus.

Foresight, defined as the ability to predict future situations, can help prepare human groups for the adverse effects of future environmental shifts, shorten the time lag of adaptive responses through innovations and hence provide a selective advantage (Suddendorf and Corballis, 2007). For example, sensitivity to the early signs of climate change and simulation of its consequences have informed scientists and policy makers of the technologies that need to be developed and new practices that need to be adopted in order to slow down global warming and mitigate its anticipated effects.

Suddendorf and Carballis (2007) conceptualize foresight as a process of "mental time travel" that allows people to foresee, plan and shape a specific future event. According to them, "to evolve a flexible anticipation system, many cognitive components may need to be in place to achieve a level of accuracy that provides a selective advantage sufficient to compensate for the enormous expense of cognitive resources" (p. 307). The cognitive components include prospective thinking, idea generation, autobiographical memory and processing of self-referential information and contextual and episodic imageries. Consistent with this idea, in a cognitive neuroscience study of foresight, Addis et al. (2007) found that imagining future events recruits the right frontopolar cortex, which is involved in prospective thinking, and the left ventrolateral prefrontal cortex, which is involved in idea generation. Future event construction also engages the right hippocampus, possibly as a response to the novelty of these events. When people elaborate a future event, the brain regions involved in autobiographical memory retrieval, self-referential processing, and contextual and episodic imagery are engaged.

Creativity drives cultural evolution and increases the complexity of cultural novelty over time (Gabora, 2018). In cultural evolution theories, creativity is a *social* process. It often starts with people receiving an inspiration from an external source, which could be an idea of other people or an idea embodied in the creative products of other people (Thrash and Elliot, 2003). The inspiration evokes the motivation to replicate the idea. Unlike other animals, humans are more oriented toward learning from others the *process* of producing inspiring products rather than merely reproducing the products. Process focus in imitation often leads to creation of low-fidelity reproductions or new variants of the original products. As creative ideas beget other creative ideas, accumulation of modifications increases the overall fitness as well as the level of diversity of the ideational outputs in the culture, a phenomenon known as the *ratchet effect* (Tenne et al., 2009).

Chaining and contextual focus are two mental facilities that have been hypothesized to invigorate the ratchet effect. *Chaining* refers to the capacity to modify thoughts and ideas by thinking about them in the context of other thoughts and ideas. As Gabora (2018) puts it, "For minds to evolve through communal exchange they must be organized such that, for any given concept or idea, there exists some pathway … by which it could potentially interact with and modify other concept or idea. The concepts and ideas must form an integrated whole, i.e., they must be able to interact with and modify others." Creative cognition researchers also recognize that when unrelated ideas are merged to form a new concept, novel ideas with appealing emerging properties often emerge (Finke, 1995). Frequent practices of solving novel conceptual combination problems (combination of concepts with no overlapping instances; e.g., what is a vehicle that is also a fish?) can improve creative performance (Wan and Chiu, 2002).

Contextual focus refers to the ability to switch between an implicit associative mode of thinking and an explicit analytic mode of thinking. Associative thinking is conducive to insight and novel idea generation, whereas analytic thinking supports logical problem-solving (Gabora, 2003). The creative process consists of a generative phase and an evaluative phase (Chiu and Kwan, 2010). Individuals are more fluent in novel idea generation when they engage in associative thinking, and are more able to select promising ideas for elaboration and further development when they think analytically (Lam and Chiu, 2002). Thus, creative performance will benefit from the ability to switch between the associative and analytic modes of thinking (Gabora, 2003, 2018) in response to the changing nature of the task.

Implications for Measuring Adaptive Intelligence

In the *APA Dictionary* (American Association of Psychology, 2021), intelligence is defined broadly as "the ability to derive information, learn from experience, adapt to the environment, understand, and correctly utilize thought and reason." However, a narrower definition of intelligence assessment is found in the same dictionary: assessment of intelligence refers to "the administration of standardized tests to determine an individual's ability to learn, reason, understand concepts, and acquire knowledge." In practice, conventional measures of intelligence have focused on assessing performance in verbal and nonverbal cognitive tasks. For example, the five primary abilities assessed in the Wechsler Intelligence Scale for Children (WISC, Wechsler, 2014) are verbal comprehension, visual-spatial processing, inductive and quantitative reasoning, working memory, and processing speed. These conventional intelligence measures portray an intelligent person as someone who is quick at acquiring verbal and visual-spatial knowledge and efficient in managing and manipulating information in their head.

Unlike these conventional measures of intelligence, assessment of adaptive intelligence aims at assessing the fitness-enhancing intellectual abilities that enable adaptation of human populations to the environment. As such, instead of measuring abilities that are decontextualized, disembodied and context-free or context-fair, adaptive intelligence tests should measure abilities that are as follows:

(a) Contextualized: the contents of assessment are relevant to the joint goals of individuals in social interactions, the collective goals of groups and collective goals worthy for humanity.
(b) Embodied: the assessment should capture individuals' abilities to access, generate and learn from information through action, and use the information to discover optimal solutions to adaptation problems (Cangelosi et al., 2015).
(c) Situated: the assessment needs to take discriminative situational variations in responses seriously (instead of treating them as noise or measurement errors). How people respond discriminatively and adaptively to varying expectations in different social, material and historical settings should constitute the substance of adaptive intelligence assessment (Roth, 1998).

Based on similar principles, Sternberg (2021) has designed solution-oriented measures of adaptive intelligence. In these tests, respondents are presented with cases related to grand challenges (e.g., climate change, racism and wealth inequality) and asked: (1) What can they do personally to meet the challenges, (2) what are the limitations of the current solutions, (3) what solutions would they recommend to the authority and (4) what are the obstacles that need to be overcome? The test requires the respondents to identify and define the problems, generate new solutions, evaluate the merits and limitations of promising solutions, and select and recommend the wisest course of action. As such, these measures assess the respondents' analytical skills, creativity, practical solving abilities and wisdom.

The theory of adaptive intelligence emphasizes co-development of the self and the collective: Individuals develop their adaptive intelligent skills to improve the environment for a common good. A valid adaptive intelligence test should be able to predict individuals' behavioral tendency to adapt their own behavior to increase mutual outcomes and avoid exploitation. Example measures of such cooperative behavioral tendency include the Social Value Orientation Scale (Van Lange and Liebrand, 1991) and the Social Mindfulness Scale (a measure that uses a social decision-making paradigm that measures the behavioral tendency to leave or limit choice options for others; Van Doesum et al., 2013). Modal performance on the adaptive intelligence test of a certain collective should also predict adaptation outcomes of the collective. Example outcome measures at the country level may include the extent to which the collective has successfully achieved the UN Sustainable Development Goals (the United Nations, 2021).

Summary and Future Directions

In this chapter, we have elucidated the cultural evolutionary foundation of the theory of adaptive intelligence (Sternberg, 2019, 2021). Many conventional conceptions of intelligence view intelligence as a concatenation of correlated *intrapersonal* abilities that predict individuals' efficiency in acquiring, manipulating and applying knowledge when performing *decontextualized* intellectual tasks. In contrast, adaptive intelligence considers adaptation a primary function of our intellectual faculties. As such, intelligence comprises a group of mutually reinforcing context-responsive abilities and processes that contribute to the perpetuation of human populations (Sternberg, 2019). By situating intelligence in the context of the multilevel selection problem and relating it to adaptive responding to environmental shifts, our analysis reveals the spatiotemporal variations in the behavioral expressions of adaptive intelligence. This analysis also helps to identify some intellectual processes and abilities that support the development of adaptive intelligence.

Table 3.3 depicts the nomological network of the constructs we discuss in the present chapter, which can be used to guide future research on adaptive intelligence. Future research is needed to test the associations of these proposed processes and abilities with the newly constructed measures of adaptive intelligence. Future research is also needed to establish the multilevel predictive relationships of adaptive intelligence with (a) behavioral expressions of it by individuals (e.g., the tendency to cooperate and make socially mindful choices) and (b) sustainable development of the collectives. Based on the theory of adaptive intelligence, we have designed an undergraduate general education course at the Chinese University of Hong Kong (*the Successful Self*) to nurture students' adaptive intelligence. Future research that attempts to identify the environmental affordances of adaptively intelligent behaviors will inspire new ideas and practices in the teaching of adaptive intelligence.

Table 3.3 Nomological network of adaptive intelligence

Supportive factors		Adaptive intelligence	Multilevel outcomes
Environmental affordances Supportive intrapersonal processes and abilities		Adaptive intelligence as measured by tests of adaptive intelligence	Sustainable development of collectives Example: The effectiveness of a society in attaining UN sustainable development goals
Environment Responsiveness	Cooperative Capacity		
Discriminative facility; Externalization of memory; Practical intelligence; Foresight	Shared attention; Transactive memory; Wisdom; Inspiration and creativity		Behavioral expressions of adaptive intelligence Examples: social mindfulness; social value orientation

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Part II

Culture and Society in the History of Research on Human Intelligence

4

A Brief History of IQ Testing: Fixed vs. Malleable Intelligence

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A Brief History of IQ Testing: Fixed vs. Malleable Intelligence

The word *flashlight* in the United States is *torch* in Great Britain. The British expression, *torch*, gives us an additional hint how people first perceived the new invention. Ancient Chinese language also often carries information about ancestors' thinking. For example, the character 靑 (q ī ng) literally

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describes a cyan or verdant color, but it also includes one's personalized feelings of saturation and brightness. In practice it was used to describe a spectrum of colors from blue to green. While modern Korean and Japanese languages now distinguish blue from green, many Eastern Asians use blue and green interchangeably due to their linguistic history. (Korean drivers still "Go on Blue," although the color used is the same around the world.) To better understand our modern conception of IQ, it seems important to consider the original IQ test creators' perspectives and languages on intelligence. That is because it is impossible to reify abstract intelligence into concrete numerical IQ scores without making errors (Gould, 1981); that notion is similar to how difficult it would be to describe only verbally the exact color of a particular verdant green.

The field of IQ testing did not have a particularly distinguished beginning in either England (Galton, 1883) or the United States (Goddard, 1908). American psychologists took Alfred Binet's scale, developed for French school children in the early 1900s (Binet & Simon, 1905), and accepted Galton's notion (not Binet's or Simon's) that a single global score can serve as *the* measure of human intelligence. Henry H. Goddard of the Vineland Training School for Feeble-minded Girls and Boys simply translated the Binet-Simon when he developed the "Goddard-Binet" (Goddard, 1908), with no thought of standardizing it for American children. Further, both Galton and Goddard were devout believers in eugenics.

In this chapter, influential IQ test developers' views on intelligence are curated based on two themes: (1) a spectrum of fixedness versus malleability within the field of IQ testing; and (2) a chronology of events, encompassing psychology, education, and society, that transformed a fixed-intelligence mentality to focus instead on the malleability of intelligence. In no case are we implying unanimity of opinions regarding the belief in fixed vs. malleable intelligence—either in the 1920s or the 2020s. Rather, we are talking about the majority of spokespersons within the fields of IQ test development and clinical assessment across the last century and a half.

We often included test developers' own words in this chapter, to best convey their intentions and conceptualization; we preferred accuracy to brevity. Further, we emphasized the field of IQ test development and research rather than trying to incorporate the beliefs of an array of scholars from diverse disciplines within the broad field of psychology. We begin by revisiting the exciting moments of the birth of intelligence tests in France. It is a history not often told, especially one with a focus on Binet's and Simon's implicit beliefs about intelligence rather than the IQ scale that became their trademark.

Alfred Binet's Unknown Worldview About Malleable Intelligence in Context

Binet is remembered for the series of Binet-Simon scales that he developed in Paris and for summarizing a person's intelligence with a single number. His legacy, both in England and in the United States, is as the father of IQ tests (TRUE)—but also as the inspiration for the notions of "*g*" and fixed intelligence (FALSE).

Binet and Simon (1916) explained their scale's limitations due to the complexity of intelligence:

> This [The Binet-Simon] scale properly speaking does not permit the measure of the intelligence, because intellectual qualities are not superposable, and therefore cannot be measured as linear surfaces are measured, but are on the contrary, a classification, a hierarchy among diverse intelligences; and for the necessities of practice this classification is equivalent to a measure. (pp. 40–41)

> I strongly urge the [Binet-Simon examiner] to calculate new averages, taking account of the state of poverty or wealth represented by the parents of the children. … I suppose that in the rich schools, there are fewer children in a class than in the poor schools … I believe, an important condition to note in order to correctly estimate the intellectual development of the child. (p. 324)

Binet (1890) even took into account attitude and determination that might be necessary to guide appropriate judgment (i.e., intelligence):

> Let us therefore not separate the will from the intelligence, let us incarnate them one in the other; and, instead of representing the function of the

> mind as having for its aim knowledge, foresight, the combination of means, and self-adaptation, we shall be much nearer the truth in representing to ourselves a being who wills to know, wills to foresee, and wills to adapt himself, for, after all, he wills to live. (pp. 167–168)

Furthermore, although Binet viewed biological perceptual learning as one of the core constructs of their intelligence scale, he also saw intelligence in the human potential to overcome inborn obstacles, "Laura Bridgman, Helen Keller and their fellow-unfortunates were blind as well as deaf, but this did not prevent them from being very intelligent" (Binet & Simon, 1916, p. 43).

Thus, Binet and Simon (1914) wanted their scales to be utilized to help children who could benefit from special education instead of being sent to the asylum:

> They [children with special needs] have sufficient intelligence to attend a school. What they probably require is instruction specially adapted to their mental state, and such instruction can be profitably given only in classes small enough to permit of individual attention. … We must try what special schools and classes can do for them. (p. 7)

Binet, though influenced by Spearman's theory, did not adhere to intelligence being "fixed," and his partner, Theodore Simon—long after Binet's death—"indicated that the use of a summary IQ score was a betrayal [*trahison*] of the scale's objective" (Wasserman, 2018, p. 15).

The Origins of the Theory of Fixed Intelligence

Despite Binet and Simon's writings about the complexity of intelligence, in the French language, the pioneers of IQ testing in the English language sang a different tune. First came Sir Francis Galton (1883), with his psychophysical intelligence test, belief in eugenics, great admiration of the scientific method espoused by his half-cousin Charles Darwin, and mantra of the innate and *fixed* nature of intelligence. Spearman (1904), likewise, was a devotee of fixed intelligence. For sheer bigotry, few can match New Jersey's Henry Goddard of the Vineland Training School. As noted, he championed Binet's work in the United States; he was also a pioneer in the fields of clinical psychology and special education. And he was a strong proponent of eugenics, segregation, racial inferiority, and the feeble-mindedness of about 80% of Jewish, Hungarian, Italian, and Russian immigrants. He later adjusted that figure to 40%, referring to them as "morons"—a term he created (Zimmer, 2018).

Lewis Terman and the Stanford-Binet

Lewis Terman of Stanford University also relied on Binet's work. Terman (1932) stated, "Of the founders of modern psychology, my greatest admiration is for Galton. My favorite of all psychologists is Binet" (p. 331). Like Galton and Spearman, however, Terman "believed that a child's *relative* standing was indeed constant, such that from a single testing occasion, one could predict a child's relative standing years later" (Ackerman, 2018, p. 226). Terman was savvy enough to publish only a *tentative* version of the scale (Terman & Childs, 1912) until he had painstakingly and patiently developed an array of 36 new mental tasks and obtained standardization data; the norms for American children and adolescents (N = 905, ages 5–14) represented a crowning achievement. His rigor produced the Stanford-Binet (Terman, 1916), a significant improvement over Goddard's Binet and a passel of other Binet adaptations because Terman placed the mental tasks at age levels based on the performance of *American* students instead of Parisians. Not quite as rigorous was Terman's adult normative sample—"150 adolescent delinquents, 150 unemployed men, 50 high school students, and 30 businessmen across California and Oregon" (Wasserman, 2018, p. 18).

However, Terman adhered to Galton's linear and fixed approaches (i.e., eugenics), rather than Binet's multiple and malleable approach—one that took into account educational resources, developmental intelligence, the faculty of adapting one's self to circumstances, and more. How differently would the history of intelligence testing have evolved if Terman had not been blinded by Binet's IQ test? Where would the field of IQ testing be in the 2020s if Terman had been impressed by Binet's sophisticated worldview about what it means to be *intelligent?* Perhaps Terman's (1922) unfortunate conclusion might have been different: "The struggle of civilization will be, not to advance, but to hold its own against a relatively increasing spawn of inferior mentality" (p. 38).

World War I and Nonverbal Testing

The measurement of intelligence, to Terman and Binet, was almost exclusively dependent on language ability. Occasional nonverbal tasks would make guest appearances at some age levels (copying a square or diamond, finding a lost object in a field), but verbal and language abilities largely determined one's global IQ. The entrance of nonverbal tasks into the testing vernacular in the United States was equally unimpressive. The practical realities of the United States's entry into the Great War in 1917, just after Terman (1916) published his masterpiece, influenced the future of intellectual assessment for generations.

Thousands of adult males had to be tested quickly to measure the abilities of the draftees and to identify candidates for officer training. The Army Alpha, essentially a group-administered version of the Stanford-Binet developed by Terman's doctoral student, Arthur Otis (1919), was almost a perfect fit, except that it did not capture the intelligence of the wave of immigrants who entered America in the late 1800s. Nonverbal tasks were needed, so a group-administered test, the Army Beta, was quickly assembled. It included tasks that would later be familiar to psychologists everywhere, such as Picture Completion, Picture Arrangement, and Digit Symbol.

Nevertheless, group testing was not the complete answer. What about possible malingerers? How do you identify those would-be soldiers trying to fake bad and get rejected from the Armed Forces? That gave Terman's new Binet test an immediate entrée into the world of psychological testing, but again, what about non-English-speaking malingerers? The need to weed them out was met by constructing the individually administered Army Individual Performance Scale, a series of tasks such as putting blocks together to match a design or assembling puzzle pieces (Yoakum & Yerkes, 1920). The one-on-one individual administration of the new nonverbal tasks gave examiners an opportunity to truly serve as clinicians; they learned to identify deliberately poor problem-solving strategies—along with either impulsive responding or very long response times—all of which tend to characterize examinees who are unmotivated or simply trying to fail.

Long-lasting Influences of Fixed Intelligence in IQ Testing

Belief in fixed intelligence and the primacy of heredity for determining a person's IQ dominated the first 70 years of the measurement of intelligence in England and the United States, starting with Galton (1883) and extending through David Wechsler's (1939) transformation of Terman's psychometric testing to clinical assessment of children (Wechsler, 1949) and adults (Wechsler, 1955).

Clinicians who administered the Stanford-Binet during the first half of the twentieth century tended to interpret the test scores in a purely psychometric fashion. The focus was on the precise IQ, its percentile rank, the band of error surrounding the IQ, group differences in mean IQ (e.g., urban vs. rural children), and mental age. The leading book on Stanford-Binet interpretation was written by Quinn McNemar (1942), Terman's personal statistician (A. S. Kaufman, 2013).

David Wechsler was no slouch when it came to psychometrics—he was mentored by Charles Spearman and Karl Pearson in London, just after World War I. But his passion was to think of intelligence as an aspect of personality, to focus on profiles of subtest scores and on the group factors identified by his personal statistician, Jacob Cohen (1959), rather than on global IQ; and that Wechsler believed that personality variables, test behaviors, and mood affected how every child and adult performed on an IQ test. As one of the first Ph.D. clinical psychologists in the United States, and as one of the first clinicians to have a private practice, Wechsler introduced the concept of clinical assessment, namely the notion that IQs had to be interpreted within a context, not as an absolute or immutable aspect of the person (A. S. Kaufman, 2013). Clinical assessment took over from psychometric assessment in the 1960s, when Wechsler's scales became the preeminent IQ tests in the United States; his approach to assessment continues to reign today.

Quite clearly, Terman's psychometric approach, and his personal belief systems, aligned with fixed intelligence, whereas Wechsler's clinical approach and philosophy were more in tune with the notion of malleability. Fixed intelligence and deification of global IQs clearly were the standard of the day into the 1960s, even the 1970s. But the notions of IQ being fixed and the global IQ reigning as king have become alien to a substantial proportion of psychologists, IQ test developers, and special educators during the last generation and a half.

Consider the following:

> This theory of fixed intelligence dominated the literature for nearly half a century. Not until the mid-1950s, when research conducted by Jean Piaget, Maria Montessori, Beth Wellman, G. Stanley Hall, and others was published, did researchers begin to question the fixed-intelligence model and begin to consider an interactive view of intelligence. (McIntosh et al., 2018, p. 588)

Yet the resistance to change in the rigid beliefs of so many about IQ being a fixed entity and as being essentially the same thing as a person's intelligence—into the 1950s and beyond—is baffling.

The Mixed Messages of David Wechsler

In many ways, David Wechsler was a puzzle. He was highly creative, yet he displayed little true innovation when he first published what would become known as Form I of the *Wechsler-Bellevue Intelligence Scale* (Wechsler, 1939). His separate Verbal and Performance IQs were new, but his choice of tasks represented a merger of Binet's and Terman's verbal tests with the nonverbal tests developed during World War I.

Wechsler Was an Advocate of *g* Theory

Yet, despite offering three separate IQs—derived from scales that would later align quite nicely with Raymond Cattell's (1941, 1963) initial two-pronged theory of "broad fluid" (*Gf*) and "broad crystallized" (*Gc*) intelligence—Wechsler remained a strong proponent of Spearman's *g* theory. In fact, he basically rejected Cattell's research, expanded on by John Horn (Horn & Cattell, 1966, 1967). Wechsler always considered both the Verbal and Performance Scales as "different ways" of accessing Spearman's *g* rather than as separate kinds of *g*s. And even though Wechsler's tests were largely responsible for a great many psychologists and educators abandoning the sanctity of Full Scale IQ, and focusing instead on the importance of an array of cognitive abilities instead of a global score, Wechsler never wavered from his belief in the importance of *g*. He enjoyed interpreting separate subtest scores, even individual items, but that kind of interpretation concerned personality traits, not intellectual ones. And he would retain these beliefs until the end of his life (A. S. Kaufman, 2009).

Wechsler Was Opposed to the Notion of Fixed Intelligence

Whereas Wechsler adhered to *g* theory, he *did not* subscribe to the theory of fixed intelligence. He never believed that his basically haphazard way of assembling an IQ test was successful at measuring every aspect of intelligence, nor was that ever his goal. Like Binet before him, Wechsler's definition of intelligence was far broader than his IQ tests were able to measure. His thoughts about its nature and development acknowledged the key role of culture, time, and place. He did not overvalue numbers or consider them immutable. His open-mindedness about the complexity of intelligence coexisted alongside his belief in *g*. He strongly believed in the *construct* of *g* and that children and adults varied along this dimension. But he did not think of *g* as genetic or immutable and he never thought of his Full Scale IQ as being all of what makes a person intelligent. He acknowledged that IQ had different meanings in different cultures; that the skills psychologists can measure in about 90 minutes, under standardized conditions, were limited by practical considerations; that test behaviors (he focused on persistence and motivation) greatly influenced a person's obtained IQs; and, at the root of his belief system, was that intelligence is an aspect of personality and that his tests were primarily clinical instruments (A. S. Kaufman, 2009; Wechsler, 1975).

Even before he published the *Wechsler-Bellevue* in 1939, Wechsler's (1930) words from nearly a century ago reverberate today:

> The tendency in recent years has been rather to exaggerate and overemphasize human differences, whether in the field of psychology, government or industry … Now every democracy and particularly our own is based on the very contrary assumption; … for the differences between men, when the totality of the capacities is considered, is surprisingly small. (p. 39)

Though not usually thought of as a theorist, Wechsler's (1939) widely quoted definition of intelligence makes it crystal clear that his IQ test does not measure anywhere nearly all of intelligence:

> Intelligence is the aggregate or global capacity of the individual to act purposefully, to think rationally and to deal effectively with [their] environment. It is global because it characterizes the individual's behavior as a whole; it is an aggregate because it is composed of elements or abilities which, though not entirely independent, are qualitatively differentiable. By measurement of these abilities, we ultimately evaluate intelligence. But intelligence is not identical with the mere sum of these abilities, however inclusive. (p. 3)

So, too, does his perspective on numbers versus accomplishments (Wechsler, 1939):

> The kind of life one lives is itself a pretty good test of a person's intelligence. When a life history (assuming it to be accurate) is in disagreement with the 'psychometric,' it is well to pause before attempting a classification on the basis of tests alone. Generally it will be found that the former is a more reliable criterion of the individual's intelligence. (p. 48)

In an interview conducted by two executives at the Psychological Corporation, David Wechsler clarified and amplified his definition of intelligence to include adaptive functioning; he explained that his definition reflected Spearman's *g*, Thurstone's group factors, Terman's abstract thinking, and Binet's emphasis on adaptation; and he urged clinicians to assess people "in as many different modalities as possible" (Wechsler et al., 1975, pp. 2–3). He also openly acknowledged his IQ tests' limitations and tried to develop methods to measure the critical personal qualities that his pragmatic IQ tests did *not* measure, such noncognitive factors as motivation and interest (Wasserman & Kaufman, 2015).

Cohen's (1959) research introduced *Freedom from Distractibility* as a major factor underlying Wechsler's scales, a dimension that emphasizes the role that *test behaviors* play in determining a person's IQ. Since behaviors such as impulsivity, concentration, anxiety, motivation, and focused attention will differ from testing session to testing session, quite obviously, there is nothing fixed about a global IQ that is so vulnerable to behaviors and mood; the IQs, themselves, are clearly changeable.

Further, the Stanford-Binet was largely a collection of language tasks and measures of school learning. The Wechsler scales continued that tradition with its Verbal Scale by including fact-oriented tests like Information and Comprehension and school-oriented tests like Arithmetic and Vocabulary. Scores on all of these measures are clearly *not* fixed but are subject to greatly increasing over time for those who embark on higher education, who begin to read voraciously, or who are exposed to a variety of cultural stimulation by parents, teachers, siblings, and peers. And the opposite is also prevalent. The loss of intelligence, especially on language tasks, is a natural outcome for school dropouts, or for those whose intellectual curiosity wanes when they enter the workforce, or for those who stop challenging their intellect when they retire, or for those who are removed from society and spend a decade or two in prison.

All of Wechsler's comments *against* the immutability of IQ, starting in the 1930s, did not capture the minds of psychologists, nor did his frequent refrain: "First and foremost, IQ tests are clinical instruments" (A. S. Kaufman, 2009, p. 40). The world embraced his IQ tests, but not his strong sense of how his tests should be interpreted. It would take important societal events to bring about the shift in the attitude of clinicians. For further details about Wechsler's life and his contributions, consult Wasserman (2018), Wasserman and Kaufman (2015), and A. S. Kaufman (2013).

The Decade of the 1960s: Challenges for Fixed Intelligence

In the 1960s, the field of IQ testing was rocked by turbulent events within society that reached across the aisle into the field of science. That decade helped break up the fixed-IQ quagmire by the momentum of the learning disabilities movement and the emergence of the new field of neuropsychology (Reitan, 1955, 1960, 1966).

The Growth of the Learning Disabilities Movement

Samuel Kirk (1963) coined the term "learning disabilities" at a packed house composed mostly of the parents of children and adolescents whose bright sons and daughters (mostly sons) were given the label "underachievers"—a designation that implied lack of effort and resulted in receiving no special education or educational interventions at all. The LD movement focused on students whose IQs did not match up with their real-world functioning, and it highlighted the undeniable reality that children and adolescents who learned little in school and could not read or perform math computations were earning low IQs *because* of the learning disability. The parents demanded a more appropriate description of their child's intelligence, knowing that an overall IQ missed their child's areas of talent. Although Kirk jump-started the learning disabilities movement, there were strong disagreements about his definition from its inception (Shepherd, 2001), and these disagreements and alternate interpretations abound in the literature (Elliott & Grigorenko, 2014) and in federal guidelines (IDEIA, 2004).

The Emergence of Neuropsychology

The field of neuropsychology, with its discovery of so many specific brain-behavior relationships, had little use for a global aggregate score (Reitan & Davison, 1974). Taken together, the fields of learning disabilities identification and neuropsychological assessment—paired with activist special educators, physicians, and parents—had an enormous influence on the conservative field of clinical psychology. When psychologists entered the fray, it was educational and developmental psychologists leading the way, not clinicians or psychometric researchers.

Hunt and Piaget

The powerful role of environment was put front and center by J. McVicker Hunt's (1961) groundbreaking *Intelligence and Experience*, and by Hunt's (1961) and Flavell's (1963) introduction of Jean Piaget to the mainstream of American culture. These societal demands pushed the one-score Spearman-based Stanford-Binet off the mountain and paved the way for the ascent of Wechsler's scales. His separate Verbal and Performance IQs and an array of 10–12-scaled scores helped to meet society's growing needs for clinical and school psychologists to adopt a more nuanced diagnostic and intervention approach, one that often pushed the Full Scale IQ aside in favor of an analysis of profile fluctuations.

The 1970s and 1980s

The events of the 1960s were just the tip of a societal iceberg that erupted on diverse fronts during the 1970s.

The Black Psychologists Association

Opposition to the bias and unfairness of IQ tests was put front and center on the educational, psychological, and societal fronts. The Black

Psychologists Association's official position was to render IQ tests obsolete, especially for diagnosis and educational placement of Black students. They had brilliant spokespersons, such as Robert Williams (1974a, 1974b), Asa Hilliard (1975), and Luther Weems (1975), who argued for the blatant unfairness of conventional IQ tests for the Black population. Their arguments were dynamic and captured the attention of convention-goers and test publishers. They claimed that IQ test developers were guilty of Black intellectual genocide, and that they were silently mugging the Black community (Williams, 1974a, 1974b). Williams even developed an IQ test based on Black culture that reversed the direction of the discrimination and had the unforgettable name *Black Intelligence Test of Cultural Homogeneity* (BITCH).

Jane Mercer's Push for Adaptive Behavior

Jane Mercer (1973, 1977), a sociologist, jumped into the fray as an advocate for Black and Hispanic American children and adolescents, especially those who were diagnosed as mentally retarded based on a single IQ score. She forced psychologists to pay attention to the legal requirements for such a diagnosis—significant deficits in IQ and *adaptive behavior*. She forced clinical and school psychologists to follow the letter of the law and actually measure the child's ability to function at an age-appropriate level within society. Edgar Doll (1935, 1965) developed the Vineland Social Competency Scale, but it was not required for identification of students with intellectual disabilities. The more common measure was what some referred to facetiously as the EBTAB—the "Eyeball Test of Adaptive Behavior"—namely, if a student earned an IQ below 70, the clinical or school psychologist would say, "Yep, that child sure *looks* as if they have deficient adaptive behavior."

Most memorable were Mercer's lectures on the "6-hour retardate." That would be, for example, the teenage Black girl with an IQ of 67 who spends the school day in a class for Educable Mentally Retarded (EMR) students. Then, once school has ended, she takes the shopping list she prepared, picks up the ingredients for the evening's dinner, cooks the meal, helps her younger siblings with homework and deals with their concerns, and supervises the household until her parents come back from the late shift at work. Mercer not only captivated the public and the fields of clinical and school psychology—but she also changed the way intellectual disabilities were diagnosed to ensure that adaptive behavior *must* be assessed with a high-quality instrument before anyone could be diagnosed with an intellectual disability. She even got her own test published, the System of Multicultural Pluralistic Assessment (SOMPA; Mercer & Lewis, 1978). Her approach to assessment intended to offer separate norms based on sociocultural background by utilizing Wechsler's scales, even though the SOMPA had some logical errors (Yonge, 1982).

The Vineland test was thoroughly revised by Sara Sparrow and Dom Cicchetti (Sparrow et al., 1984) and was co-normed with the Kaufman Assessment Battery for Children (K-ABC; A. S. Kaufman & Kaufman, 1983). Jane Mercer's impact would remind psychologists and educators that intelligence measurement is not limited to IQ, but it also encompasses how a person displayed that intelligence in everyday life.

Advances in Theory Finally Had an Influence on IQ Test Interpretation

The 1970s continued the rejection of fixed IQ via the flourishing of a variety of cognitive, developmental, and neuropsychological theories, several of which landed directly in the laps of psychologists and special educators who would be spearheading theory-based interpretation of existing IQ tests (A. S. Kaufman, 1979; Matarazzo, 1972; Sattler, 1974) and, in the next decade, would be on the front line developing a new wave of IQ tests (A. S. Kaufman & Kaufman, 1983; Thorndike et al., 1986; Woodcock & Johnson, 1989).

David Wechsler at APA

In the 1970s, David Wechsler would go on record, in a visible way (packed auditoriums at American Psychological Association conventions; *American Psychologist* featured article (Wechsler, 1975)), to remind everyone that he never thought of intelligence as being just scores on his IQ test, or as a construct that is separate from adaptive behavior, or that can only be measured in one way, or that is static from society to society or across cultures.

In fact, Wechsler never stopped pondering the nature of intelligence, and he continued to refine its definition. At two APA meetings, he emphasized that intelligence must be useful to society (contemporarily, adaptive intelligence; Sternberg, 2019, 2020a, 2021). He explained to a large audience at a 1973 APA symposium in Montreal that intelligent behavior needed to also be purposeful (A. S. Kaufman & Wechsler, 1973): "You can't sit for 20 days on top of a telegraph pole like Shipwreck Kelly did when I was in college and claim that is an intelligent act. It has no purpose. It has no use."

The next year, in an invited 1974 APA address that was later published in the *American Psychologist* as his most updated definition of intelligence, he continued on the same theme. Wechsler (1975) explained that intelligence is a multifaceted concept that must be interpreted within a sociocultural context: "[I]ntelligence cannot be equated with cognitive or intellectual ability. … To be rated intelligent, behavior must not only be rational and purposeful; it must not only have meaning but it must also have value, it must be esteemed" (p. 136).

Alan Kaufman's Intelligent Testing Philosophy

In his book on WISC-R interpretation, A. S. Kaufman (1979) acknowledged that even in the 1970s, some advocates of IQ tests still lived in a metaphorical Stone Age: "they unquestioningly accept 'what intelligence tests measure' as an adequate definition of the construct of intelligence, pay homage to global IQs, and perceive these IQs to be immutable reflections of the magical *g* factor" (pp. 3–4). A. S. Kaufman (1979) advocated the malleability of IQ and the incompleteness of the tests' coverage of the multifaceted nature of intelligence (see also Ceci, 1996; Greenfield, 1997). Joseph Matarazzo (1972), Jerome Sattler (1974), and Alan Kaufman (1979) wrote with an urgency to help rid the field of clinical and psychometric assessment of its ignorant vestiges that lingered on the contemporary scene.

In A. S. Kaufman's (1979) influential *Intelligent Testing with the WISC-R*, "Kaufman provided a logically appealing and systematic method for WISC-R interpretation that was rooted in sound measurement theory" (Kamphaus et al., 2018, p. 62); this method "became the gold standard for psychometric test interpretation and clinical assessment" (Fletcher-Janzen, 2009, p. 15). The philosophy of Intelligent Testing rested on three basic premises, all of which argue against the fixed nature of the IQ.

First, "*The WISC-R subtests measure what the individual has learned* … From this vantage point, the intelligence test is really a kind of achievement test" (A. S. Kaufman, 1979, p. 11). Flaugher (1978) noted the societal benefits of the achievement label—namely that low *achievement* scores will likely lead to educational interventions, whereas the widespread belief in fixed *intelligence* "may be seen as a justification of the *withdrawal* of educational resource" (p. 672).

Second, "*The WISC-R subtests are samples of behavior and are not exhaustive*. As samples of behavior, one must be cautious of generalizing the results to other behaviors or to performance under different circumstances. … [Further], the Full Scale IQ should not be interpreted as an estimate of a child's global or total intellectual functioning" (A. S. Kaufman, 1979, p. 12, italics in original).

Third, "*The WISC-R assesses mental functioning under fixed experimental conditions* … They sacrifice the in-depth understanding of a youngster's cognitive functioning that may be obtained from a technique such as Piaget's probing *methode clinique*" (A. S. Kaufman, 1979, p. 12, italics in original).

Regarding the Full Scale IQ, A. S. Kaufman (1979) issued a challenge to every examiner: "The Full Scale IQ serves as a target at which the examiner will take careful aim. … [The goal is] to declare the Full Scale IQ ineffectual as an explanation of the child's mental functioning (p. 21).

A Shift in Focus Away from *g* and Outmoded Notions of Fixed Intelligence

Others joined in to push global IQs aside when interpreting profiles of test scores for children and adults. The original *Woodcock-Johnson Psycho-Educational Battery* (Woodcock & Johnson, 1977) did not even provide a global score for examiners to misinterpret. And since the advent of theory-based tests in the 1980s (A. S. Kaufman & Kaufman, 1983; Thorndike et al., 1986; Woodcock & Johnson, 1989), the emphasis has been on the interpretation of test profiles and the use of a person's strengths and weaknesses to improve their cognitive functioning and academic achievement.

Although there are a small group of persistent "*g*-only" researchers (e.g., Watkins et al., 2005), it has literally been decades since major IQ test developers and most clinicians have thought of intelligence as fixed or have interpreted the IQ as measuring all of a person's intelligence. In the original *K-ABC Interpretive Manual*, the test authors included a section, "What the K-ABC is *Not.*" Their test was *not* a "Measure of Innate or Immutable Abilities," nor was it "The 'Complete' Test Battery" (A. S. Kaufman & Kaufman, 1983, pp. 20–24).

On malleability:

> The development of intelligence, from our perspective, involves a dynamic interaction of heredity and environment beginning with the prenatal environment. … The intelligence that is measured by the Mental Processing Scales is seen as a present-day intelligence that describes current functioning in the context of each child's personal interaction between genetics and environment. … Hunt (1961) presented compelling evidence that intelligence is neither predetermined nor fixed. … Consequently, the K-ABC profile is not seen as immutable, but as subject to the influences of future environmental variables, including direct educational intervention. (A. S. Kaufman & Kaufman, 1983, pp. 20–21)

On the K-ABC's measurement of *all* of a person's intelligence, the test authors emphasized that the K-ABC was incomplete, that selection of tasks was limited by practicalities such as its administration time and factor loadings, and that priority was given to subtests' clinical applications. They acknowledged that the K-ABC did not assess important abilities such as paper-and-pencil coordination, oral expression (beyond speaking one or two words), or creativity (A. S. Kaufman & Kaufman, 1983).

Although some of the Head Start studies produced short-term IQ gains (Barnett & Husted, 2005), they tended not to produce lasting gains (Barnett, 2004). The gains were not sustained over time, probably due to the cultural and educational limitations at home, and at school, after the interventions ceased. It is also feasible that interventions need to begin during infancy and toddlerhood, when children's brains are most malleable, rather than at age 3.

In contrast to Head Start studies and other similar preschool intervention programs, the malleability of children's IQs, as hypothesized by Hunt (1961) and endorsed by the K-ABC authors, was demonstrated by the ambitious and highly publicized Carolina Abecedarian longitudinal project (e.g., Ramey & Campbell, 1984). The children in that study were given comprehensive interventions starting in infancy and lasting five years (Campbell et al., 2001; Ramey & Campbell, 1984). Intelligence testing was conducted numerous times between age 3 and 21 years. The treatment groups outscored the control group by about 16.5 IQ points at age 3 and by 7.5 points at age 5; the advantage remained about 6 points at ages 6.5 to 15 and was still a significant 4.5 points at age 21.

However, the optimistic results observed for the Abecedarian project are in no way definitive. Campbell et al.'s (2001) decades-long investigation virtually stands alone among early intervention studies in demonstrating support for long-term gains in intelligence; and even that rigorous intervention study has been criticized on several methodological grounds (Nickerson, 2020). Further, an overview of more than 50 years of intervention research between early childhood and adulthood—especially efforts to train fluid reasoning—reveals a dismal success rate (Hambrick et al., 2020).

An Emphasis on Theory-Based Tests and Profile Interpretation

From the start of this chapter, we have focused almost entirely on the IQ testing movement. From that viewpoint, it is notable that there is now an array of theory-based IQ tests—mostly founded on the Cattell-Horn-Carroll or CHC model (Schneider & McGrew, 2018)—that are available for clinicians to administer across the broad range from toddlerhood to old age (Elliott, 2007; A. S. Kaufman & Kaufman, 2004, 2018; Naglieri et al., 2014; Reynolds & Kamphaus, 2015; Roid, 2003; Schrank et al., 2014).

Though not specifically grounded in a particular theory, the recent versions of Wechsler's scales were developed primarily from the vantage point of recent cognitive neuroscience research in auditory and visual working memory, fluid reasoning, and processing speed (Wechsler, 2003, 2008, 2012, 2014). Further, most contemporary IQ tests have relied on advances in psychometric theory, item-response theory, confirmatory factor analysis, and structural equation modeling.

As we will discuss in the last section, however, methodological and statistical improvement is essential—but not a substitute for the types of conceptual, technological, and societal advances (albeit not all positive) that have happened in the past.

Research Has Consistently Supported the Lack of Constancy in a Person's IQ Over Time

More than a half-century of research on aging and IQ has documented that an adult's IQ—when compared to a common norm—varies widely during their lifetimes. Based on cross-sectional, longitudinal, and quasi-longitudinal research, crystallized intelligence generally increases throughout most of the life span, whereas fluid intelligence, visual-spatial ability, and processing speed usually peaks early (about age 20–25) before typically declining rapidly throughout middle age and old age (Salthouse, 2010, 2014). Additionally, the Flynn effect research has documented that children and adults improve their scores on diverse intelligence tests at a steady rate, decade after decade, across dozens of nations and cultures (Flynn, 1987, 2007). But this trend can also depend on the context and may not be permanent; for example, many economically developed countries showed recent stagnant or decreasing IQ scores (Dutton et al., 2016; Rindermann et al., 2017).

Also, it is well known that different IQ tests yield different IQs for the same person, and those IQs vary over time. For example, Lamp and Krohn (1990) tested children on both the Stanford-Binet IV and the Kaufman Assessment Battery for Children (K-ABC) at age 4, and again at age 6. A sampling of these children earned IQs that differed, on average, by 8 points on the two different tests at age 4 and also at age 6. When comparing IQs on the same test at age 4 and age 6, again, the average difference was 8 points (A. S. Kaufman, 2009, pp. 148–151). When 12- and 13-year-olds were tested on three different IQ tests, their global scores often had a huge range. For example, one girl had scores that ranged from 105 on the third edition of the Woodcock-Johnson (WJ) to 125 on the second edition of the K-ABC; another boy's scores ranged from 102 on the WJ to 124 on the third edition of the WISC (A. S. Kaufman, 2009, pp. 151–153). These findings reflect both the variability in a person's score on an IQ test and the fact that tests differ widely in how they define and measure intelligence.

IQ Tests and Society

Each new revision of an older version has been responsive to some changes in society, such as public outcries for less biased tests that do a better job of assessing the cognitive abilities of members of ethnic minorities; improved technology, access to the internet, and the prevalence of smartphones; advances in theories of learning, memory, development, and intelligence; modifications in assessment due to the pandemic (Wright & Raiford, 2021); changes in diagnostic criteria of some disorders based on legislation (PL-94-142, *Education for All Handicapped Children Act*, 1975; IDEIA, 2004) or revisions of DSM manuals (*American Psychiatric Association*, 2013); and so forth.

Intelligence tests have grown with the times, to some extent. Traditional IQ tests have been transformed into theory-based tests of multiple cognitive abilities. Spearman's *g* has given way to CHC abilities and contemporary applications of the processes that Russian neurocognitive psychologist, Alexander Luria (1970) researched a half-century ago in clinical settings (Naglieri & Das, 1997). A Canadian psychologist, Jagannath Prasad Das (e.g., Das et al., 1979), conducted a series of studies on attempts to improve **P**lanning **A**ttention, **S**uccessive processing, and **S**imultaneous processing ability, which make up the Naglieri-Das **PASS** model. Later, an array of studies specifically designed to improve children's executive functioning via educational or strategical interventions were conducted (Naglieri & Gottling, 1997; Naglieri & Johnson, 2000).

Notions of fixed intelligence have been replaced, for most knowledgeable professionals, by awareness of the malleable nature of intelligence and the fact that IQ tests measure only a fraction of what can legitimately be thought of as intelligent behavior. Wechsler emphasized the complexity of human intelligence even before he published the *Wechsler-Bellevue* in 1939. Robert Sternberg (1985) made it abundantly clear that the "Analytic" IQ component was only a piece of the puzzle, sharing the stage with the Practical and Creative components in his groundbreaking Triarchic theory. And just as Sternberg (1999, 2019, 2020a, 2020b) has continued to revise and develop his theory of successful intelligence, keeping pace with changes in society, so too has the field of IQ assessment generally grown with the times. But there is room for much more growth, and removing the shackles of the past and present, especially in an age that has become entrenched with divisiveness—at the same time that social consciousness has moved to front and center in the public arena, and the world is so high tech.

What the Future Holds

Contemporary researchers have warned about what IQ tests *cannot* capture. For example, cognitive psychologists proposed the dual process model of intelligence, including intuitive, implicit, and interactive reasoning as well as analytical, explicit, and depersonalized processes (e.g., Stanovich, 2009). In the field of social psychology, cultural and environmental impact on intelligence have been empirically supported (e.g., Nisbett, 2009). However, the future of the clinical assessment of intelligence remains a mystery. In the foreword of Dawn Flanagan and Erin McDonough's *Contemporary Intellectual Assessment*, A. S. Kaufman (2018) wrote:

> I must admit that the field is *not* where I thought it would be now, and it is not where test publishers (at least Pearson, the publisher of the Wechsler and Kaufman batteries) thought it would be. A half-dozen years ago, really closer to a dozen years ago, we thought that the assessment of intelligence and achievement would follow the rest of the world into the digital age. We thought that somewhere in basements, groups of 19-year-old nerds were applying the latest technology to assemble the next generation of IQ tests that would take the field by storm. … We were advised by different professionals at Pearson that "paper-and-pencil" tests like the KABC-II had a shelf life of 5–7 years; that almost all examiners would switch to Pearson's Q-interactive administration in that time; and that the future was digital. Well, it didn't happen … It still may be the wave of the future, but it does not define the cutting edge of the present. (pp. ix–x)

In anticipation of this "future," Alan and Nadeen Kaufman developed a computerized, gamelike test for French-speaking children based on principles of adaptive testing (K-CLASSIC; A. S. Kaufman & Kaufman, 2007). Subsequently, they worked on the Kaufman Assessment Battery for Children—Digital (KABC-D), which is currently "on hold" by the publisher (A. S. Kaufman, 2018). The KABC-D was developed to broaden the definition of intelligence by merging traditional notions of static assessment with research and theory on dynamic assessment. To achieve the latter goal, the KABC-D was intending to apply computer technology to gauge how much a person's intelligence can be boosted during an assessment; it relied on Lev Vygotsky's (1978) Zones of Proximal Development (ZPDs) as a theoretical and methodological guide.

The K-CLASSIC never caught on. The KABC-D will not happen. And test developers continue to revise and restandardize what has now become the same old thing. In that sense, they are responding to the needs of the market. Clinicians, school psychologists, and neuropsychologists apparently want to retain the one-on-one relationship with the child or adult, and clinicians want to continue to observe their clients manipulate blocks or cards. So, the handful of publishers of cognitive batteries have been taking take mini-steps toward the future. The tests are certainly improved. Some tests are administered by laptops but are still one-on-one. The theoretical and statistical foundations have gotten more sophisticated (A. S. Kaufman & Kaufman, 2018; Naglieri et al., 2014; Schrank et al., 2014; Wechsler, 2014)—but the tests continue to measure the same old constructs. When one refers to *modern* IQ testing, it is unfortunate that *modern* refers to about 35 or 40 years ago when the WJ (Woodcock & Johnson, 1977) included novel tasks that did *not* trace their roots to Alfred Binet or World War I, and when both the K-ABC (A. S. Kaufman & Kaufman, 1983) and WJ-Revised (Woodcock & Johnson, 1989) were founded in theory rather than developed haphazardly or to meet practical concerns.

We believe that cognitive tests of the future need to broaden what they measure. Adding adaptive behavior to the diagnosis of intellectual disabilities was a major step forward, but that happened more than 40 years ago. Why should the measurement of adaptive intelligence, the latest evolution of Sternberg's reconceptualization of intelligence (Sternberg, 2019, 2020a, 2021a), be limited to low-functioning children and adults? Why can't test developers expand the concept of adaptive behavior to measure these skills at high levels of competency? Why shouldn't the ability to function intelligently in society be measured across the ability spectrum and be included as a key component of intelligent behavior for everyone? Charles Darwin, in *The Origin of Species*, states that it isn't the most intelligent who survive; rather, it is those who best adapt and adjust to their changing environment (Megginson, 1963).

However, the same variables that undoubtedly have limited the influence of computerization on the clinical assessment of intelligence are at work in preventing wholesale modification of IQ tests. First is basic conservatism among test publishers. Second is territoriality among psychologists—anyone can administer a computerized IQ test, but only carefully trained psychologists, or the equivalent, are allowed to give Wechsler tests, or Kaufman tests, or Woodcock-Johnson tests. And third, test publishers are governed to a large extent by the bottom line. Somebody will have to "show them the money."

We are not necessarily arguing that IQ tests need a 180-degree overhaul, but they do need to be supplemented with other measures of adaptive behavior to remain relevant. Since the first development of intelligence testing, we have been dealing with increasing varied and dire globalized issues such as climate change, pandemics, pollution, and water and resource shortages (among many others). Thus, as the types of problems that need to be intelligently solved evolves, so must the tools to assess that intelligence. We also acknowledge that there are few incentives to changing existing IQ tests; therefore, we propose approaching the assessment of IQ more holistically by appending a battery of measures.

Such measures could include components of transformative deployments of intelligence (Sternberg, 2021b). People who show transformational giftedness seek to improve the world and help people. Current measures rely on what Sternberg (2020b) calls transactional giftedness; students who perform well in school and on tests are given access to resources (such as gifted program or elite colleges) with the expectation that they will work hard and succeed in a traditional fashion (i.e., a well-paying job).

What would comprise transformational intelligence? Such constructs could include wisdom, values, intrinsic motivation, tacit knowledge/practical intelligence, and creativity. There is a bit of a Catch-22 situation in that suggestion because these constructs are frequently studied and discussed but rarely incorporated into high-stake test batteries; most measures are either self-report or artificial. For example, let us briefly explore creativity assessment. Most creativity measures are either self-report (J. C. Kaufman, 2019) or divergent thinking tests, measures of creative potential which ask students to answer hypothetical open-ended questions with many different responses (Acar & Runco, 2019). Although both of these techniques offer a certain amount of information, we believe neither would offer enough additional reliable valid information to convince most skeptics who work with high-stakes assessment (e.g., J. C. Kaufman, 2015, 2016).

Performance-based measures, typically asking expert raters to judge actual creative products (Amabile, 1996), have been used in such real-life contexts as college admissions (Sternberg, 2010). However, at this moment, they consume extensive resources and time (J. C. Kaufman & Baer, 2012). For any publisher to devote resources toward a high-quality, performance-based measure of creativity—especially one that might be easy and cheap to score—would mean there would need to be a demand. That kind of demand, however, is largely contingent upon such measures existing and the relevant audience becoming aware of their availability.

Many people, particularly educators, have a certain awareness of divergent thinking tests, which continue to rely on core concepts developed more than 50 years ago (e.g., Guilford, 1967). Therefore, most of the work on bringing creativity into the internet age is largely adapting, modifying, and expanding divergent thinking tests. Many of these new developments are notably improvements and offer suggestions as to ways computerized creativity testing might be pursued, such as physics-based games that stealthily measure creativity (Shute et al., 2016; Shute & Rahimi, 2021) and a digitized figural divergent thinking test that asks for a single use of multiple items (Barbot, 2018, 2019). Although such progress is certainly welcome (J. C. Kaufman et al., 2022), we are still waiting for such technological advances to be applied to a more real-life, performance-based measure.

Indeed, such a Catch-22 seems to encapsulate the state of the field in IQ testing. More is possible. More has been proposed, developed, and tested. But people do not choose systems that they do not even know exist. If IQ tests have largely remained stagnant for the last several decades, then hoping that they might expand to such an extent that they include a broader conception of the construct is likely a zero-point response that would require a follow-up query from the examiner: "How"?

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5

The Idea of a Peculiarly Female Intelligence: A Brief History of Bias Masked as Science

Gerd Gigerenzer

Her philosophy is not to reason, but to sense.
Immanuel Kant (1764)

Her logical thought is slower, but her associations quicker than those of man, she is less troubled by inconsistencies, and has less patience with the analysis involved in science and invention.
G. Stanley Hall (1904)

Immanuel Kant's conviction that women's nature is sense rather than reason surprised few scholars during the Enlightenment. Learned ladies, Kant believed, were worse than useless, and the very thought of women intellectuals interested in Greek philosophy or the foundations of mechanics seemed almost comical in his eyes (Kant, 1764/2011). Kant stood in a long and tenacious tradition convinced that the mind of a woman differs from that of a man. It can be traced back to Aristotle's

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influential contention that "the female is softer in disposition, is more mischievous, less simple, more impulsive, and more attentive to the nurture of the young; the male, on the other hand, is more spirited, more savage, more simple and less cunning … She is, furthermore, more prone to despondency and less hopeful than the man, more void of shame, more false of speech, more deceptive, and of more retentive memory" (Aristotle, 350 BCE/1984, pp. 948–949). At the beginning of the twentieth century, modern psychology reiterated the idea that women are qualitatively different. G. Stanley Hall, founder and first president of the American Psychological Association, held that women "excel in mental reproduction rather than production" (1904/1976, p. 565) and are intuitive and emotional, slow in logical thought, and too impatient for analysis and science:

She works by intuition and feeling; fear, anger, pity, love, and most of the emotions have a wider range and greater intensity. If she abandons her natural naiveté and takes up the burden of guiding and accounting for her life by consciousness, she is likely to lose more than she gains, according to the old saw that she who deliberates is lost (p. 561).

Hall, then president of Clark University, consequently opted against coeducation. Like Clark, Harvard set up a female institution in the 1890s, Radcliffe, next to all-male Harvard College. But even there, women were not treated like men. Not until 1967 did Harvard's Lamont Library open its doors to female students (Masters, 1986), an opening vehemently opposed by the administration and the majority of male undergraduates, on grounds that females would distract male students and that there weren't even bathroom facilities for women. And it took another ten years before Harvard terminated its policy to admit only one female student for every four male students.

Hall expressed what psychologists at the time held to be a fact of nature, traces of which can be found in people's thinking today. When my colleagues and I asked representative samples of twenty-first-century Germans and Spaniards about gender differences, the result was surprising—or perhaps not. The vast majority of women and men, young and old, believed that women had better intuitions than men about matters of personal affairs, but not of science and finance (Gigerenzer et al., 2014). And the rejection of learned ladies persists: Most contemporary

American men in search of a partner on online dating sites find well-educated women with a master's degree or a PhD unattractive and prefer those with lower education (Bruch & Newman, 2018).

This chapter is a case study on how lack of theory about the nature of "intelligence" enabled cultural biases about women to be presented as science by major psychologists. A discipline that is unaware of the errors in its history is potentially hazardous: "Those who cannot remember the past are condemned to repeat it" (Santayana, 1905). I reconstruct the history of the idea of a peculiarly female intelligence in three overlapping views. In the first view, from Aristotle through to the mid-nineteenth century, the idea of intelligence as we encounter it today—as a general ability that is measurable and is largely independent of personality and moral character—did not exist. Instead, the difference between men and women was understood in terms of polarities that were a mixture of intellect, personality, and moral character, such as men's abstract versus women's concrete thought. The notion of these polarities wore away in the mid-nineteenth century and was supplanted by the concept of an inherited "natural ability" (soon to be named *intelligence*), mainly through the writings of the English polymath Francis Galton. As a consequence, in this second view, men and women differed no longer in quality but in quantity: On average, it was thought, women had inherited a smaller share of intelligence. The psychologist Louis Terman put an end to this view by eliminating particular test items from his Stanford-Binet test and balancing the rest so that girls and boys had the same mean IQ. The eliminated items landed in a personality scale called *masculinity-femininity*, which illustrates the arbitrariness of what counted as a measurement of intelligence rather than of personality. What remains debated to the present day is the third view, promoted by sexologist Havelock Ellis. It alleges that men's intelligence varies more than that of women, implying the existence of more male idiots and geniuses.

Whatever the hallmark of a peculiarly female intelligence has been—polarities, lower average, or lower variability—it has served the dubious purpose of justifying men's superior role in society. Similarly, whatever the supposed mental differences were, these became presented as part of the natural order, expressed in the female body and women's reproductive function (Daston, 1992).

Before Intelligence: Male–Female Polarities

Intelligence, as we know it from IQ tests, refers to a general ability that can be measured by a single number and is assumed to be largely independent of personality and moral character. IQ tests have been given to millions of children, recruits, and job applicants, and continue to influence access to education and jobs. The IQ has often been presented as a hard fact, and debates raged over how much of its variability is due to nature and nurture. These debates ignored the fact that intelligence as we know it was "invented" in the late nineteenth and early twentieth century.

Before that time, what we now call the intellect was considered neither a single general ability nor as largely unrelated to moral and personality traits. Rather, psychological theories conceived of the mind as a collection of faculties or talents. For instance, the key concept of *sensibility* in early eighteenth-century psychology encompassed both perceptual and emotional sensitivity as the precondition for empirical knowledge and the emotions of charity and compassion (Rifkin, 2002). Reason was even more closely identified with morality because the light of reason enabled one to recognize all forms of truth, including the distinction between good and evil. No single one of these faculties or a combination thereof corresponds to the contemporary concept of intelligence (Daston, 1992).

The prototypical male and female occupied opposite poles on the spectrum of these faculties. For instance, men were characterized by abstract thought, judgment, and genius, while women were considered to lack these and instead excel in concrete thought, imagination, and retentive memory. Male strength was opposed to female delicacy or bodily and mental weakness. This supposed weakness was in turn seen as evidence that nature intended women to confine themselves to the home and subordinate themselves to men. It was reasoned that because men's thought was abstract, they could comprehend truth, including moral truth, while women's concrete thinking prevented them from grasping abstract moral principles. Hence, women who lied or stole were considered incapable of understanding that their actions were evil. When Hall, in 1904, wrote that women were unfit for science and invention because they lacked patience, he was simply reiterating the timeworn conviction that women did not have the necessary self-discipline and stamina to reason by following a lengthy chain of argument.

Women's and men's virtues were also seen as diametrically opposed. For centuries (and in many contexts even today), chastity was considered the chief female virtue, and its violation a cardinal sin for women alone. Timidity, in contrast, was a cardinal sin for men, but easily excused in women (Daston, 1992). The view that women's intellect, character, and moral traits are intimately connected to their biology survived in various forms into early twentieth-century philosophy. Consider the controversial Austrian philosopher Otto Weininger, hailed by Freud and Wittgenstein as a great genius (Dury, 1984). In his book *Sex & Character* (1903, translated into English in 1906), Weininger drew on a wide range of philosophers and psychologists to assert that reasoning and feeling are equivalent in women, who as a consequence are prone to suggestibility, hypnosis, and hysteria, as documented by Freud. These alleged flaws correspond to Aristotle's view that women's memory is easier to imprint. From biologists Geddes and Thomson (1890), Weininger borrowed the conviction that each cell in a woman's body is sexually marked to make the female in every respect passive, submissive, and lacking in personality. Unlike man, he wrote, "woman is non-logical and non-moral" (p. 297). Faced with the fact that more men stand trial for crimes, he argued that behind every lawbreaker there is a woman who proposes the crime and profits from it. Weininger gained great popularity when he killed himself at the age of 23 at a spectacular site, the room in which Ludwig van Beethoven had died. This dramatic finale led to huge book sales and an enthusiastic reception by many contemporaries, including the Swedish playwright and novelist August Strindberg, who claimed that Weininger's book had finally solved "the problem of women" (Abrahamsen, 1946).

In sum, for millennia, a fairly consistent view reigned about women's intellect as differing fundamentally from that of men. My brief account does scant justice to the variations of this view among scholars and centuries. Yet the common denominator between them is that there was no concept of a general intelligence, which was instead defined by a number of diametrically opposed polarities attributed to the prototypical male and female, a combination of what were later separated into intelligence, personality, and moral traits.

The Invention of General Inherited Intelligence

The idea of mental faculties was slowly abandoned in the mid-nineteenth century for that of a single overarching intelligence. In contrast, the associated idea that this intelligence combines cognitive abilities, personality, and moral traits faded away only in the early twentieth century. The transition from multiple mental faculties to a single intelligence was driven not by data or experiment but by concerns outside the realm of science, chief among them Francis Galton's interpretation of evolutionary theory, his fascination with measurement, and his involvement with the fateful eugenics program.

Women Are Granted the Same Kind of Intelligence as Men, But Less of It

Galton, a cousin of Charles Darwin, promoted a strict distinction between nature and nurture, which had not been considered mutually exclusive before his time (Daston, 1992). That artificial distinction later led to a flood of psychological research trying to find an answer to the (wrong) question of what percentage of the variation in intelligence is due to nature and nurture (as opposed to asking how genes and environment interact, as in epigenetics). For Darwin's theory of evolution to work, it was clear that something must be passed on to the next generation and inherited by both boys and girls. In *Hereditary Genius* (1869/1979), Galton called this something *natural ability* (later known as *intelligence*). As he saw it, evolution implied that men and women must have the same kind of natural ability and also that this ability shows variability between individuals, given that variation is a driver of evolution. Men and women were assumed (no measurements or tests were involved) to exhibit the same bell-shaped ("normal") distribution of intelligence, an assumption Galton justified by analogy with height. Using the same analogy, he assumed the female distribution to have a lower average. Consequently, in *Hereditary Genius*, women feature solely as the mothers or wives of male geniuses.

Galton maintained the view that natural ability is a combination of intellect, personality, and moral traits, such as capacity, zeal, and the power to do laborious work. With respect to morals, he wrote that it is the nature of all of us to believe blindly in what we love, rather than in what we think most wise. "We are indignant when others pry into our idols, and criticize them with impunity, just as a savage flies to arms when a missionary picks his fetish to pieces. Women are far more strongly influenced by these feelings than men; they are blinder partisans and more servile followers of custom" (p. 196).

The invention of a single form of intelligence, or natural ability, allowed Galton and his followers to compare men and women on a single dimension, similar to how he compared humans of different racial categories and even animal species. For instance, he conjectured that the "negro race" differed from the Anglo-Saxon in their lower mean (p. 338), not in the nature of their intelligence, and that certain gifted dogs had superior intelligence to some human "idiots and imbeciles" (Galton 1869/1979, p. 36).

Today, the idea of single kind of intelligence is mostly related to Charles Spearman's (1904) "g" factor. In fact, Spearman was strongly influenced by Galton, and his main statistical tool was correlation, developed by Galton. Like Galton, he thought that high sensory discrimination and high intelligence are part of the same universal intellectual function. Unlike Galton, however, Spearman (1904) steered clear of prejudices about women or nonwhites being genetically inferior in their intelligence.

The Failure to Measure Intelligence

After Galton had invented the concept of general intelligence, he tried to measure it in his Anthropometric Laboratory in London, which opened in 1884. He started with the hypothesis that intelligence, being inherited, can be found in mind and body—in the entire nervous system. Therefore, greater sensory acuity would be the external sign of higher intelligence. Inspired by Galton, James McKeen Cattell established another anthropometric laboratory in Cambridge University, which also focused on sensory acuity. However, Clark Wissler (1901), a student of

Cattell's, could not find a clear relationship between sensory acuity and mental ability when looking at college freshmen's grades. Moreover, the various acuity measures did not appear to correlate with each other (see Blum, 1978; Sternberg, 1990). Rather than acknowledging this failure as an invalidation of his hereditary theory of intelligence, Galton assumed a need for better measures of innate ability. His search failed.

The key to measuring intelligence was found later in the work of Alfred Binet and Théodore Simon in France. In contrast to Galton and his followers, however, neither Binet nor Simon conceived of intelligence as fixed or inherited, and Simon protested against the misuse of their test in England and the US for measuring an allegedly inherited ability (Wolf, 1973).

How Women's and Men's Average Intelligence Were "Made Equal"

Binet, a member—and, later, director—of the French Ministerial Commission of Abnormal Children, was concerned about the unreliable diagnoses of children with intellectual disabilities in France. One and the same child might be classified as "imbecile," "idiot," "feeble-minded," or "degenerate" in different certificates (Binet & Simon, 1916/1973). Binet set out to classify these children in an objective way with scientific precision. His goal was to place children with intellectual disabilities in special schools geared to improve their abilities, as in the German school system at the time, and also to ensure that children without any intellectual disabilities would not be placed in special classrooms solely because they were behaviorally challenging. But Binet had no coherent idea how to measure intelligence. Like Galton, he searched in vain for correlations with sensory acuity and tried almost everything else that seemed viable, including assessing intelligence on the basis of facial features (physiognomy), measurements of the head (cephalometry), and handwriting (graphology). For instance, he presented handwriting samples from convicted murderers mixed with those from normal citizens and asked expert graphologists for character assessments, only to find out that even the most eminent experts arrived at disastrously false assessments (Wolf, 1973). The results were consistently disappointing. It remained a mystery what intelligence was, or how to measure it.

Eventually, however, Binet and Simon found an ingenious answer to the question of finding a test that correlated with teachers' assessments. They developed questions about subjects that mirrored what was taught at school, such as reasoning skills, knowledge, memory, and attention. Children's answers to these questions now correlated with their school grades as well as with teachers' evaluations. By 1905, Binet and Simon had their first test of intelligence for classifying intellectually challenged children into several levels of developmental delay; in 1908, the test was revised and called a test of the "development of intelligence among children." Note that the test was intended to sort children into categories, not to assign them a single number such as an IQ. It was also not intended to measure innate intelligence, but to replace teachers' and physicians' unreliable diagnoses of children with intellectual disabilities, as a "means of prophylaxis, a means of escaping conscious and unconscious error" (Binet & Simon, 1914, p. 10).

Binet and Simon's test questions still reflected the meaning of intelligence as a combination of intellect, character, and moral traits. For instance, the test included questions such as the following: "If you are late for school, what would you do?" and "Why should one judge a person by his acts rather than by his words?" Today, one might call this social intelligence, but Binet and Simon thought of social judgment as inseparable from intelligence. Now they had a test, but without a theory of intelligence, apart from a loose definition of intelligence as "judgment, otherwise called good sense, practical sense, initiative, the faculty of adapting one's self to circumstances. To judge well, to comprehend well, to reason well, these are the essential activities of intelligence" (Binet & Simon, 1916, pp. 42–43). Before his death, Binet (1911) wrote: "Thus we return to our favorite theory: intelligence is marked by the best possible adaptation of the individual to his environment" and "to this we really do not want to add another thing" (p. 172). To which his biographer Theta H. Wolf added: "How strikingly inept is such a pronouncement if we think of the excellent 'adaptation' to their environment of mice and moose!" (1973, p. 210). Measuring without precisely knowing what one is measuring has been, and still is, one of the striking features of research on intelligence. And this feature conveniently allowed researchers to adjust the facts about female intelligence.

Binet's Intelligence Test Crosses the Atlantic and Becomes Seen as a Test of Genetic Ability

After getting his PhD from G. Stanley Hall at Clark University, Lewis Terman joined the faculty at Stanford University and became known as *the* leading U.S. researcher on intelligence. Terman was more interested in gifted children than in intellectually challenged ones. In line with Hall and Galton, he firmly believed that intelligence was inherited. He translated Binet and Simon's test into English, added and deleted some questions, and published the product in 1916, which became known as the *Stanford-Binet Intelligence Scale*s.

Yet Terman had made important alterations that went largely unnoticed in the US but were to have damaging implications. He named the test an *IQ test* (the term was originally introduced by the German psychologist William Stern), where IQ was the ratio between mental age and chronological age. He believed that whatever the test measured was fixed and inherited, or at least predominantly so. Whereas Binet and Simon thought of the test as a means to send children with intellectual disabilities to special schools so that they could ideally be channeled back into normal classrooms, Terman instead advocated special institutions and sterilization of the "mentally retarded" (Minton, 1988, p. 149). Terman had a strongly biased vision of what would happen once his test was widely applied: "There will be discovered enormously significant racial differences in general intelligence, differences which cannot be wiped out by any scheme of mental culture" (Terman, 1916, p. 92).

Under the leadership of Robert Yerkes, president of the American Psychological Association and a member of the Eugenics Record Office's Committee on the Inheritance of Mental Traits, the *Army Alpha and Beta Tests*, based on Terman's IQ test, were applied to 1.75 million men in World War I (Carson, 2007). Yerkes and his staff were convinced that the test measured native intelligence, even though it included items such as

"The Overland car is made in Buffalo/Detroit/Flint/Toledo" (Minton, 1988, p. 70). They recommended immediately discharging about 8900 men with low test results from service, many of whom were foreign-born or illiterate. The army officers disagreed with the psychologists, pointing out that these men would become good soldiers after training (Minton, 1988, p. 73). Nevertheless, Yerkes hailed the test a great success, despite little evidence that it had made recruiting more efficient or had contributed to winning the war. On the contrary, the war helped to win publicity for mass testing—if only because the psychologists had shown that such testing could be accomplished. On that wobbly basis, IQ testing spread across the US.

Binet, who died in 1911, did not live to see what happened with the Binet-Simon test once it crossed the Atlantic, but Simon did. He objected to the term *IQ* because it suggested a fixed, inherited mental age. In interviews with Binet's biographer Theta Wolf, Simon even called the term and its genetic interpretation a betrayal ("trahison") of their test's original objective (Wolf, 1973, p. 203).

Men and Women Are Assigned the Same Mean Intelligence

Without much fanfare, Terman eradicated the idea that females have lower average intelligence. In his revised Stanford-Binet test, he deleted questions for which boys and girls had different success rates and balanced the rest so that, on average, girls ended up with the same IQ as boys. Terman was not particularly explicit about this correction, nor about its reasons. But his decision finally made women equal to men in terms of IQ, at least on average.

What was Terman's motivation? Terman and Merrill (1937) explained that they plotted the difficulties of each item against age groups "for the sexes separately as a basis for eliminating tests which were relatively less 'fair' to one sex than the other" (p. 22). Moreover, "a considerable number of those retained show statistically significant differences in the percentages of success for boys and girls, but as the scales are constructed these differences largely cancel out" (p. 34). The explanation of "fairness" appears strange in face of Terman's intention to measure largely genetic differences in intelligence. And fair to whom? Were boys or girls originally better, and whose mean was upgraded? Terman and Merrill did not say.

Others proposed that Terman made the means equal to reckon with the fact that girls usually perform better in school, or in response to pressure generated by the increasing women's movement of the period (Blum, 1978). A third explanation is that Terman, working closely with a large number of women coworkers (according to his biographer, Henry Minton, 1988, sometimes too closely), was influenced by them to make the averages equal. Yet all three explanations assume that boys tested better than girls, and that item deletion served to upgrade the girls' average. Who really did perform better in the original set of test, girls or boys?

It took me a while to find an answer in Terman's writings. It appeared years later, in a different context, in the study on gifted children by Terman and Oden (1947), hidden in a side remark on another topic, the question of why there were more boys than girls in the group of gifted children. Terman and Oden discussed the possibility of a nomination bias (teachers nominate more boys than equally gifted girls), and also the possibility of "a real average superiority of boys in the intellectual function tested" (p. 13). They concluded that such a real average superiority is unlikely because for the 905 subjects on whom the 1916 Stanford-Binet was standardized, the mean IQ was slightly higher in girls. In other words, Terman appears to have found that girls had higher average scores in his intelligence test than boys, and then deleted items and balanced others to lower the mean of the girls to match the inferior mean of the boys!

One might ask what would have happened if girls had had the lower scores. Would Terman also have deleted items to make the averages equal? If not, the test might have been standardized such that females' average IQ was a few points lower than males'.

Terman's decision to make the average IQ of males and females equal put an end to the second idea of a peculiarly female intelligence. It also illustrates the deep problem of how to measure something in the absence of a theory, where there is wiggle room to make decisions about test items that produce the result one favors—for fairness or whatever other reasons. In principle, Terman could have designed a test in which women are superior to men, or where certain cultures or races are superior to white Americans. The problem is this: One can measure whether women and men differ in a specific and clearly defined task, such as memory span. But if one has neither a clearly defined task nor a theory and instead selects dozens of test items and adds the points up to determine an IQ, there are many degrees of freedom that allow for tinkering with the test to fit its result with preconceived beliefs and biases.

This key problem of measuring IQ is not always acknowledged. Consider Hans-Jürgen Eysenck, who once was the most frequently cited living psychologist and one of the most controversial intelligence researchers. In his *Intelligence Controversy* with Leon Kamin (Eysenck & Kamin, 1981), he reified the equal averages, complaining that psychologists "are said to have selected items in such a way that equal scores are achieved regardless of whether there might or might not be genuine differences between the sexes. This accusation is false" (p. 40). He continued: "Given that unselected items give the sexes equal IQ scores, it was only reasonable for other test designers to avoid bias in favour of one or the other sex" (p. 41). However, there is no such thing as "unselected" items in the absence of a theory of what intelligence is and how it can be measured. Terman himself occasionally also reified the equality of mean IQ to support women's equality. In *Sex and Personality* (Terman & Miles, 1936), Terman and Catherine Cox Miles wrote: "Intelligence tests, for example, have demonstrated for all time the falsity of the once widespread prevalent belief that women as a class are appreciably or at all inferior to men in the major aspects of intellect" (p. 1). All in all, Terman's IQ test ended the view that females have lower average intelligence than males so that men and women were finally seen as equally intelligent—at the expense of favoring racial prejudice.

How Differences in Intelligence Became Differences in Personality

In the introduction to *Sex and Personality*, Terman and Miles (1936) noted that it appears impossible to explain sex differences in behavior wholly in terms of biological factors and complained that the concepts of masculinity and femininity are even more vague than the nineteenth-century concepts of intelligence (pp. v–vi). As an example, they referred to the stereotype of the "occidental" woman whose moral life is shaped less by principles than by personal relationships, and whose everyday behavior is more determined by emotion, submissiveness, and inferior steadfastness of purpose.

Nevertheless, Terman and Miles did not present a theory that replaced the vagueness and stereotypes to which they objected. How then could they measure personality differences between men and women? Terman and Miles came up with an ingenious solution, which was initiated as subtly as Terman's strategy to discard test questions had been. It turns out that the discarded questions ended up in their "masculinity-femininity scale" (Terman & Miles, 1936). That action guaranteed differences between males and females on the new scale, which contained, among others, questions on interests such as movies and amusement, opinions such as "The unmarried mother deserves the scorn she gets" and "Blondes are less trustworthy than brunettes," and "information" such as "The most gold is produced in Alaska/NY/Tennessee/Texas." Once seen as items that measured inherited intelligence, these now served to measure personality and gender-specific knowledge. In the absence of a theory of intelligence that determines what questions are relevant, one-and-the-same item can be applied to measure sex differences in intelligence or in personality. In various forms, the masculinity-femininity scale is still in use and still presented as measuring sex differences in personality.

Larger Variability in IQ Justifies Male Superiority

In 2006, Harvard President Larry Summers resigned from his position in the wake of a no-confidence vote by his faculty. Among the reasons cited by the faculty was a remark he had made regarding women's intelligence and ability. On the question of women's aptitude for science, Summers said: "It does appear that on many, many different human attributes—height, weight, propensity for criminality, overall IQ, mathematical ability, scientific ability—there is relatively clear evidence that whatever the difference in means—which can be debated—there is a difference in the standard deviation, and variability of a male and a female population" (2005). From that he drew the conclusion that the greater variability of males explains why top universities such as Harvard hired relatively few women as professors.

Summers's statement simply repeated a hypothesis discussed in psychological research for over a century: that the variability of women's physical and mental traits, including IQ, is smaller than that of men. This *variability hypothesis* both explains and justifies observations that there are more male geniuses than female ones and also explains why that there are more male idiots at the other end of the IQ distribution.

After Galton replaced the first version of intelligence—that men's and women's mental abilities were at opposite poles—with one common intelligence, and Terman in turn put an end to the subsequent idea of average differences, the only possible remaining difference on the bell curve was the variability, or standard deviation, in IQ. After all, a bell curve has only two parameters, mean and standard deviation. The variability hypothesis became the third and last bastion for the idea of a specifically female intelligence, contributing to Summers's fall. Its origins seem to be in an observation by Darwin in the second edition of *The Variation of Animals and Plants Under Domestication* (1875, p. 457) that male animals tend to be more variable than females, although Darwin himself devoted little attention to this issue. Instead, the claim of greater male variability was promoted by the English sexologist Havelock Ellis (1859–1939).

The Variability Hypothesis

Ellis rebelled against the conspiracy of silence surrounding the sexes and decided to devote his life to their scientific study. For him, women and men were different but complementary—in contrast to Galton, who did not see much usefulness in women's lower average natural ability. In the first edition of *Man and Woman* (1894, p. 367), Ellis wrote: "From an organic standpoint, therefore, men represent the more variable and the more progressive element, woman the more stable and conservative element, in evolution. It is a metaphorical as well as a literal truth that the center of gravity is lower in women and less easily disturbed." (In the fourth and fifth editions, Ellis left out the "progressive element," indicating second thoughts about the generalizability of biological variation, particularly to politics.) He wrote that women's smaller stature approximated that of humans' ancestors, and that women—as in witches and soothsayers—preserved ancient custom and methods of thought. Women had "an organic tendency to stability and conservatism, involving a diminished individualism and variability" (p. 369). As an example, he made the case that women had opposed the French Revolution, albeit also noting that the revolutionary movement of Christianity was to a considerable extent furthered by women (p. 370). He acknowledged that the facts are very complex and that that the claim of absolute inferiority for either sex is untenable, but nonetheless concluded: "It is undeniably true that the greater variational tendency of the male is a psychic as well as a physical fact" (p. 370).

Man and Woman received scant attention when it first appeared (Grosskurth, 1980, p. 170). Yet that changed when the statistician Karl Pearson (1897) vigorously attacked Ellis's variability hypothesis. Pearson was a committed socialist and promoted feminism and eugenics, both of which were considered progressive and revolutionary at the time. Pearson argued that the claim of greater male variability contradicts Darwin's theory of evolution by natural selection, which emphasizes variability as one of the driving forces of evolution but postulates that the more intense the struggle, the less is the variability. Therefore, he expected men, not women, to be less variable. Next, he criticized Ellis's inconclusive evidence, based almost entirely on pathological variation such as criminality and color blindness. And, finally, Pearson contended that measuring the variability of absolute variables such as the length of bones (as opposed to ratios such as cephalic index) by the standard deviation, as Ellis did, was an error. Instead, one needed to calculate the coefficient of variation, that is, the standard deviation divided by the mean. After all, women's bodies were smaller than men's and so, therefore, was the standard deviation of bodily measures. Pearson concluded from his own physical measures that the coefficient of variation is slightly larger for women, not smaller, reflecting their "slightly less severe struggle for existence" (1897, p. 297).

In an Appendix in *Man and Woman*, Ellis rejected Pearson's "hostile" criticism at length, which Pearson did not deem worthy of a response. Pearson's sole reaction was a footnote in an article unrelated to variability, in which he noted that Ellis's response required no reply, as Ellis did not appear to understand that scientific evidence, not vague generalities, was what counted (Pearson & Lee, 1903, p. 372). Afterward, Pearson did not pursue the variability hypothesis any further.

Why did this bitter controversy over females' allegedly lower variability erupt? According to Ellis's biographer Phyllis Grosskurth (1979), one likely reason was personal resentment. Many women of the time found Ellis, who with his flowing beard resembled "a combination of archetypal Father and sensual Faun," irresistibly attractive (p. xvi). The South African writer Olive Schneider was one of the women upon whom Ellis had a strong influence, before she fell in love with Karl Pearson. Whatever its motivation, Pearson's critique of the variability hypothesis in fact contributed to making the hypothesis popular.

Ever since, psychologists, biologists, and statisticians have debated the variability hypothesis. Whereas Ellis and Pearson related it to both physical and mental traits, psychologists have focused largely on intelligence. McNemar and Terman (1936) reported greater variability in boys on the Stanford-Binet and other tests but, given the inconsistent evidence, were careful not to draw any general conclusions. In 1932, Scotland undertook the ambitious project of testing all 11-year-old Scottish children with the goal of discovering the amount of mental deficiency in the country (Scottish Council for Research in Education, 1933). Because suppliers demanded too much money for the nearly 100,000 commercial tests, the Council used the *Morey House Test* in place of the Stanford-Binet. The conclusion was that boys and girls did not differ in average IQ but that the standard deviation of boys was one IQ point larger than that of girls. In 1947, the same project was repeated with all 11-year-olds at that time, and again the standard deviation was one point larger for boys (Scottish Council for Research in Education, 1949). That appeared to support the hypothesis of both higher and lower male intelligence. Although this result was hailed as the most comprehensive demonstration of the greater variability of mental ability among males (Deary et al., 2009, p. 185), the small difference in variability in the 1947 study was mainly due to an excess of males with very low scores, not to male genius (Deary et al., 2009, pp. 21, 184). The primary impetus of the 1947 study (and that of 1932) was not variability, but rather the concern that the nation's intelligence would decline because people with lower mental ability tended to have more children. Yet the children scored no worse than those studied 15 years earlier; in fact, their average IQ went up by about one point in boys and three points in girls.

Follow-ups of the Scottish children have shown similarly inconclusive results. In 1939, the Council found no significant difference in variability between boys and girls; in 1949, it reported slightly larger standard deviations in boys; and in 1958, it reported a greater proportion of females than males at the lower end of the IQ scale. Thus, one could find support for or against the variability hypothesis in intelligence, depending on the age group and study. More fundamentally, findings about variability—like mean differences—always depend on how the test items are selected and weighted. Just as Terman made the means between males and females equal, one can select items to make the variability equal.

Outspoken advocates have presented greater male variability as a biological fact, possibly due to sex linkage, speculating that intelligence might be located on the X chromosome. According to this line of reasoning, intelligence in males can express itself without interference of a second X chromosome, thereby causing greater variability in IQ (Johnson et al., 2009; Lehrke, 1978). This ignores the fact that the same hypothesis could be likewise used to predict that females have higher average intelligence than men, given their two X chromosomes, once again illustrating the utter arbitrariness of genetic explanations in the absence of a theory. Whereas the first two ideas about a peculiarly female intelligence had been conceived and debated virtually entirely by men, the variability hypothesis was challenged by an early generation of women scientists (Shields, 1982). Helen Bradford Thompson (1903) conducted her own studies and criticized Ellis's conclusions. Her critique of the variability hypothesis was widely read yet had no equivalent impact. In the most systematic critique of the variability hypothesis at the time, Leta Setter Hollingworth (1914) reported no evidence of it in her review of the literature. Beth Wellman (1933) found in her review slight support for greater variability in boys, which, however, depended on the measure of variability used, the selection of children, and other details. The variability hypothesis remains a matter of discussion. In her review of the state of art in sex differences in cognitive abilities, Halpern (2012, p. 103) concludes "that females and males are very similar when we consider the average performance, and they are highly dissimilar when we consider performance at the high and low extremes."

As with the question of whether males and females differ in their average IQ, the absence of a theoretical understanding of what a test actually measures opens the door to including or excluding items that make the mean and variance of IQ equal or different.

Lessons Learned

The idea of a peculiarly female intelligence emerged in three different and unrelated versions: male-female polarities, female lower mean intelligence, and female lower variability. The idea that men and women occupy opposite poles on a continuum, such as analytic versus intuitive, reigned for millennia. It began to fade away when Francis Galton invented intelligence (natural ability) as a single dimension, which later morphed into IQ or g (general intelligence), so that the mind of men and women now had the same quality, but with women having less of it. The idea that women have lower intelligence expired in the hands of Louis Terman, who eliminated test items so that both males and females had the same average IQ—otherwise, female means would in fact have been higher. The third idea was that while the means are the same, woman's variability is smaller, resulting in more male geniuses and idiots. This variability hypothesis is still debated today.

Despite the differences in these three ideas about a peculiarly female intelligence, their justifications are strikingly similar, and the supposed nature of women features prominently in all three. Woman's mind was said to be determined by her reproductive biology, her body, her genes, and her naturally ordained functions. The first president of the American Psychological Association, G. Stanley Hall, staunchly believed that the female mind was created for nursing and motherhood, serving the production of men of genius and of daughters to bear future male geniuses (Diehl, 1986). Education, he felt, would damage women's reproductive organs, particularly coeducation in competition with men. Like many others at the time, Hall did not think of women as generally inferior but instead idealized them. In his view, women who entered men's world of education and business became innocent victims of man's evil nature, losing their purity and sainthood (Schofer, 1976).

The historian of psychology, Edwin Boring, famously said that intelligence is whatever the IQ tests measure. But that is precisely the problem. The idea of a peculiarly female intelligence is a striking case of measurement without understanding what one is measuring, paired with the hope that sophisticated correlation statistics and factor analyses could fill this theoretical void. From Galton to Binet to Terman, researchers variously believed that one could measure intelligence in terms of sensory acuity, head size, facial features, handwriting, memory capacity, or knowledge of facts, or by asking questions about proper social behavior.

This absence of theory left too many points of entry for biases and preset convictions, to the detriment of many. Galton's vision was to promote the eugenics program: to detect the less-well-endowed and prevent them from reproducing. Both Ellis and Pearson were early feminists but also proponents of eugenics, both of which were considered progressive movements at the time. Binet and Simon intended to give children with intellectual disabilities a second chance through special education. Yet when adapted "to American conditions and needs," as the editor's introduction to the 1916 edition of Terman's *The Measurement of Intelligence* put it, their test came to serve the various goals of eugenics, sterilization, racism, feminism, and, last but not least, a multibillion testing industry.

Why Is History Relevant?

Knowing one's history provides an opportunity to learn from errors and avoid repeating these. Differences between men and women, as well as their causes, have been an emotionally and politically charged topic for centuries. Firm convictions continue to be enforced in the guise of new technology. For instance, Diane Halpern warns that modern neuroscience is being misused to justify sex role stereotypes in how men and women think, a program dubbed "neurosexism" (Halpern, 2012, p. xi). Basing conclusions about human thinking and behavior on the firing of neurons or changes in blood oxygen levels entails a long leap in logic. We have seen such leaps before, as with the argument that the smaller brain of females is responsible for woman's alleged intellectual inferiority. The stereotypes of the past also tenaciously survive in popular psychology bestsellers that present men and women as if they were alien species, as in *Men Are from Mars, Women Are from Venus* (Gray, 1992). In a throwback to the view of women being submissive by nature, such books imply that a wife's role is to hide her intelligence, to admire and appreciate her husband, and not to offer him advice unless he asks.

What is the current consensus about differences in cognitive abilities between men and women? According to Halpern (2012; Halpern & Wai, 2020), the list of differences is relatively small, and the similarities between the sexes are larger in number. Few of the differences that have been claimed over the years are stable across age, task, and culture. Among the few exceptions are that women have better memories than men (p. 119) and excel in reading and verbal abilities, while males excel in science and math (pp. 126–127). What causes these differences is far from being understood.

This history of the idea of a peculiarly female intelligence can teach us several general lessons. The first is to beware of research that evaluates the sexes in terms of polarities and, in general, uses polarities as a means to understand the human mind. Second, beware of composite index numbers, such as IQ. Unless there is a strong theory, test items can be selected to verify any existing bias "scientifically." And third, keep in mind that intelligence is about cognitive processes. Therefore, we would be well-advised to replace polarities and IQ numbers with the study of the actual processes underlying intelligent behavior, a scientific research agenda that would also leave little room for individual and cultural biases.

The Persistence of Polarity-Based Theorizing

In his paper "You can't play 20 questions with nature and win," Newell (1973) criticized that psychological explanations are often in the form of binary opposites, such as nature versus nurture, serial versus parallel processing, conscious versus unconscious, and intuitive versus analytic. Newell thought of these general dichotomies as the nadir of theorizing where, instead of achieving clarity, "matters simply become muddier and muddier as we go down through time" (pp. 288–289). Together with Herbert Simon, Newell instead set out to study the heuristic decision processes people use to solve problems and make intelligent decisions. Yet half a century later, theorizing in terms of polarities (as opposed to processes) remains popular in cognitive psychology. Here is a prominent case.

Recall the opposition between intuition and analysis, as in Immanuel Kant's and Stanley Hall's view of female and male cognition. By the twenty-first century, its association with gender was mostly dropped in psychology, albeit continuing in parts of the general public (Gigerenzer et al., 2014). The polarity itself, however, has survived in psychological theorizing and is now used to characterize two allegedly opposite poles of a continuum of thinking, despite a meta-analysis of 75 studies that showed that measures of intuition and analysis are *not* negatively correlated (as opposites should be) but instead independent (Wang et al., 2017). Theorizing in terms of polarities also has survived in dual-process models (e.g., Evans & Stanovich, 2013; Kahneman, 2011). These consist of poles such as intuitive versus analytic, unconscious versus conscious, fast versus slow, and automatic versus deliberate, not unlike those in the first version of the idea of a peculiarly female intelligence. The poles are said to be aligned and form two systems of cognition, System 1 and System 2, despite the absence of evidence for such an alignment (Kruglanski & Gigerenzer, 2011; Melnikoff & Bargh, 2018). The intuitive, impulsive, and impatient System 1 has been linked to women's thinking. Consider the Cognitive Reflection Test (CRT), a short test comprising three numeracy questions. Women score on average lower than men, which is attributed to their supposedly higher reliance on the intuitive System 1 (Frederick, 2005, p. 37), a reinstatement of the old stereotype about women. Yet leaping to the conclusion that lower numeracy results from higher intuition or impatience is neither necessary nor supported by the evidence (Bago & De Neys, 2019; Easton, 2018).

As this case illustrates, intuition and analytic thinking are still perceived by some psychologists as contraries, with intuition as the inferior pole that requires (male) analytic thinking to prevent it from error. This devaluation of intuition ignores the empirical evidence that experts need to rely on intuition to achieve better performance (Gigerenzer, 2007; Klein, 2017). As Albert Einstein famously said, "The intuitive mind is a sacred gift and the rational mind is a faithful servant. We have created a society that honors the servant and has forgotten the gift" (Calaprice, 2011). History is destiny. Despite Newell's warning, theorizing in terms of polarities persists and is still able to trump empirical evidence.

Beyond Polarities and IQ: Intelligent Decision Processes

The history of the idea of a peculiarly female intelligence shows, in my view, that the field of sex differences in intelligence, and of intelligence in general, could benefit from a fresh start. Herbert Simon's and Alan Newell's work on heuristics and artificial intelligence, which has inspired my own research on heuristic decision-making (Gigerenzer & Gaissmaier, 2011), can provide such a new framework. Heuristics are strategies that help to make decisions and solve problems in an intelligent and efficient way. After all, what we call intelligence manifests itself in the quality of the decisions we make. In the context of this chapter, I can only sketch out the research agenda, which centers on two questions: (i) What is the repertoire of intelligent strategies (such as heuristics) at a person's disposal for making decisions, and (ii) what is a person's ability to choose a proper strategy for the situation at hand (Gigerenzer, 2020; Gigerenzer et al., 2011)? In this framework, intelligence has a very concrete meaning that connects cognitive abilities with behavioral strategies, namely the adaptive toolbox of strategies available and the ability to choose a strategy wisely to achieve a goal.

While the study of intelligent heuristics is well established, it has had a blind spot for sex differences in how males and females search for information, when they stop searching, and how they make or delay decisions. One exception is the work of Meyers-Levy and Loken (2015), who reported that females search more extensively for information than males, while males are more selective in search and rely on faster stopping rules. Moreover, they concluded that females are more sensitive to environmental cues, whereas men more often ignore these and rely on the same heuristics across contexts, indicating less ability in adaptive choice. As for social heuristics, they found that women are more likely to base decisions on trust, are more likely to be trusted, and have higher ability in reading nonverbal cues and making inferences about the mental states of others. Note that these are preliminary findings, but they indicate a different kind of question to pursue: Abandon studying polarities and differences in IQ test outcomes and instead ask whether there are differences in the way males and females search for information and make decisions.

Conclusion

Does women's intelligence differ from men's? I believe it became clear over the course of the years that this question is ill-posed because the very idea of what intelligence is has shifted several times, and the various answers have been polluted by preconceived beliefs and biases in the absence of a theory of the nature of intelligence. Moreover, understanding potential sex-based differences in intelligence appears not to have been the primary course that history took, nor was it always the goal of measurement. Rather, measurement served to fortify preconceptions and biases. In my opinion, progress in the field requires going beyond polarities and IQ and analyzing the very strategies (heuristics) that males and females use to make intelligent decisions. Such a research program would also eliminate loopholes through which persisting strong beliefs about the nature of men and women can distort science. That said, some of the arbitrary decisions in the study of male and female intelligence have nevertheless contributed to an erosion of the millennia-old idea that nature has assigned women a subordinate social position. The idea that men and women's intelligence is polarized has largely been eradicated, as has the idea that women are on average less intelligent than men. The supposedly greater male variability remains the last bastion of those who cling to the idea of male supremacy.

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6

Wisdom as Perfect Intelligence: Intelligence and Wisdom in Chinese Intellectual History and in Modern-Day Taiwan

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In Taiwan, the term for "intelligence" is often used interchangeably with the term for "wisdom" (Yang & Sternberg, 1997a). Most English-Chinese Dictionaries indicate that the Mandarin Chinese translation for the noun "wisdom" and for the adjective "wise" is *zhihui* (智慧), while the translation for the noun "intelligence" is *zhili* (智力) and the translation for the adjective "intelligent" is *cōngmíng* (聰明) (*Eurasia's Modern Practical English-English and English-Chinese Dictionary*, 1979; Liang et al., 1973, 2007; Lu et al., 2000). Nevertheless, in everyday life, many intelligence-related terms are often expressed using the word *zhihui*. For example,

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"artificial intelligence" is *rengong zhihui* (人工智慧) in Mandarin Chinese (Chen, 1995) and "intellectual property rights" is "*zhihui cáichǎn quan*" (智慧財產權) in Mandarin Chinese (National University of Kaohsiung, n.d.). Needless to say, many AI-related products use the term *zhihui*. For example, in Taiwan "smartphones" are called "*zhihui xing shǒuji*" (智慧型手機) (Tech Focus, 2015, October 26).

Do Taiwanese people view wisdom and intelligence as identical? Previous studies have shown that Taiwanese people understand the two concepts differently since they view the core components of each as different. Taiwanese people's conceptions of intelligence consist of five factors: general cognitive ability, interpersonal intelligence, intrapersonal intelligence, intellectual self-promotion, and intellectual self-effacement (Yang & Sternberg, 1997a). However, a different set of four factors showed up in their conceptions of wisdom: competencies and knowledge, benevolence and compassion, openness and profundity, and modesty and unobtrusiveness (Yang, 2001). As a researcher collecting these data from Taiwanese participants, the first author of this chapter can attest that research participants gave notably different descriptions for intelligence versus wisdom. Furthermore, in many interviews that the first author conducted regarding the differences between intelligence and wisdom, the most frequent responses she got were "little intelligence, great wisdom" (小聰明, 大智慧 *xiao cōngmíng, da zhihui*) (Yang, 1996, 1998). Thus, it seems that Taiwanese conceive of intelligence and wisdom differently; they also think that wisdom is more important and valuable than intelligence.

If Taiwanese conceive of intelligence and wisdom differently, what is the reason for the interchangeability of the two words "intelligence" and "wisdom" in Chinese? We speculate that it is because most Taiwanese believe that wisdom is perfect intelligence. This personal experience from the first author may help to illustrate this belief. Before going to the United States for graduate studies on intelligence, she generally assumed that it is human nature to use intelligence to do good. She also believed that as long as people have adequate intelligence, they will see the benefit, and hence the necessity, of doing good. Following this line of reasoning, the more intelligent a person is, the greater the good he or she should pursue and accomplish. No one ever challenged or corrected her assumption in the years she was growing up in Taiwan. It therefore shocked her to learn that intelligence as conceived by many in the West is amoral (i.e., unrelated to morality), and that very smart but bad people may still be considered intelligent persons. Her assumption that people generally use their intelligence to do good predisposed her to conceive of intelligence in light of wisdom. Do other Taiwanese hold the same belief? While writing this chapter, we shared this experience with members of our research group, and most of them were as shocked as she had been to learn of the Western view that intelligence is sometimes separate from morality and that it differs from wisdom in this sense (Shin-yi Huang, personal communication, May 13, 2021).

Why, then, does this group of researchers believe that people generally use their intelligence to do good? We look to Taiwan's cultural context for an answer. Taiwanese conceptions of intelligence and wisdom differ from those in some other cultures. In the United States, for example, Sternberg (1985) found that intelligence consisted of six factors (practical problem-solving ability, verbal ability, intellectual balance and integration, goal orientation and attainment, contextual intelligence, and fluid thought), while wisdom consisted of a different six factors (reasoning ability, sagacity, learning from ideas and environment, judgment, expeditious use of information, and perspicacity).

Taiwan and Its Cultural Context

What is the history and what are the ideas that have shaped Taiwan's cultural context? Prior to the seventeenth century, Taiwan was inhabited mainly by indigenous peoples. It became first a Dutch and then a Spanish colony between 1622 and 1662. It was a territory of the Qing dynasty of China between 1662 and 1895, and then a Japanese colony between 1895 and 1945. Since 1945, Taiwan has been a territory of the Republic of China (ROC); its government was founded in 1912 by Dr. Sun Yat-sen in mainland China, which relocated to Taiwan in 1949 after it lost the civil war with the Chinese Communist Party (CCP), which founded the People's Republic of China (PRC) in 1949 in mainland China. Taiwan has thus absorbed a large number of Chinese immigrants since the seventeenth century, with the most recent being the 1.2 million people who fled the CCP in mainland China around 1949 (Government Portal of the Republic of China, Taiwan, n.d.; Hwang, 2015). At present, the majority (>95%) of Taiwanese are of Han Chinese ancestry (Chen et al., 2016).

Thus, Taiwan has been influenced by many cultures. In addition to the Chinese and Japanese cultures it has inherited, Taiwan opened itself to the influence of American culture when it began receiving American aid in the postwar period; according to Lin (2004), Taiwan received as much as US$1.48 billion from 1950 to 1965. Contemporary Taiwan is considered to be "the first and only democracy yet to be installed in a culturally Chinese society" (Chu, 2012, p. 42); as Weller (1999) noted, "The really stunning recent political change has been Taiwan's move from authoritarian control to true democracy beginning in the late 1980s" (p. 1). We think this may be credited to U.S. influence.

Among the many cultures influencing Taiwan, Chinese cultural traditions play a predominant role in Taiwan's cultural context. For most Chinese in Taiwan, Confucian ethics provide a way of life. Even during the Japanese occupation when Chinese studies were forbidden, many people still secretly taught and learned Confucian texts (Shen, 2009). Studying Chinese cultural traditions was further encouraged after the ROC government moved to Taiwan. Several movements were launched to revitalize Chinese culture, most notably the "Chinese Cultural Renaissance" in 1967, the ROC government's response to the Cultural Revolution launched in PRC in 1966 (Shen, 2009).

Growing up in Taiwan, we and many other Taiwanese studied most Confucian and Daoist (also called "Taoist") classics in Chinese literature classes and Chinese history in history classes from elementary school all the way to college. Our impression is that many, if not most, people in Taiwan know Chinese classics and history well, and people study Chinese cultural traditions for their own interest. For example, as a psychology major, the first author studied and even memorized the 5000-word *Laozi* (*Daodejing*) during her sophomore-year summer vacation. She later found that many Taiwanese act similarly when they want to learn more about Daoism, Confucianism, and other Chinese philosophies. These

Chinese philosophies form an important part of Taiwan's cultural context and have influenced Taiwanese conceptions of wisdom and intelligence.

Intelligence and Wisdom in Chinese Intellectual History

Some ideas in those Chinese philosophies have influenced people's conceptions of intelligence and wisdom more than others. Here, we describe the decisions and actions that were made throughout Chinese intellectual history to introduce the essential cultural elements derived from Chinese philosophies that have strongly influenced people's conceptions of wisdom and intelligence. We introduce Chinese intellectual history in eight important eras, from the beginning of the civilization to the present (see Table 6.1). After briefly describing the events from each era that are important in the development of the concepts of wisdom and intelligence, we explain the meanings of "wisdom" and "intelligence" found in the texts of that particular era.

Here we present Chinese intellectual history based on what we have learned in Taiwan, a historical interpretation that, to our understanding,

Table 6.1 Principal eras in Chinese intellectual history

	Era	Time
1	Chinese civilization in the Neolithic Age and Yin-Shang civilization	c. 7000 BCE–1046 BCE
2	Zhou dynasty and "Contention of a Hundred Schools of Thought"	c. 1046 BCE–221 BCE
3	A unified country and experiments with Legalism, Daoism, and Confucianism	c. 221 BCE–220 CE
4	Neo-Daoism and Confucian scholars' profound learning	c. 220–580
5	Chinese Mahayana Buddhism: A Confucianized version of Buddhism?	c. 580–907
6	Neo-Confucianism: Incorporating lessons learned from Buddhism and Neo-Daoism to Confucianism	c. 960–1644
7	Qing dynasty and the study of history	1644–1911
8	The Republican era and the scientific ways of research	1911–now

is shared by many non-Communist Chinese communities around the world. However, we note that there are divergences between the PRC and Taiwan in the interpretation of Chinese history; in Taiwan, Chinese history has rarely been interpreted from a Marxist perspective.

1. Chinese civilization in the Neolithic Age (around 7000 BCE–1500 BCE) and Yin-Shang civilization (cf. 1600 BCE–1046 BCE). Although Chinese civilization in its earliest stage probably developed in relative isolation from other civilizations, it had multiple origins (Mair, 2005). The archeologist Chang Kwang-chih (2004) indicated that during the Neolithic Age, at least six different regions had independent cultures. These six are: (a) the central region, roughly the middle reaches of the Yellow River; (b) the eastern region, roughly the lower reaches of the Yellow River; (c) the southwest region, consisting of the upper reaches of the Yangtze River; (d) the southeast region, consisting of the lower reaches of the Yangtze River; (e) the southern region, the area around Poyang Lake, stretching to the Pearl River Delta; and (f) the northern region, the territory surrounding the Great Wall areas (Chang, 2004; Hsu, 2012).

Through contact and conflict, these six cultural systems gradually influenced one another and eventually coalesced to form the Yin-Shang civilization, well-known for its bronze technology, writing, and chariot warfare. The Yin-Shang people worshipped gods, and their writings were preserved in oracle bones which they used for divination. Moreover, they viewed their state as a central kingdom of high culture surrounded by other peoples with lesser cultural attainments (Mote, 1971).

2. Zhou dynasty and "Contention of a Hundred Schools of Thought" (c. 1046 BCE–221 BCE). Nevertheless, the great Yin-Shang state was conquered around 1111 BCE by the smaller Zhou state, a state in the west with lesser cultural and economic attainments, originally a subject of the Yin-Shang state. This victory, which established the Zhou dynasty, surprised everyone, even the Zhou. Why did it happen? Among the explanations that the Zhou people identified, they interpreted the conquest in terms of virtue: destruction came to Yin-Shang because it had lost its virtue. Historically, this interpretation was a novel one, for the Yin-Shang deities which the Zhou people also worshiped were not identified as benign or evil. This interpretation, which linked the power of

deities with the virtues of humans, had a profound influence, serving as a foundation for many Chinese philosophies (Hsu, 2012).

Confucius's (551 BCE–479 BCE) ancestors were Yin-Shang aristocrats. Like many of Yin-Shang descent, Confucius was well-versed in Yin-Shang culture. He was born at a time when the Zhou polity was falling apart, with feudal lords' power surpassing the king's and increasing conflicts between the different fiefs (Hsu, 2012). As one familiar with Yin-Shang ceremonial ritual, who often assisted in temple rites, Confucius, perhaps more than most of his Zhou contemporaries, knew from personal experiences that harmony can be achieved if everyone follows rules with a reverent heart. Nevertheless, Confucius also identified strongly with the virtue-focused Zhou culture; as he stresses in the *Analects (n.d.)*, the collection of his words and deeds, "I follow the Zhou" (Book III:14, cited in Bloom, 1999, p. 48). He instilled the Zhou ideal of virtue into his Yin-Shang culture, and argued that sacred rituals would be meaningless if the persons following them are without virtue: "If a man be without the virtues proper to humanity [*ren*], what has he to do with the rites of propriety?" (*The Analects*, Book III:3).

The virtues that Confucius upheld were wisdom (*zhi* 知), humaneness (*ren*, or benevolence and humanity), and courage, as his words in the *Analects* attest: "The man of wisdom [*zhi* 知] is never in two minds [about right and wrong]; the man of benevolence never worries; the man of courage is never afraid" (*Confucius*, 1979, p. 100). Here, the Chinese word *zhi* (知) denoting wisdom refers to the cognitive ability used in making clear judgments. It is a classical word now written in the modern script as *zhi* (智), the same word as in the compounds *zhihui* and *zhili* described earlier. This character was also used in the *Analects* to refer to intelligence, when Confucius distinguishes people of different levels of cognitive ability: "The Master said, 'It is only the most intelligent [知 *zhi*] and the most stupid who are not susceptible to change'" (*Confucius*, 1979, p. 143). Confucius, then, held that most people can change their intelligence through education except for those whose intelligence is extremely high or low.

Of these three virtues, the second one, humaneness or benevolence, is seen as Confucius's innovation. The Chinese character for this word is 仁 (*ren*), which before Confucius denoted sensory pleasure (Liu, 1995), appearance (Hsu, 2012), or a practice of human sacrifice (Xu, 2019). Confucius completely transformed its meaning and made it a term for virtue (Hsu, 2012; Liu, 1995). We can tell that this was a new meaning for *ren* since the *Analects* describes countless people asking Confucius to explain this term, and the book is full of Confucius's explanations for this virtue and how it should be embodied in different contexts. What is *ren*? The pithy definition in the *Analects* is, "Do not impose on others what you yourself do not desire" (*Confucius*, 1979, p. 112). This is why common English translations for *ren* include humaneness (Bloom, 1999; Hu, 2021), benevolence (Lau, 1979), or humanity (Shen, 2003). Many believe that Confucius's *ren* marked in Chinese civilization the beginning of the Axial Age, a period when an emphasis on humanity appeared in many civilizations around the world (Jaspers, 1953; Liu, 1995).

Contrary to the respect and honor that Confucius received in later periods of Chinese history, he was not popular in his own time. Although famous for his knowledge and virtue, his ideas were not adopted by any of the feudal lords when he was alive. Not long after Confucius's death, the political situation of the Zhou dynasty worsened: the fiefs had turned into powerful states and fought against one another for supremacy. The Warring States period (475 BCE–221 BCE) was characterized by almost nonstop warfare. Paradoxically, during this era different schools of thoughts flourished. It was during this time that Legalism, Mohism, Confucianism, Daoism, and many other schools took shape, as their respective proponents contended before feudal lords for political application. This phenomenon is called "Contention of a Hundred Schools of Thought" in Chinese history.

Mencius (or Mengzi, 372 BCE–289 BCE), the most famous proponent of Confucian thought, was born at the beginning of this era, almost a hundred years after the death of Confucius. Even though the *ren* of Confucius was not popular at that time, Mencius took up the ideal and expanded it. Not only did he exalt *ren* as the highest Confucian virtue, but he also went so far to argue that all human beings are born with the capacity to cultivate this virtue:

> Suppose a man were, all of a sudden, to see a young child on a verge of falling into a well. He would certainly be moved to compassion,… From

> this it can be seen that whoever is devoid of the heart of compassion is not human,…. The heart of compassion is the germ of benevolence [*ren*]. (*Mencius*, 1970, p. 82)

Thus, according to Mencius, it is intrinsic to human nature to be virtuous. In the same paragraph, Mencius also states, "whoever is devoid of the heart of right and wrong is not human… the heart of right and wrong is [the germ of] wisdom [智 *zhi*]" (*Mencius*, 1970, p. 83). From Mencius onward, *ren* has been considered more important and valuable than intelligence/wisdom and courage. Following Mencius, Xunzi (or Hsün Tzu, 289 BCE–238 BCE) also identified strongly with *ren* and argued that it should be cultivated through knowledge and education. In fact, the main function of knowledge and education is to cultivate *ren*, and the purpose of learning is to becoming a virtuous person (Lao, 1995–1996). *Xunzi*, the work traditionally attributed to the Chinese philosopher Xunzi, begins with an essay entitled "Encouraging Learning," which says, "Learning should never cease.…. If the gentleman studies widely and each day examines himself, his wisdom [智 *zhi*] will become clear and his conduct be without fault" (*Hsün Tzu,* 1963, p. 15). Later in the same chapter, the text says, "Where does learning begin and where does it end?…, it begins with learning to be a man of breeding, and ends with learning to be a sage" (p. 19).

It is during this period that *zhi*, the word root for both *wisdom* and *intelligence*, was elevated to include moral judgment, and the efforts required to cultivate it. In addition, it is in texts attributed to the late Zhou period that we find the three compounds *zhihui, zhili*, and *cōngmíng*, which often denote high cognitive ability, with *cōngmíng* sometimes having an emphasis on sensory acuity. For example, in *Laozi* (*Daodejing*) the text reads, "When intelligence and wisdom [*zhihui*] emerged, there was great artifice" (Bloom et al., 1999, p. 84). In *Mencius,* a conversation that Mencius cites a saying from the state of Qi that is translated as, "You may be clever [*zhihui*], but it is better to make use of circumstances; you may have a hoe, but it is better to wait for the right season" (*Mencius*, 1970, p. 75). In *Xunzi*, the text describes a sage as "Astutely intelligent [*cōngmíng*] and possessing sage-like wisdom [*zhi* 知]—he does not use these to place others in difficulty" (Knoblock, 1988, Book 6:10, p. 226). In *Han Feizi (n.d.),* a book attributed to the key Legalist philosopher Han Fei (281 BCE–233 BCE), the text reads: "kings sell official posts, subjects sell intellectual capabilities [*zhili*]" (*Han Feizi,* Book 35:195). Thus, in this period of time, *zhihui, zhili*, *and cōngmíng* probably denoted intelligence or high cognitive ability.

3. A unified country and experiments with Legalism, Daoism, and Confucianism (c. 221 BCE–220 CE). Legalism, a branch of Chinese philosophy whose essential conviction was that strong law and severe punishments rather than morality was the most reliable and useful instrument for ruling a state (Wong, 2003), eventually won the contention among different schools of thought. The king of Qin, who adopted Legalism, eventually unified the whole country in 221 BCE and became the first emperor of the Qin dynasty. The Qin dynasty (221 BCE–206 BCE) brought standardized currency, weights, measures, and a uniform system of writing, which had a strong influence on Chinese civilization. As sinologist Victor Mair (2005) observes, it is the uniform system of writing that binds "Chinese civilization in a cohesive and enduring whole" (p. 4). However, the Qin dynasty is also well known for its "burning of books and burying of scholars" (Hsu, 2012; Lao, 1995–1996). Legalism proposes that rulers should rule through force and should make people obedient and easy to be controlled by depriving them of knowledge and education. These propositions are antithetical to Confucianism, which holds that rulers should rule with the virtue *ren* and encourage the people to cultivate their own virtue of *ren* through knowledge and education. When Confucian scholars' criticism of the first emperor of the Qin dynasty increased, the emperor responded by burying alive 460 Confucian scholars in 212 BCE and, in 213 BCE, burning texts that the Legalists had not approved (Goldin, 2005). This harsh Legalistic rule failed, and the Qin dynasty (221 BCE–206 BCE) lasted only 15 years before it collapsed in political chaos and was replaced by Han dynasty (206 BCE–220).

The early Han dynasty adopted the philosophy of Daoism (c. 206 BCE–141 BCE). However, people soon noticed that government officials trained in the Confucian tradition were the most well-received and effective in public administration (Liu, 1999). Historical records show that Dong Zhongshu (179 BCE–104 BCE), a high-ranking official and a philosopher in the Han imperial court, wrote a memorial/

memorandum to the Emperor Wu (141 BCE–87 BCE) around 140 BCE, suggesting that knowledge of Confucianism be a requirement for selecting officials. Emperor Wu later issued a decree regulating that the Confucian texts be included as a requirement for selecting officials. This decree, which later historians dubbed as "revering only the Confucianism," ensured that all public officials were trained in the Confucian tradition, a practice that continued up until the Qing dynasty (1644–1912).

As a result of Dong Zhongshu's suggestion, an Imperial academy, the *Taixue*, was established in 124 BCE where officials were taught Confucian ideas. Normally, instruction took one year to complete, and those who graduated were given positions in the Imperial bureaucracy. The number of students enrolled in the college grew from 3000 at the end of the first century BCE to 30,000 in the late Han period (c. third century). Thus, the bureaucracy in Han dynasty was dominated by officials trained in the Confucian tradition (Kwok et al., 1999). By the middle of Han dynasty then, the experiment with Legalism, Daoim, and Confucianism came to an end, and Confucianism became the dominant ideology.

From our perspective, it is Confucius's emphasis on *ren*, with its focus on being compassionate in the interpersonal realm and cultivating oneself in the intrapersonal realm, that has guided the modern Taiwanese conception of intelligence to focus on the interpersonal and intrapersonal aspects of intelligence, and the modern conceptions of wisdom to include benevolence and compassion as important factors. We also credit the influence of Confucian philosophy for the assumption held by many Taiwanese that people by nature will use their intelligence for good and humane purposes.

4. Neo-Daoism and Confucian scholars' profound learning (c. 220–580). However, when Confucian training gained a favored position, both the teaching and the learning of Confucianism became stagnant, since the classics were restricted to a particular mode of interpretation and texts of other schools of thought were often dismissed. To people who truly identified with Confucius's ideal of *ren*, the situation was unbearable. Thus, they turned to Daoist texts for a deeper understanding of the Way (*dao*), a concept that Confucius also mentioned frequently in the *Analects*. When the unified Chinese state fell apart in the post-Han period, Confucian scholars devoted themselves to "profound learning"

(*xuanxue*), a type of learning aimed at explicating the true meaning of the Way, for an innovative interpretation of the dominant Confucian orthodoxy as well as a critique of corrupt practices. Neo-Daoism, a revival of Daoist philosophy, came into prominence from the third to sixth centuries in Chinese intellectual history (Chan, 2003). During this period, scholars who were well-versed in Confucian classics also read the Daoist "three profound treatises"—the *Book of Changes* (*Yijing*), *Laozi*, and *Zhuangzi*—for insights into nature and the human condition. They believed that ancient sages, including Confucius, shared a profound understanding of the Way and were thus all Daoists (Chan, 2003). However, like Confucians who identified strongly with the ideal of *ren*, those scholars "may be said to have interpreted Daoism in the light of social and moral philosophy of Confucianism" (Lynn & Chan, 1999, p. 378). Nevertheless, it is because of their efforts to integrate Confucianism and Daoism that these Daoist classics are considered as essential reading for Chinese scholars, whether they identify themselves as Confucians or not.

Important texts of this period include *Book of the Master Who Embraces Simplicity* (or *Baopuzi*), *Records of the Three Kingdoms* (or *Sānguózhì*), *A New Account of the Tales of the World* (or *Shishuo Xinyu*), *The Literary Mind and the Carving of Dragons* (or *Wén Xīn Diāo Lóng*), and *Precepts of the Yan Family* (or *Yanshi Jiaxun*). The meanings of the compounds *zhihui, zhili*, and *cōngmíng* found in these texts all seem to denote high cognitive ability or sound moral judgment (*Chinese Text Project*, n.d.). However, we speculate that it is the Daoist influence from this period onward that has guided Taiwanese conceptions of intelligence to include self-effacement and Taiwanese conceptions of wisdom to include modesty and unobtrusiveness; both point to an emphasis on humility and nonaction (*wuwei*) derived from Daoist philosophy. In addition, it is through *Zhuangzi*, a book attributed to the Daoist philosopher Zhuangzi (369 BCE–286 BCE), that the distinction between "great understanding" and "little understanding" was engrained in the mind of Chinese people. In *Zhuangzi*, the text reads "Little understanding [*xiao zhi*小知] cannot come up to great understanding [*da zhi*大知],… The morning mushroom know nothing of twilight and dawn; the summer cicada knows nothing of spring and autumn" (*Chuang Tzu*, 1964, p. 24). This distinction corresponds well with the distinction that the Taiwanese make between little intelligence and great wisdom.

5. Chinese Mahayana Buddhism: A Confucianized version of Buddhism? (c. 580–907). History shows that Mahayana Buddhism, a branch of Buddhism claiming to offer salvation for all, spread throughout Central Asia to China (Hurvitz & Tsai, 1999). Based on official records, Buddhism came to China around the first century from India as a foreign religion (Lao, 1995–1996). The first generation of Buddhist monks were of Indian ancestry. Up to the fourth century, most Buddhist monks were ethnically Chinese. Some of them, such as Huiyuan (334–416) and Zhu Daosheng (360–434), were well-versed in Confucian and Daoist texts. After joining the discussion of *xanxue*, profound learning, they often impressed contemporary intellectuals with Buddhist philosophy by interpreting the texts of profound learning from a Buddhist perspective. Moreover, they were able to introduce Buddhism using common terms derived from Confucianism and Daoism, thus making knowledge of Buddhism fashionable and popular among the Chinese intellectuals (Hurvitz & Tsai, 1999; Lao, 1995–1996). In this way, Buddhism recontextualized itself in China, where it evolved into various Chinese traditions. Among them, the Chan school, which later in its Japanese version was called "Zen Buddhism," was a full-blown Chinese Mahayana Buddhism (Shen, 2008). By the late tenth century, at the end of Tang dynasty (618–907), Buddhism had been assimilated into Chinese culture and became an essential cultural component (Hsu, 2012).

What is key in this assimilation process is the incorporation of the Confucian ideas, that *ren* is intrinsic to human nature and that everyone is capable of being virtuous, into Buddhism. In the Indian tradition, not everyone can attain Buddhahood, and there is a class of people—the *Icchantika* (Lao, 1995–1996)—who are "sentient being[s] without Buddha nature" (Shen, 2008, p. 124). However, the Chinese Buddhist master Zhu Daosheng, perhaps adopting Mencius's idea that "all human beings are capable of becoming a Yao or a Shun [ancient sages]" (*Mencius*, Book VI-B: 2, cited in Bloom & Watson, 1999, p. 154), argued that "all sentient beings can become Buddha" (Shen, 2008, p. 125). Later, Chan Buddhism not only followed this central tenet of Chinese Mahayana

Buddhism but put it more radically: "All sentient beings are originally Buddha" (Shen, 2008, p. 126).

Regarding conceptions of intelligence and wisdom, Buddhism brought to the Chinese culture the Sanskrit word for wisdom "*prajñā*," the understanding of the true nature of phenomena, which in the India tradition means both perfect and imperfect wisdom (Shen, 2008). Xuanzang (602–664), a Chinese Buddhist monk and also the greatest translator of Indian Buddhist texts in Chinese history, noted in his works that although the Chinese equivalent of *prajñā* is *zhihui*, *prajñā* (or "*bore*"般若, the phonetic translation of *prajñā*) should be used because "the use of the Sanskrit term '*prajñā*' shows respect, whereas the use of the Chinese term *zhihui*智慧 (wisdom) turns out to be superficial" (般若尊重，智慧輕淺) (Shen, 2008, p. 114). However, as Chinese Mahayana Buddhism became popular among the commoners, many Chan Buddhist texts adopted *zhihui*, rather than *prajñā* or *bore*, to denote perfect wisdom (Lao, 1995–1996), with the meaning of "immediate self-realization of the Buddhahood in the details of everyday life" (Shen, 2008, p. 114).

Searching for *zhihui, zhili*, and *cōngming* through such full-text databases pertaining to the traditional Chinese classics as Scripta Sinica (n.d.) and the Chinese Text Project (n.d.), we found that the majority of appearances of *zhihui* in most writings after the Tang dynasty are in Chinese Buddhist texts (e.g., the Taishō Tripiṭaka/大正新脩大藏經, a definitive edition of the Chinese Buddhist canon). In these texts, *zhihui* most often denotes realization of Buddhahood or enlightenment. By contrast, most instances of *cōngming* and *zhili* in the same time period appear in non-Buddhist texts, such as in *Tongdian* (*通典,* c. 776–801), and still denote intelligence or high cognitive ability.

6. Neo-Confucianism: Incorporating lessons learned from Buddhism and Neo-Daoism to Confucianism (c. 960–1644). During the roughly eight centuries after the fall of the Han dynasty (c. 220) to the rise of the Song dynasty (960), Chinese culture was strongly influenced first by Neo-Daoism and then by Buddhism. In this period, the great Buddhist temples became intellectual centers, where Buddhist ways of teaching that encouraged direct learning sessions between a master and disciples were practiced (de Bary et al., 1999). Confucianism remained the accepted code of ethics and the basis of the educational system because its

classics were required for civil service examination. Many treated the study of Confucian classics as an avenue for worldly success or as a method for achieving a degree of mastery over the language (Dien et al., 1999). For those very few who identified strongly with Confucius's ideal of *ren*, it was a time for reflection on Confucianism and learning from Daoism and Buddhism. Among them, Han Yu (768–824), a Tang dynasty scholar and official, was the most important figure (de Bary et al., 1999). Han Yu adapted the terminology of Neo-Daoist and Buddhist philosophy to explain the Confucian ideas. Let's take *ren*, for example. Confucius's *ren* refers mostly to the compassionate intention and virtuous acts one feels or does for other persons. After learning Daoist philosophy, in which *dao* involves everything in the world and Buddhist philosophy in which Buddhahood involves all sentient beings, Han Yu broadened the definition of *ren*, stating, "To love largely is called humanness (*ren*)" (*Yuandao*, ["*Essentials of the Moral Way*"], cited in Dien et al., 1999, p. 569). Facing the preeminence of Buddhism, Han Yu reaffirmed the Confucian integration of the private moral life of the individual with the public welfare of society (Dien et al., 1999). The works of Han Yu and other like-minded Confucians in the Tang dynasty (608–907) set the foundation for the Neo-Confucianism that blossomed in the Song dynasty (960–1279).

The Song dynasty ended the chaotic Five Dynasties and Ten Kingdoms (907–979) period, during which five dynasties succeeded one another in the north and more than twelve independent kingdoms were established in the south (Chan, 1987). In the early Song, Fan Zhongyan (989–1052), a scholar-official of humble origin who identified strongly with Confucius's ideas, led a political reformation that laid the foundations for China's public education system for the next millennium (Lee, 1990). Thus, many Confucians taught in public schools throughout the Song dynasty, and the Confucian ideals they disseminated changed the zeitgeist and nourished Neo-Confucianism (Chan, 1987; Yang, 2016). The improvement in public schools also stimulated the development of private schools, where influential scholars gave lectures from the Southern Song period (1227–1279) on until the Qing dynasty (1644–1912) (Lee, 1990).

Neo-Confucianism began as a philosophical movement in a renaissance of Confucianism by several scholars who, as with most individuals who identify themselves as Confucians, upheld Confucius's ideal of *ren* and shared Mencius's belief that people are predisposed to be good. Neo-Confucianism later developed into a moral, ethical, and metaphysical philosophy (Hon, 2003). Nourished by lessons learned from Neo-Daoism and Buddhism, Neo-Confucian scholars enriched Confucius's *ren* with *li* (理), a philosophical concept that they learned from Huayan Buddhism and which can be loosely understood as the principle that governs the universe (Liu, 2003). In his treatise "On Understanding the Nature of *Ren*"(識仁論), one of the most celebrated essays in Chinese literature, Neo-Confucian philosopher Cheng Hao (1032–1085) wrote, "The student must first of all understand the nature of *ren* [humaneness]. The humane man forms one body with all things comprehensively. Rightness, decorum, wisdom [*zh*i 智], and trustworthiness are all expressions of *ren*" (cited in Adler et al., 1999, p. 694). From this, we can see that Confucius's *ren* is applied not only to fellow individuals but to all things, a broadened perspective which perhaps can be credited to the lessons learned from the Neo-Daoist and Buddhist philosophies. Moreover, wisdom, which was once understood as the realization of Buddhahood, is now considered an expression of *ren*. Thus, through this and other similar integrations, Neo-Confucian philosophers transformed what they learned from Neo-Daoism and Buddhism into Confucian ideas.

Roughly a hundred years after Cheng-Hao, Zhu Xi (1130–1200) synthesized the contributions of his Neo-Confucian predecessors and attributed *ren* to the cosmic principle (*li*) that produces and embraces all things (Adler et al., 1999). In humans, this principle is our moral nature, which is fundamentally good. Thus, Zhu Xi defined *ren* as compassionate love in the widest sense; it is not only the essential human virtue but also a cosmic force. He argued that "*ren* involves love for all" and "[h]umaneness is the principle originally inherent in the human mind… It must be put into practice by human beings before it becomes humaneness" (*Zhuzi wenji* 67:21, cited in Adler et al., 1999, p. 712). Thus, for Zhu Xi, wisdom is a component of *ren*: "it can be seen that *ren* includes wisdom" (*Zhuzi wenji* 67:21, cited in Adler et al., 1999, p. 712) and "[w]henever and wherever humaneness flows and operates,…wisdom will be fully wisdom" (*Zhuzi* *wenji* 67:21, cited in Adler et al., 1999, p. 711). We believe that it is this all-encompassing *ren* and its relation to wisdom that guides Taiwanese to include "profound and open-mindedness" in their conceptions of wisdom.

What is special about Zhu Xi's philosophy is that, as a dynamic teacher at a prestigious private academy, he selected four books as basic texts for learning Confucian philosophy: the *Analects*, the *Mencius,* the *Great Learning*, and the *Doctrine of the Mean*. These four books, together with Zhu Xi's commentaries, were known as the "Four Books" in subsequent dynasties; they became the basis of the civil service examinations and hence the official orthodoxy from the fourteenth century to the turn of the twentieth century. In addition, his writings were accepted as the most complete and authoritative exposition of Confucian teaching in Japan and Korea, and hence exerted significant influences on the cultural development of East Asia well into modern times (Adler et al., 1999).

More than a hundred years after Zhu Xi, Wang Yangming (1472–1529) in the Ming dynasty (1368–1644) reasoned that if humaneness is the principle originally inherent in the human mind, then whoever has inner knowing of this principle will naturally act upon it. He thus argued for the unity of knowledge and action by stating, "There have never been people who know but do not act. Those who are supposed to know but do not act simply do not yet know" (*Instructions for Practical Living*, cited in de Bary et al., 1999, p. 850). Thus, the high value that the Taiwanese conception of wisdom gives to actions that embody wisdom may also be credited to the Neo-Confucian emphasis on the unity of knowledge and action.

7. Qing dynasty and the study of history (1644–1911). The Qing dynasty, a Manchu-led conquest dynast, succeeded the Ming dynasty and was the last dynasty before the founding of the Republic of China (ROC), the government of Taiwan. Pained by the rule of the Manchu, who were considered an alien ethnic group and had their own distinct culture and language, many Confucian scholars turned to history to seek the "principle" (*li*) of being Chinese. Thus, the study of history absorbed the best minds in the Qing dynasty. It is owing to their investigation of history that the concept of "Chinese civilization" as we now identify it was formulated. They put great emphasis on checking historical knowledge with objective evidence, and their exegetical studies lead us to know that many Confucian classics that had been attributed to Confucius and his

disciples, such as the *Book of Changes (Yijing)*, *The Doctrine of the Mean,* and *Great Learning*, were actually written by his admirers in the Han dynasty (Lao, 1995–1996). Moreover, they also reflected on and criticized Neo-Confucianism and argued that practicality of thought, that all-encompassing Neo-Confucian philosophy, should be put into practice to benefit daily living and to manage society. This was thus an era in which the value of knowledge and wisdom was upheld. For example, Dai Zhen (1724–1777), "possibly the most representative thinker and scholar of the Qing dynasty (MacMorran et al., 2000, p. 43), discussed *zhi* (智or wisdom) intensively in his famous treatise the *Inquiry into Goodness* (*Yüan Shan 原善*). He wrote: "A mind that acquires the principles of order and reason and therefore exhibits orderly patterns in its thoughts in accordance with the principles of order and reason can be said to be wise [*zhi*]. Is it not hidden in wisdom [*zhi*] that one may find benevolence [*ren*]?" (cited in Cheng, 1971, p. 67). From this we can see that the status of wisdom had changed. Thus, from the Song and Ming dynasties to the Qing dynasty, the conceptions of wisdom had lifted from an expression of humanness to the platform through which humaneness can be displayed. It is perhaps owing to Qing Confucian scholars' emphasis on practicality of thought that Taiwanese people emphasize that wisdom should be embodied in real-life contexts.

8. The Republican era and the scientific ways of research (1911–now). In 1842, the Qing lost the Opium War to Great Britain; this event marks the beginning of modern Chinese history (Hsu, 2012). What came with opium were Western influences. Learning Western knowledge so as to catch up with the West has become the zeitgeist since then (Sun, 1924). Many young people started to study abroad (Leibovitz & Miller, 2011). In 1911, a revolution led by Dr. Sun Yat-sen overthrew the Qing dynasty, and the Republic of China (ROC), which adopts the Western style of government, was founded. The Chinese civilization thus entered its Republican era (Hsu, 2012). Scientific ways of research have attracted the best Chinese minds since then, including those in humanities. Those who identify strongly with Confucius's *ren* also have devoted themselves to scientific ways of research, including psychology. However, they adopted the same strategy as Confucius, scholars of profound learning, Chinese Mahayana Buddhists, and Neo-Confucians when facing other

cultures and new knowledge: they chose to incorporate the best of West and East rather than total Westernization. This proposition, that one should learn maximally from other cultures while cherishing one's own culture, has been followed by many even after the ROC government was relocated to Taiwan in 1949.

It is with this mindset that the Taiwanese met IQ tests. When the Wechsler Adult Intelligence Scale and the Revised Wechsler Intelligence Scale for Children were first introduced to Taiwan in the 1960s and 1970s, they were translated using the Chinese compound *zhihui*, as "Wechsler *Zhihui* Scale" (Fan, 1979; Lu & Chien, 1968). With IQ tests being administered more frequently in schools, it is our observation that many Taiwanese are learning to re-conceptualize intelligence as innate ability, the very abilities that IQ tests claim to measure. In fact, the translation of "IQ tests" was soon changed to "*zhili* tests" (Lu et al., 1988). However, some authors still use *zhihui* to translate "multiple intelligences" and "emotional intelligence" (Chang & Chang, 2003; Chen, 2008), perhaps because "intelligence" in these two terms denote more than high cognitive ability.

Focusing on some of the major points from this brief review of important cultural elements in Chinese intellectual history, we note that *zhi*, the Chinese word root for the Chinese term for wisdom (*zhihui*) and intelligence (*zhili*), originally denoted high cognitive ability, but gradually expanded in meaning. It came to incorporate Mencius's idea of "the heart of right and wrong" to denote the ability to make sound moral judgment, and Zhuangzi's idea of "greater understanding" to denote having rich knowledge and a broadened perspective. Of the two compounds, *zhihui* gradually came to incorporate "the understanding of the true nature of phenomena" from the Indian concept of "*prajñā*" (Shen, 2008), "the realization of Buddhahood" from Chan Buddhism (Shen, 2008), "an expression of humaneness" from Neo-Confucianism (Adler et al., 1999), and "a mind that acquires and exhibits the humane cosmic principle" from Qing scholars (Cheng, 1971). It thus encompasses much more meanings than *zhili*, which literarily means the power of *zhi*. Thus, perfect *zhi* or intelligence can be wisdom in the Taiwanese cultural context.

A Study of the Differences between Wisdom and Intelligence as Perceived by Young Taiwanese in Modern Times

How do modern Taiwanese conceive of wisdom and intelligence? Compared to elderly Taiwanese, young Taiwanese are less entrenched in traditional Chinese ways of thinking but may be more sensitive to Taiwanese culture. To examine empirically how young Taiwanese perceived intelligence and wisdom, we conducted a pilot study by giving an open-ended questionnaire to 148 Taiwanese college students asking about the differences between wisdom and intelligence.

These 148 young Taiwanese were recruited from university classes: students were invited to participate and to spread the word to their friends and relatives who were less than 30 years old. Among them, 90 were females (61%) and 58 were males (39%). Their ages ranged from 18 to 26 years old (M_{total} = 19.2, SD_{total} = 1.94). Their majors can be roughly classified into nine categories (e.g., Language and Literature, Policy and Administration, Education, Chemistry, Engineering, Finance, Information Management, Social Policy and Social Work, and Economics). They came from the northern, central, and southern parts of Taiwan.

They were asked to respond to a "Survey of Wisdom and Intelligence," which involves eight open-ended questions: (a) "What do you think is the major difference between wisdom and intelligence?"; (b) "What are the most important differences between an intelligent person and a wise person?"; (c) "Would you like to become an intelligent person?"; (d) "Based on your own standards, are you an intelligent person?"; (e) "What efforts are needed for you to become the ideal intelligent person you envisioned?"; (f) "Would you like to become a wise person?"; (g) "Based on your own standard, are you a wise person?"; and (h) "What efforts are needed for you to become the ideal wise person you envisioned?"

They were reminded that there were no "right" answers for those questions. They received credits in a psychology course for responding to the questionnaire. Because the term *zhili* is more often used in formal or academic writings, the Chinese term used in this study for intelligence is *cōngming,* and for wisdom is *zhihui*, both following the examples set by previous studies (Yang, 2001; Yang & Sternberg, 1997a, b).

Once their responses were collected, we recruited five analysts from a university in central Taiwan to conduct independent thematic analyses. The analysts came from education-related departments: One had a graduate level of education, while the rest had a college level of education. Four were females. Their ages ranged from 19 to 22 (M_{age} = 20.6, SD = 1.04). Analysts were instructed to read each response thoroughly, and then to analyze it thematically (Guest et al., 2014). Each response was unitized and coded based on its dominant themes. Similar themes were then clustered into dimensions. A research team, consisting of the five analysts and the principal researcher, met to discuss and resolve disagreements after the analysis was complete.

Results of this preliminary study showed that most participants conceived of wisdom and of intelligence somewhat differently. Following is a brief description of the most frequent responses collected for each question, which includes five sections: (1) The major differences between wisdom and intelligence; (2) The most important difference between "an intelligent person" and "a wise person"; (3) The desirability of being an intelligent or a wise person; (4) Self-evaluation of own intelligence and wisdom; and (5) Efforts needed to become the ideal intelligent or wise person.

1. The major differences between wisdom and intelligence. The 148 young Taiwanese most frequently compared wisdom and intelligence on two dimensions: origin and application. In terms of origin, participants most frequently mentioned that wisdom results from accumulating lessons learned from life experience (n = 101, 68%), while intelligence was most frequently described as being related to innate ability (n = 85, 57%). In terms of application, they most frequently stated that intelligence is most often used to learn knowledge and skills (n = 55, 37%), while they described wisdom most frequently as being applied to dealing with human affairs (n = 54, 36%).

2. The most important difference between "an intelligent person" and "a wise person". Twenty-two (15%) of the 148 young Taiwanese indicated that wise persons are not necessarily intelligent, nor are intelligent persons necessarily wise. Nevertheless, 18 of them (12%) believed that

wisdom is more difficult to achieve and that intelligence is a component of wisdom. They described wise persons as individuals who can manage human affairs, including their own, well (n = 67, 45%), who continually and purposefully learn from life experience (n = 39, 26%), who are rational and calm (n = 31, 21%), selfless and altruistic (n = 15, 10%), have broad perspectives and profound visions (n = 11, 7%), and earn true respect from people (n = 8, 5%). While they gave no negative descriptions for wise persons, more than one-third of them (n = 57, 38%) described intelligent persons negatively. They described intelligent persons as individuals who have a high IQ (n = 30, 20%), are good at learning knowledge and skills (n = 23, 16%), can solve problems with efficiency (n = 22, 15%), are often conceited (n = 27, 18%), profit-oriented (n = 15, 10%), quick-tempered, and short-sighted (n = 21, 14%), and can be too smart for their own good (n = 24, 16%).

3. The desirability of being an intelligent or a wise person. Among the 148 young Taiwanese, 144 (97%) indicated that they "very much" or "definitely" wanted to be a wise person, and 4 (3%) answered "not really" or "doesn't matter." One hundred and eleven (75%) of the same 148 indicated that they wanted to be an intelligent person, and 37 (25%) wrote "not really" or "not at all." The results of a chi-square test showed that these two distributions were significantly different: $\chi^2_{(1, N=148)} = 5.48$ ($p < 0.05$), with more participants desiring to be a wise person than an intelligent person.

4. Self-evaluation of own intelligence and wisdom. Altogether, 122 of the respondents (82%) indicated that they did not think they were wise persons, and 26 (18%) believed that they had some wisdom. One hundred and seven (72%) of the same 148 indicated that they were not intelligent persons, and 41 (28%) believed that they could be considered intelligent persons. The results of a chi-square test showed that these two distributions were not significantly different: $\chi^2_{(1, N=148)} = 2.39$ ($p = 0.12$).

5. Efforts needed to become the ideal intelligent or wise person. Their responses on the efforts needed to become the ideal wise or intelligent person are similar. They mentioned (1) continuously learning and broadening one's perspective (n_{wise} = 73, 49%; $n_{intelligent}$ = 66, 45%); (2) having

a modest attitude and purposefully learning from more intelligent or wiser people (n_{wise} = 51, 34%; $n_{intelligent}$ = 24, 16%); (3) constantly applying what has been learned into real-life practices and continuing to accumulate experiences (n_{wise} = 49, 33%; $n_{intelligent}$ = 47, 32%); (4) managing emotions better and having more patience (n_{wise} = 26, 33%; $n_{intelligent}$ 5, 3%); (5) having more confidence and courage to face difficulties and remembering the mistakes one made (n_{wise} = 24, 16%; $n_{intelligent}$ = 4, 3%); (6) thinking more deeply and thoroughly and forming one's own opinions (n_{wise} = 24, 16%; $n_{intelligent}$ = 36, 24%); (7) having good relationships with others and trying to help others as much as possible (n_{wise} = 18, 12%; $n_{intelligent}$ = 12, 8%); and (8) learning more about oneself and finding one's own goals (n_{wise} = 7, 5%; $n_{intelligent}$ = 11, 7%). In addition, 31 respondents (21%) indicated that intelligence is primarily an inborn trait and so not subject to change; no one indicated that it is impossible to become a wise person.

The results of a chi-square test showed that these two distributions were significantly different: $\chi^2_{(8, N = 508)} = 71.92$ ($p < 0.001$). Post hoc tests showed that those young Taiwanese put more emphasis on "having a modest attitude and purposefully learning from wiser people" ($p < 0.05$), "managing emotions better and having more patience" ($p < 0.05$), and "having more confidence and courage to face difficulties and remembering the mistakes one made" ($p < 0.05$) when considering the efforts needed to become wise, but more emphasis on "thinking more deeply and thoroughly and forming one's own opinions" ($p < 0.05$) and "being unable to change what one is born with" ($p < 0.05$) in becoming intelligent.

To summarize, results of this preliminary study show that this sample of young people in Taiwan conceived of both wisdom and intelligence broadly; each of the two concepts covers more ground than cognitive ability. However, they also were conceived somewhat differently: wisdom, which was described in positive terms, was regarded more highly than intelligence. While more of the young Taiwanese indicated that they were not wise, they all believed that wisdom can be achieved by one's efforts. More than half of them believed that intelligence is related to innate ability, and one-fifth of them believed it cannot be changed. Nevertheless, the efforts that the respondents prescribed for becoming wise or intelligent individuals were similar, even though they emphasized certain kinds of growth more for becoming wise than for becoming intelligent.

The results largely correspond with the concepts of wisdom and intelligence we examined in Chinese intellectual history. However, not all young Taiwanese shared our assumption that people will naturally use their intelligence for good purposes, since some described intelligent persons negatively. Nevertheless, participants mentioned similar efforts for becoming wise and becoming intelligent. Our results suggest that young Taiwanese view wisdom as perfect intelligence.

Conclusions and Suggestions

Based on our work here, we suggest that that future psychological studies of wisdom and intelligence make it a point to take important contextual elements, including intellectual and cultural history, into account. We suggest too that future studies of wisdom and intelligence in the Chinese language make a distinction between these two concepts *a priori* and choose the appropriate translations accordingly.

Altogether, this exploration shows how perceptions of the two concepts are influenced by historical events, and people's actions and choices both in the past and present. It also demonstrates how understanding of the two concepts is enhanced when looking at them in cultural context. Such understanding may help in recognizing applications of people's intelligence and wisdom when they occur in the real world, in both small-scale and large-scale situations. Taiwan's decisions and actions during the COVID-19 pandemic is an example of the latter: "Taiwan has successfully fought COVID-19 as a democracy, particularly in its incremental improvements on testing, tracing, and isolation without significantly compromising fundamental freedoms and civil liberties" (Soon, 2021, July 29) even though it "is 81 miles off the coast of mainland China and was expected to have the second highest number of cases" (Wang et al., 2020 March 3). An earlier, and similarly national-scale event concerns Taiwan after World War II when it was one of the "only two major emerging economies to grow faster than 5 percent for five decades in a row and to rise from poverty into the ranks of developed economies" (Sharma, 2020, December 14) despite the constant threat of military invasion from China (Tai et al., 2021, April 30). These facts attest to the efforts of the Taiwanese people to strive toward wisdom by using their intelligence for good and humane purposes, as well as their decisions and actions to incorporate the best of the East and West. Hence, intelligence in context means not only seeing and understanding intelligence in context, but also encouraging contextualized applications of intelligence. In the cultural context of Taiwan, such applications point to perfecting intelligence in the effort to realize wisdom.

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Part III

Socio-cultural Influences in Human Intelligence

7

The Status of Intelligence as a Panhuman Construct in Cross-Cultural Psychology

Johnny R. J. Fontaine and Ype H. Poortinga

In early research with intelligence tests, it was found time and again that people of European descent outperformed others. Such score differences were widely interpreted in terms of innate differences in mental capacities. A strong reaction followed: comparison of intelligence test scores between populations was deemed inherently discriminatory and should be abandoned. As a consequence, research on intelligence was greatly reduced in cross-cultural psychology. The viewpoint of this chapter is that in a shrinking world, often equated with a global village, the notion of intelligence has to be either abandoned entirely or conceptualized and applied as a feature of human psychological functioning everywhere.

The first section of this chapter outlines the early history of research comparing intelligence test scores between populations as well as the

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reactions to it. Next to a few research traditions claiming support for these earlier findings, two dominant reactions have emerged: (i) rejection of the idea that intelligence can be a common construct for all humankind and (ii) critical examination of the psychometric comparability of intelligence assessment. The second section presents a broad conceptual and methodological framework from cross-cultural psychology about comparability of psychological constructs and assessment across populations. In the third section, this framework is applied to identify weaknesses and strengths of two different positions about population differences in intelligence and to explore the scope for transfer and adaptation of tests.

Some Historical Trends

There is a widespread tendency to evaluate one's own group as superior to other groups, and this clearly predates intelligence testing. The explanations of surmised differences have varied over time and place. In Europe during the Enlightenment, reference was made to the external condition of climate. Temperate climates, as found in Western Europe, were considered more conducive to the development of "*civilisation*" (high culture) than arctic or tropical regions. Somewhat later, Darwin's evolution theory provided a rationalization for the superiority of white people; allegedly, they had evolved further. In the twentieth century, psychologists obtained with intelligence tests a powerful tool that could help assess how smart people are. In study after study, evidence of superiority of Europeans emerged (see Mann, 1940 for a summary). A research program that can serve as an illustration is that of Porteus (e.g., Porteus, 1937), who administered a maze test to peoples across the world. He considered this paper-and-pencil test to reflect foresight and planning, which in his view was the essence of "intelligence", conceptualized as an inherited capacity. On the basis of the score distributions of small ad hoc samples, he provided a ranking of several populations, qualified as "races", in which the Bushmen, or San, of the Kalahari Desert gained the lowest position, followed by the Australian Aboriginals, and in which "Caucasians" held the top position. Of interest for the present discussion is Porteus' rejection of criticisms challenging his findings (e.g., Klineberg, 1935). Notably, he insisted that performance on tests with concrete materials, such as colored blocks or mazes, does not depend on prior experience, such as schooling; careful instruction was, according to Porteus, the only prerequisite for obtaining good estimates of inborn intellectual capacity. The interpretation of scores on Western tests as reflecting innate differences in intelligence has contributed to a history of discrimination and has made of intelligence a deeply and widely challenged concept.

Three broad traditions can be distinguished that can help explain contemporary views on intelligence as a psychological construct and the use and misuse of intelligence tests in international and cross-cultural settings. The first tradition is seeking further confirmation of population differences in intelligence as inherited. The second tradition is to reject intelligence as a panhuman concept. The third tradition, emphasized in this chapter, is to accept intelligence as a common psychological concept, but to examine critically the scope for cross-cultural comparison of scores obtained with tests.

Seeking Further Confirmation

Strong claims about both universality of intelligence and the validity of common assessment instruments are associated with the notion of "g". The basis for these claims is the positive manifold of correlations between scores on very different subtests in intelligence batteries. In multivariate analysis with a variety of cognitive ability tests, a single higher-order factor emerges, which is called "g" (e.g., Carroll, 1993). Empirically, cognitively demanding tests (e.g., tests of abstract reasoning) tend to have high loadings on this latent variable, and the size of the loadings also tends to correlate with the size of population differences in score distributions.

From this constellation of findings, some authors have continued to infer that observed differences between populations (especially populations defined as "races") must be due to genetic inheritance (Jensen, 1974; Lynn, 2006). However, there is explicit empirical evidence incompatible with this position. We mention three key findings. First, cognitively complex tasks with a high "g" loading have been found to be more context-dependent[1] than those with lower "g" loadings, uprooting claims of high heritability at population level for tasks with high "g" loadings (Helms-Lorenz et al., 2003; Kan et al., 2013). Second, differences in context almost invariably come with differences in the experiences needed to respond quickly and accurately to the items in an ability test. In cross-cultural research, effects of differences in stimulus familiarity have been demonstrated extensively for speeded tasks, such as Choice Reaction Time tasks (that are part of the "g" hierarchy according to Jensen and Lynn). In addition, it has been shown that a large amount of experience (training) is needed to reduce such effects (e.g., Sonke et al., 2008). In a set of tasks presenting figural codes and Roman letters to Iranian migrant students and Dutch students in the Netherlands, Sonke et al. (1999) found faster response times for the Dutch students. When (four) easily distinguishable Arabic letters were used as stimuli, the Iranian students responded faster than the Dutch students did. Training sessions for both samples with the letters from the less familiar alphabet did not change the differences substantially. Thorough familiarity requires extensive experience, as demonstrated for traditional Morse code telegraphers, who show slight increases in performance even after years of practice (e.g., Fitts & Posner, 1968). The third finding is that the mean level of performance on intelligence tests within a population can change dramatically over time. Increases of more than 1.0 standard deviation in the mean of test score distributions from one generation to the next have been observed in some Western populations. Such changes are referred to as the Flynn effect (Flynn, 1987), after the author who showed this effect in longitudinal data sets. There are debates over explanatory factors, including school education and economic prosperity (e.g., Pietschnig & Voracek, 2015). The point to note here is that substantial changes in score levels over one or two generations are a further argument that population means on intelligence tests to an important extent reflect context effects. In terms of genetic inheritance, we cannot be, on average, much more or much less intellectually gifted than our parents and grandparents.

[1] Context refers to the social and ecological environment in which humans function. The term has a more limited meaning than "culture" (see Poortinga, 2021).

In our opinion, such findings as mentioned make valid assessment of population differences in intelligence as an inherited capacity fictitious.[2] Therefore, this position is not further discussed in this chapter.

Rejecting Intelligence as a Universal Concept

An important tradition in cross-cultural psychology that emerged as a reaction against conceptualization and test use differentiating between human groups holds that intelligence needs to be conceptualized differently for many non-Western populations. Needless to add, that, as a consequence, operationalization used for assessment also has to be developed within each local context. For example, Mundy-Castle (1974) distinguished two aspects in traditional African "intelligence", a technological aspect and a social aspect. In his view, the Western world has emphasized the first at the expense of the second. The importance of the social aspect was linked by Mundy-Castle to the socialization of African children. Dasen et al. (1985) examined the concept of *n'glouèlê* among the Baoulé in Ivory Coast. They found both social and technological components, with the technological or cognitive dimension being subordinate to the social dimension. Grigorenko et al. (2001) identified in an ethnographic study among the Luo in Kenya four concepts on how locally qualities of individual children are assessed. Ratings for these concepts were obtained for a sample of children from others (peers, teachers, community elders) who had first-hand knowledge of these children. For each of the three sets of ratings, Principal Components Analysis led to the identification of two components: cognitive competence and social-emotional competence.[3]

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[2] We do not argue that genetic underpinnings of population differences in intellectual functioning can be ruled out. However, before we can even consider to examine such underpinnings, the equivalence and validity of test score differences have to be demonstrated. Moreover, it requires the identification of genetic variations that directly causally affect intellectual functioning within and across populations. The only relevant empirical research to date are genome-wide association studies that explore correlations between the genetic variations and intelligence scores (GWAS studies; e.g., Lee et al., 2018). However, they offer no evidence for the equivalence and validity of the test score differences, nor can they identify direct causal effects.

[3] Grigorenko et al. administered also two Western intelligence tests to the children. Only the cognitive component showed some (moderate) correlations with scores on these tests.

Critically Examining Assessment

By the 1960s, most psychologists had realized that the interpretation of population differences in score distributions on psychometric tests is highly problematic. Notions that tests can be "culture-free" or "culture-fair" were challenged. In a commentary in the proceedings of a major conference on cross-cultural testing held in 1971, the editors noted:

> It is hazardous to interpret a test in its new setting as if it measured 'the same thing' as it did originally. Serious questions of comparability arise for translated performance tests as well as verbal tests. (Cronbach & Drenth, 1972, p. 470)

A plethora of approaches followed, addressing either the measurement or the conceptualization of intelligence, or both of these. Cattell (1963), for instance, formalized the idea that some ability tests are more dependent on specific knowledge and experience than other tests, with the distinction between crystallized and fluid intelligence. Crystallized intelligence reflects previously acquired knowledge and skills (e.g., tests of vocabulary). Fluid intelligence reflects cognitive processing, notably reasoning and problem-solving. Fluid tests tend to be seen as operationalizations of intelligence that can be used for assessment of intelligence across populations. Such tests are sometimes called "culture-reduced" tests. The best-known example are Raven's Progressive Matrices tests (RPM; Raven et al., 2004). However, avoiding tests for crystalized intelligence does not solve the problem as experience and familiarity affect all test results.

Reuning and colleagues conducted extensive studies of the cognitive and perceptual abilities of the Bushmen (Reuning & Wortley, 1973). Addressing measurement issues, their focus was on the adaptation and transfer of existing assessment instruments. For example, with a three-dimensional device to present items from Porteus' maze test in a more context appropriate manner, they found with a fairly large sample that the Bushmen performed rather well.[4] They thus demonstrated that the

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[4] In a fairly recent monograph, Lynn (2006) continues to attribute subnormal intelligence to the Bushmen, referring to work by Reuning. This is a blatant misrepresentation of Reuning's views. On the basis of field observations and of their performance on a range of tests, he considered the Bushmen to be "clever" (see Reuning & Wortley, 1973, for extensive evidence).

original Mazes test—a nonverbal test—used by Porteus, severely underestimated (the form of) intelligence assessed with solving mazes.

We can conclude that there is nowadays a broad tendency to treat comparisons of scores on intelligence tests with suspicion. We wish to state explicitly that there are valid reasons for this suspicion. In the next section, we make suggestions on how to move forward.

Conceptual and Methodological Framework for Comparability

A broad framework addressing both conceptual and psychometric issues of comparability has been developed in cross-cultural psychology. The conceptual issues center on the contrast between universalism and relativism, which differ on the question whether or not the psychological traits and processes that are underlying daily psychological functioning differ between groups of humans, labeled as cultural groups (e.g., Berry et al., 2011; Fontaine, 2011; Fontaine & Breugelmans, 2021). The methodological issues center on the analysis of bias and equivalence in psychological data (Fontaine, 2005, 2008; Poortinga, 1989; Poortinga & Van de Vijver, 1987; Van de Vijver & Poortinga, 1997; Van de Vijver & Leung, 2021; Van de Vijver et al., 2008). This framework can help to guide us with the theoretical questions to be asked and the choice of methodological and psychometric tools to be used in empirical analysis of intelligence. In this section, we present an integrated version of this framework (see Table 7.1), and in the next section we address its application to issues encountered in the intelligence domain.

In the framework, a distinction is made between four conceptual positions on the comparability of constructs across populations: full relativism, construct universalism, domain universalism, and full universalism. Each of these four positions is linked to the empirical requirements for comparability to justify that position. The required levels of equivalence as well as sources of bias to be excluded for each conceptual position are mentioned.

Table 7.1 Overview of the integrative framework for comparability of test scores across populations

	Full relativism	Construct universalism	Domain universalism	Full universalism
Theoretical claims				
There exists behavior within each of the populations that can be accounted for by the same theoretical variable	No	Yes	Yes	Yes
The domain of behavior accounted for by the theoretical variable is highly overlapping between populations	No	No	Yes	Yes
Populations can be compared quantitatively on the theoretical variable	No	No	No	Yes
Empirical conditions				
Required level of equivalence	No equivalence possible	Construct equivalence	Domain and structural equivalence	—Metric equivalence for comparisons of score differences between more than one measurement —Full score equivalence for direct comparison of scores
Sources of bias and threats to be disconfirmed	Lack of validity evidence within specific population	Construct bias	Partial domain nonoverlap leading to: – Construct underrepresentation – Construct irrelevance	Method bias Item bias

Four Conceptual Positions

The conceptual positions are based on three basic claims that can be made about a psychological construct (like intelligence) and the way it becomes manifest in observable behavior:

(i) There exists behavior within each of the populations examined that can be accounted for by the same theoretical variable. For example, in every population evidence of inductive and deductive reasoning can found.
(ii) The domain of behavior accounted for by the theoretical variable is highly overlapping between populations. For example, in populations that have Western-type schooling, pupils learn to apply inductive and deductive reasoning to both familiar and new, unfamiliar problems.
(iii) Populations can be compared quantitatively on the theoretical variable. For example, the validity can be demonstrated of population differences in average inductive and deductive reasoning ability as assessed with a common reasoning test.

These three claims are hierarchically ordered. When the first claim is rejected, the two other claims have to be rejected also. When the last claim is made, the first two claims are implied. Thus, based on the three claims, four positions are possible:

Full Relativism

When none of the three claims is made, we are dealing with the position of "full relativism". Population-specific processes and/or traits are needed to account for manifest behavior. The construct concerned does not cross population boundaries: it can only be studied within the context of a specific population.

Construct Universalism

When only the first claim is made, we are dealing with the position of "construct universalism". The same theoretical framework can be applied to account for behavior across populations, but without the behavior manifestations necessarily being the same in each of the populations. The fact that the behavioral repertoire differs between populations does not imply that different explanatory variables are needed to account for it. For instance, empirical evidence makes it plausible that logical reasoning follows Aristotelian principles everywhere (e.g., Scribner, 1979). The fact that non-Western populations have more difficulties solving deductive reasoning tasks with typical Western items does not prove that the processes to solve these tasks are a Western construction not applicable elsewhere. Rather, the type of problems to which Aristotelian reasoning principles are applied depends on the relevance for a specific context (e.g., van de Vijver & Willemsen, 1993).

Domain Universalism

When the first two claims are made, but not the third claim, we have the position of "domain universalism". It means that the domains of observable behavior accounted for by the same explanatory variable shows sizable overlap across populations. However, this position does not imply that direct quantitative comparisons of test scores between populations are valid. It is a fundamental insight in psychological assessment that concrete behavior has multiple determinants (e.g., Messick, 1989). Thus, differences between populations in nontargeted constructs may affect the observed behavior. For instance, populations differ in the extent to which speed versus accuracy are valued in solving cognitive tests, in Western populations speed being more valued than accuracy (e.g., Sternberg et al., 1981). When speeded cognitive tests are used, in which performance heavily depends on the trade-off between speed and accuracy, scores cannot be compared across populations that have different expectations about the optimal trade-off. Thus, within this position the same theoretical framework is used to account for behavior within populations, but generally one refrains from direct population comparisons.

Full Universalism

If all three claims are made, full universalism is specified. This implies that not only the same theory is assumed to account for the same observed behavioral repertoire, but that there is scope for valid quantitative comparison of scores and/or of score differences (e.g., across measurement occasions) between populations (see below).

Levels of Equivalence

The lead question is: Does a score of a test taker have the same meaning across certain populations in terms of the intended interpretation? In other words, are scores comparable; are they equivalent, are they unbiased? In samples of test takers, both item scores and test scores form variables of which equivalence can be analyzed. There is more to the answer than a simple yes or no; various levels of equivalence can be distinguished. Analysis of equivalence takes place mostly, though not exclusively, through examination of statistical conditions that are set in such a way that they are likely to be satisfied by equivalent sets of scores, but not by nonequivalent or biased scores.

In this chapter, four hierarchically ordered levels of equivalence are distinguished:

Construct Equivalence

Comparison of data always requires that there is construct equivalence, that is, the construct is identifiable in all populations in a study. For this type of equivalence, validity should be demonstrated of (possibly context-specific) instruments using the same theoretical framework.

Content and Structural Equivalence

For the same instrument to be used validly across contexts and populations, content and structural equivalence must be demonstrated. The content of the instrument should be relevant and representative within each of the populations, and the dimensions assessed with the instrument (internal structure) should be the same. Content and structural equivalence do not necessarily imply the same quantitative scale for all populations. The state of affairs is reminiscent of recordings of temperature made on the Celsius scale in one setting and on the Fahrenheit scale in another setting; temperature is assessed everywhere, but readings of the same temperature differ.

Metric Equivalence or Measurement Unit Equivalence

For a test, the measurement units on the scoring scale are the same across populations, but there may not be a common scale anchor (e.g., the same origin or zero point). A given difference between two scores can be interpreted in the same way, independent of the population in which it was found. Imagine that recordings of temperature are made on the Celsius scale in one setting and the Kelvin scale in another setting. Although no direct comparisons can be made, it is possible to compare directly the difference between recordings (e.g., between averages of summer and winter temperatures in various locations).

Scale Equivalence or Full Score Equivalence

A score of a given value can be interpreted in the same way independent of the population of a test taker. Imagine that recordings of temperature are made on the same scale, for example Celsius scale, in all settings. Only when this type of equivalence is achieved can direct comparisons be made between populations.

These four levels of equivalence can be linked to the three universalist positions.[5] Construct universalism requires construct equivalence. Domain universalism allows the construction of a common instrument that must satisfy both content and structural equivalence. The content of the common instrument is relevant and representative for the respective domains in the different populations (content equivalence), and it is

[5] Relativism precludes any form of equivalence as a construct does not cross borders.

assessing the same psychological dimensions across populations (structural equivalence). For full universalism, metric or full score equivalence is needed, depending on whether only score differences or scores are compared between populations.

Sources of Bias

Bias, or lack of equivalence, refers to the sources that can distort valid comparisons (e.g., Van de Vijver & Leung, 2021). Major sources of bias are construct bias, construct underrepresentation and irrelevance, method bias, and item bias.

Construct Bias

Construct bias means that a theoretical framework, or a part of it, is tied to the context of a specific population, and poorly crosses population boundaries. Theories are typically developed within a specific context and may confound universal and population-specific aspects. For example, the operational rules for multiplication with and multiplication without an abacus differ, even though they are based on the same arithmetical principles. The development of a theory for numerical ability may be influenced by whether or not an abacus is used in the local context.

Construct Underrepresentation and Construct Irrelevance

Construct underrepresentation and irrelevance can occur when there is less than full overlap across populations of the domains accounted for by the construct. A simple example is the inclusion of items requiring root extraction in a test of numerical ability when in some populations root extraction forms part of the school curriculum for a certain age group and in other populations it is not included in the curriculum. Having root extraction items in a test will lead to construct irrelevance in the latter populations, while omitting such items will create construct underrepresentation in populations where root extraction has been taught.

Construct irrelevance can be identified by applying psychometric analyses for item bias on the data obtained with the test itself. Construct underrepresentation requires additional information on the domain in populations where the instrument is going to be applied. Such an analysis is conducted with exploratory (often qualitative) methods.

Method Bias

Method bias refers to differential distortion between populations by biasing factors affecting most or all items in a test, for example due to differential stimulus familiarity or differences in guessing strategy with multiple-choice items. For tracing method bias in test scores, multimethod approaches involving additional instruments are needed.

Item Bias

Item bias entails a distortion in (one or more) separate items, for example due to poor translation. Item bias can be identified by psychometric analyses on the data obtained with the same instrument across populations.

These four sources of incomparability can be linked to three of the four conceptual positions. Since no comparisons are made in the full relativism position, none of these four types of bias applies there. A threat to this position is the lack of validity evidence for population-specific constructs. Just like not all concepts proposed in Western psychology have received empirical support, the fact that a population-specific concept is identified in exploratory (qualitative) research does not guarantee without further analysis of construct validity that it is a valid psychological construct for the population concerned. For construct universalism, a major threat is construct bias, while for domain universalism the major threat consists of construct underrepresentation and irrelevance. Full universalism can be distorted both by method bias affecting all items in an instrument and by item bias making direct comparisons of scores or score differences between populations flawed.

Applying the Framework to Intelligence

One of the more recent traditions identified in the first section focuses on what is common in intellectual functioning across human populations, and the other tradition looks for context-specific forms of intelligence. The framework presented in the second section is meant to provide a set of tools to clarify the strengths and the weaknesses of both traditions, and how these affect the transfer of intelligence tests across populations and test score interpretations.

Context-Focused and Assessment-Focused Approaches to Intelligence

The strength of relativist approaches to intelligence is the study of the construct and the domain as they emerge through performance in a specific context. The focus is on what appears to be relevant for a specific context. However, most studies just *assume* both construct validity within the specific context and lack of comparability across contexts (see examples mentioned in the first section of this chapter). Convergent evidence may be quoted extensively, but critical examination is lacking. Identifying how a domain of psychological functioning is conceptualized within a particular population does not make in itself a valid psychological construct in that population (as the history of psychology has amply demonstrated). Assessment of intelligence does require not only the operationalization of specific forms of intelligence but also empirical evidence that a context-specific test behaves as the context-specific theory would suggest. Moreover, the fact that a context-specific instrument provides a valid assessment of intelligence in a certain population does not in itself justify the claim that the construct measured is a context-specific construct. To the best of our knowledge, there is no research ruling out that a universal intelligence theory can account for what is measured with context-specific instruments. Rather, there is contrary evidence. One of the strongest claims for the indigenous nature of intelligence is the focus on intra- and interpersonal functioning in non-Western populations that has been argued to be incompatible with the Western intelligence construct that is technologically focused. However, with the emerging construct of emotional intelligence in Western psychology this claim no longer holds. Maximum performance tests have been developed in Western populations assessing the abilities to perceive, understand, and regulate emotions, and substantial correlations with traditional cognitive tests of intelligence have been found (MacCann et al., 2014).

A strong point of the tradition focused on comparison of intellectual functioning with intelligence tests is that it does not take equivalence of these instruments for granted. Scores on existing instruments are analyzed for lack of equivalence, or "bias". Such psychometric analyses investigate the comparability of the internal structure and, in addition, allow the identification of items that function differently across populations (item bias). Most difficult to identify are biasing factors that affect most or all items in an instrument and that are referred to as "method bias" (see above). An example of a possible distorting factor with the RPM (and similar tests) is an interaction between direction of reading and writing in a language and the left-right orientation embedded in the construction of the items.

A weak point of the assessment-focused approach is that it concentrates on the test itself (and possibly method factors affecting all items in the test). However, such procedures do not address identification of construct underrepresentation. Moreover, as a rule studies in this tradition simply assume construct validity across populations without providing empirical evidence, beyond what is generated by the psychometric analysis of bias. The nomological network of a test or test battery is seldom studied. Processes and mechanisms underlying responses are even less studied. Moreover, population-comparative research has focused on nonverbal tests at the expense of verbal tests. While verbal tests tend to be more context sensitive than performance tests, simply omitting verbal tests leads to gross underrepresentation of the intelligence domain. Verbal abilities form an essential part of the intelligence construct that cannot be captured with nonverbal tests.

In summary, the two research traditions tend to either simply reject (relativist approach) or simply assume (instrument approach) construct equivalence. The position of construct universalism with its requirement of construct equivalence has not been a major target of investigation. Constructing a test that can only assess intelligence within a specific population does not in itself justify the claim that the intelligence construct is context-bound.

Trade-offs Between Positions

Within the framework outlined in the previous section, the choice is not between either accepting full comparability of intelligence scores or assuming context specificity of the intelligence construct. There are intermediate positions that require increasingly restrictive forms of equivalence.

Within the relativist position, environmental factors can be investigated only within a specific context. If the intelligence construct does not cross borders, then this also applies to the factors that affect intelligence. It requires at least a position of construct universalism to investigate meaningfully whether the same environmental variable (e.g., the amount of time a child interacts with adults) has a similar impact across contexts. A position of domain universalism makes research easier, as it allows research with the same assessment instruments across contexts, but (as in the position of construct universalism), it does not allow to compare the size of impact of an environmental factor. With both positions, the scale units on which the construct is measured can differ between groups. Only within the position of full universalism, studies of the size of environmental factors across contexts can be undertaken. Depending on the type of comparison one wants to make, different psychometric conditions associated with different levels of equivalence apply (see Table 7.1).

We give an example of a comparative study where only score differences needed to be analyzed in order to answer the question posed. Brouwers et al. (2009) analyzed studies of the Flynn effect during the last century based on the RPM tests across the world. They found that this effect was steeper in non-Western compared to Western populations and attributed this to a much larger change in environmental factors stimulating intellectual performance in the non-Western populations, notably implementation of universal education in countries with previously high levels of illiteracy. As the Flynn effect offers one of the strongest forms of evidence for environmental impact on intelligence, the claim that it emerges more strongly in non-Western than in Western societies is highly informative. However, this claim can only be justified if score differences have the same meaning across contexts and populations (requiring the form of equivalence called "metric equivalence" earlier on (see Table 7.1). For making direct comparisons of test score levels, full score equivalence is needed. For instance, the studies by the OECD on school performance, the PISA studies (https://www.oecd.org/pisa/) link country differences in cognitive achievement tests to differences in the educational system of countries and formulate advice on how to improve the educational system. Such interpretations and such advice can only be justified if a given test score allows the same interpretation, independent of the population in which that score was obtained.

This analysis shows that a relativist position is not the only way to do justice to the effects of the context in which a population lives. A relativist position allows to make some claims about environmental effects (those that are unique to a specific context), but precludes other claims (identifying effects that are similar across contexts). There is thus a trade-off between the position one takes and the type of claims one can make about contextual factors. In an increasingly globalizing world, in which resources and especially adverse life conditions are unevenly distributed, being able to study effects of context factors on (forms of) intelligence is highly relevant. Factors such as poverty, lead pollution, COVID infections, and so on all have demonstrably negative effects on intellectual performance, and some populations (within countries and across countries) are more affected by these factors than other populations. Being able to identify these effects, the underlying processes, and, especially, how they can be mitigated is highly relevant. One has to avoid errors on both sides: one can unjustifiably compare populations and misrepresent how context-specific factors mold the construct and expression of intelligence, or one can unjustifiably reject comparisons and miss out on identifying context factors that operate on expression of intelligence across populations.

Transfer of Instruments

The four positions identified earlier on are hierarchically ordered in terms of increasing restrictions on equivalence. Thus, the positions represent four possible states of affairs, in which some claims can be meaningfully made and other claims are precluded. Which position best represents the state of affairs in a particular instance requires empirical scrutiny. A central theme in this endeavor is the transfer of instruments. Three types of instrument transfer have been distinguished in the literature: assembly, revision, and adoption (e.g., Van de Vijver & Poortinga, 2005, 2020). With *adoption,* the same instrument is applied across populations after careful translation of the instructions, the items, and other test materials. *Revision* implies that the original instrument is taken as a basis and elements of the instrument (such as some of the items or the response scale) are changed to make them more appropriate to the local context. When only the design and the broad themes and goals of the original instrument are kept, but new content and possibly other administration methods are developed, one speaks of *assembly*. The zero option is to develop a completely new instrument for a specific population. In this way, an instrument can be optimally adapted to the behavior repertoire of that population. However, this is a time- and cost-intensive procedure. Probably more important, there is no accumulation of knowledge on the target construct and/or domain across populations.

The type of transfer that has been chosen needs to be justified by the level of equivalence that can be demonstrated for the adapted version of the instrument in the target population. When a completely new instrument is developed to assess a context-specific form of intelligence, predictions characteristic for the context-specific form of intelligence need to be examined and justified empirically within the target population. Construct equivalence needs to be demonstrated across the populations concerned when test adaptation amount to assembly. In the case of revision, equivalence of the domain as well as structural equivalence across populations has to be shown. In the case of adoption and quantitative comparison of scores across populations, additionally strict requirements for score equivalence have to be met.

Ideally, an instrument, new or adapted, is developed by a group of experts representing each of the populations where it will be used. This strategy is followed in large-scale country projects, comparing school performance data, such as Program for International Student Assessment (PISA) of the OECD and Trends in International Mathematics and Science Study (TIMMS) of the IEA. By involving experts from all populations right from the start, context specificity and bias can be avoided in the theoretical conceptualization, the item content of instruments, as well as the way in which the items are displayed. Unfortunately, this ideal situation is only possible for large-scale well-funded projects. For most research, this ideal situation is not within reach. At the same time, it is clear that only a careful translation and investigating the internal structure and item bias is insufficient. The relevance and representativeness, as well as the adequacy of the method through which the content is offered within the new context, needs to be investigated. The ITC Guidelines for Translating and Adapting Tests (International Test Commission, 2017) contain many practical recommendations.

Whether and to which extent instruments are transferable and which level of equivalence can be reached will depend on the (lack of) overlap in behavior repertoire between the populations involved, as well as on the aspects of the intelligence domain that are studied. The larger the differences in behavior repertoire and the more a test assesses acquired knowledge (think of the vocabulary subtest of the Wechsler scales) rather than underlying information processes (think of the digit span test that assesses the size of the phonological loop in the Wechsler scales), the less likely adoption can be justified and the less likely that strict demands on equivalence will be met. Even for populations with large overlap in behavior repertoire and for tests that assess underlying information processes, test adoption needs to be supported empirically and strict conditions of equivalence need to be demonstrated.

Conclusions

There lies a whole world between the assertion that tests prove innate differences in intelligence between populations and the claim that intelligence can only be defined and studied within the specific context in which it becomes manifest. These extremes are often the only positions that are articulated. However, there is a danger that they function as straw men in debates; finding evidence that rejects one extreme position does not necessarily form evidence supporting the other extreme position. Convincing evidence for population differences in distributions of test scores does not imply that test scores are strictly comparable. Equally, the demonstration of context specificity in performance on cognitive tasks does not necessarily imply that the intelligence construct is context-specific.

In this chapter, we have argued that fighting the misuse of intelligence tests, typical for the early history of psychology, does not require the concept of intelligence to be abandoned. Intelligence should be defined contextually where needed, but as a common human capacity where possible. Transfer and adaptation of tests to other populations as where they originated is connected to the transfer of insights about validity. Only for (the aspects of) intelligence that can be defined and assessed in the same way across contexts and populations can factors be identified that hamper intellectual development across these populations and that contribute to marginalization and exclusion. Comparability of psychological data can neither be accepted nor be rejected out of hand, but is a matter of empirical scrutiny.

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8

Cultural Intelligence: From Intelligence in Context and Across Cultures to Intercultural Contexts

Kok Yee Ng, Soon Ang, and Thomas Rockstuhl

Interest in intelligence permeates civilizations and cultures. From ancient philosophers such as Homer and Confucius (Niu, 2020; Sternberg, 2020a) to modern-day scientists around the world, the nature of intelligence has been a topic of lively debates. While intelligence is a "real phenomenon to be explained," it is clear that "people's perceptions of that phenomenon differ quite radically" (Sternberg, 2019, p. 1). Yet, "for all their disagreements, [scholars] agree on one thing—that intelligence crucially involves the ability to *adapt to the environment*" (Sternberg, 2019, p. 1, emphasis added).

We contribute to the scholarly discussion by expounding on the role of the "environment," or context, in shaping the myriad views of intelligence in the literature. We surmise that context—defined as the "situational or environmental stimuli that impinge upon focal actors" (Johns, 2019, p. 22)—is a major reason for the multiple views of intelligence.

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Environmental stimuli may be temporal, geographical, cultural, cognitive, or emotional (Avgerou, 2019). Explicating the nature of context in intelligence research is therefore of essence in deepening our understanding of the literature and pushing the boundaries of intelligence research.

In this chapter, we describe three streams of research on intelligence that arise from different conceptualizations of context. The first stream of research—intelligence in context—responds to the traditionally narrow focus of intelligence as IQ by defining different intelligences for different contexts beyond academic settings. The second stream of research—intelligence across cultures—adopts an ethnological perspective, and examines how views of intelligence are shaped by national cultures. We propose a third stream of research—cultural intelligence, a perspective that integrates the first two streams of research. Essentially, cultural intelligence (CQ) shifts the research focus from a comparative approach to examining a capability to function effectively in the specific context of intercultural interactions (Earley & Ang, 2003). CQ is therefore a form of meta-intelligence crucial for the twenty-first century that is marked by global interconnectedness.

Below, we elaborate on the three streams of intelligence research and the role of context in each. We discuss our views of intelligence in conceptualizing CQ and conclude with implications for intelligence in the Anthropocene epoch.

Intelligence in Context: From School-Smart to Street Smart

This stream of research defines intelligence as abilities required for success in the major domains of life that apply to most, if not all, societies (e.g., schools, social contexts, and real-world problem-solving). In fact, the origins of modern measurement of intelligence can be traced back to efforts to identify intelligence in a very narrow context—schools. Of all the early intelligence scholars, Alfred Binet is often seen as the "father of intelligence testing" (Aiken, 1996). In 1904, Binet was commissioned to develop tests to identify students who struggled with learning and required special education. Together with his colleague, Theodore Simon, Binet devised tests to assess mental abilities relevant to success in schools. They include memory, reasoning ability, numerical faculty, comprehension, object comparison, and others (see reviews by Aiken, 1996; Sternberg, 2020b).

Although IQ was developed for the specific context of schools, it became widely used outside of academic settings. To some extent, this could be attributed to longitudinal studies of gifted students by Terman and colleagues (e.g., Terman & Oden, 1959) that showed a positive relationship between IQ and real-world measures of success. As a result, IQ became a popular selection tool for industrial and organizational psychologists. In a meta-analysis of 85 years of research in personnel selection, Schmidt and Hunter (1998) found that IQ tests were one of the strongest and most consistent predictors of job performance. Such research inadvertently fueled the international spread of standardized IQ testing and propagated the view of a "universal" cognitive intelligence that predicts superior human behavior in wide-ranging contexts.

There were, however, critiques to such a narrow view of intelligence. Several scholars observed that individuals who succeed in school settings may not necessarily adapt well in real-world settings (Sternberg & Wagner, 1986). Sternberg (2019) noted that the standardized set of cognitive abilities is "related only vaguely, if at all, to intelligence as adaptation" in broader contexts (p. 2). That is, there appears to be a clear distinction between academic success versus practical problem-solving, or what Sternberg characterizes as "book smart" versus "street smart" (Wagner & Sternberg, 1990). Moreover, Sternberg (2019) noted that despite increasing IQ scores in the world, many real-world problems remain unresolved.

As a result, several forms of nonacademic intelligences emerged. For instance, Wagner and Sternberg (1985) proposed the idea of practical intelligence, which encompasses broadly one's ability to succeed in everyday life, including managing one's jobs, one's career, oneself, and others. Subsequently, Sternberg (1997, 2020c) proposed the theory of successful intelligence, which refers to one's ability to achieve one's goals in life by adapting to, shaping, and selecting environments, through a combination of analytical, creative, and practical abilities.

Similarly, Gardner (2006) rejected the view “that an individual who has a high *g* could be equally accomplished in any intellectual area” (p. 69). In response, Gardner (1993) developed the theory of multiple intelligences comprising eight different abilities that would predict success in different contexts such as occupations or social roles. These abilities are: linguistic, logical-mathematical, and spatial intelligence (typically relevant for academic contexts); musical and bodily kinesthetic (relevant for contexts involving the arts and sports); intrapersonal and interpersonal (relevant for social contexts); and naturalistic intelligence (relevant for contexts involving nature).

Other scholars have also advanced different types of nonacademic intelligences targeted at meeting demands of different contexts. Social intelligence, which refers to the ability to understand and manage people and to act wisely in human relations (e.g., Kihlstrom & Cantor, 2020), is important for contexts involving interpersonal interactions. Emotional intelligence, which refers to the ability to process and act on affective information gathered about both the self and others (e.g., Rivers et al., 2020), is important for contexts involving the effective management of human emotions.

Intelligence Across Cultures: An Ethnological Approach

While the first stream of research examines intelligence in major domains of life applicable to all societies (e.g., schools, social contexts, real-world and problem-solving), the ethnological approach views intelligence in the cultural context of a society or nation (Ng & Earley, 2006). The cultural context of a nation comprises the objective and subjective culture (Triandis, 1994).

Objective culture, commonly studied by anthropologists, refers to observable and visible artifacts and practices of cultures that address fundamental human needs of gathering food and relating to others, the environment, and the universe (Brown, 1991). Examples include different economic, political, legal, religious, social, and education systems;

languages, technologies, and arts and crafts. Subjective culture, commonly studied by cross-cultural psychologists, refers to the less visible psychological features of culture such as shared values, beliefs, norms, and assumptions. Common dimensions of subjective culture include values of individualism-collectivism, power distance, or uncertainty avoidance (e.g., Hofstede, 1980; House et al., 2004; Triandis, 1995).

Greenfield (1998) succinctly captured the essence of the ethnological approach to intelligence when she described culture as defining intelligence by what is adaptive in their particular niche. Sternberg and Grigorenko (2004) observed that "intelligence, considered outside its cultural context, is in large measure a mythological construct" (p. 1428). Similarly, cross-cultural scholars have argued that intelligence is a cultural product, in that different cultures ascribe different meanings and expressions to intelligence (e.g., Berry & Ward, 2006; Sternberg & Kaufman, 1998).

Evidence that culture affects intelligence comes from several streams of research. One stream of cross-cultural research examines and compares the philosophical underpinnings and operational definitions of intelligence across culture. For example, Yang and Sternberg (1997a) reviewed Chinese philosophical conceptions of intelligence. They noted that the Confucian perspective not only shares with Western notions the idea that intelligence relates to learning capabilities but also emphasizes the characteristic of benevolence and of doing what is right. By contrast, the Taoist tradition places greater emphasis on humility, freedom from conventional standards of judgment, and deep knowledge of oneself and external conditions.

A second stream of cross-cultural research compares lay perceptions of intelligence, or what Sternberg (1985) termed the "implicit theories of intelligence" across different cultures. These studies have a long history. Early examples include Berry's (1966) study of the perceptual abilities between Inuit in the Canadian Arctic and Temne in Sierra Leone, and Serpell's (1974) exploration of lay perceptions of intelligence among the Chewa adults in Zambia. Several extensive reviews of this literature demonstrate that different cultures possess different implicit theories of intelligence (e.g., see Niu, 2020; Sternberg & Kaufman, 1998).

For instance, findings from the United States show that people tend to emphasize cognitive abilities akin to those measured by IQ tests (Neisser, 1979) as well as problem-solving and social competence (Sternberg et al., 1981). Studies in China show that while cognitive abilities are central to intelligence (Wan et al., 1997), qualities such as diligence and malleability (e.g., Fwu et al., 2017); values such as benevolence and filial piety (Chen & Wong, 2014); and intrapersonal knowledge and skills to express oneself appropriately in social settings are just as important (e.g., Yang & Sternberg, 1997b). In Africa, intelligence goes beyond having knowledge and cognitive abilities, to include social skills that facilitate harmonious and stable relationships (Grigorenko et al., 2001).

A third stream of research examines cross-cultural differences in the relative effects of intelligence on adaptation outcomes. In a study of urban versus rural Yup'ik children in Alaska, Grigorenko et al. (2004) assessed children's academic and practical intelligence and compared their effects on adaptation skills valued by the Yup'ik people (e.g., good thinker, respectful of elders, and great hunter). As expected, results show that practical intelligence, assessed by tests of everyday-life knowledge (e.g., knowledge of herbs and berries, and fishing), was more predictive of adaptation skills for rural children than urban children because rural children engaged in more activities with nature than their urban counterparts.

Another example can be found in the management literature. Miao et al. (2018) hypothesized that leaders' EQ has a stronger relationship with subordinates' task performance and organizational citizenship behaviors in low power distance, collectivistic, feminine, and high uncertainty avoidance cultures. Using a meta-analysis of 17 samples, the authors found general support for their hypotheses, suggesting that culture serves as a boundary condition to the intelligence-performance relationship.

In summary, the ethnological perspective suggests that culture influences intelligence in two ways. First, culture exerts a main effect on intelligence by shaping the philosophical conceptions and implicit theories of intelligence, as demonstrated in the first two streams of research described in this section. Second, culture can also serve as a boundary condition that affects the magnitude of the relationship between intelligence and outcomes, as demonstrated in the third stream of research described above. This latter view of the relationship between culture and intelligence is consistent with arguments of trait-activation theory (Tett & Burnett, 2003), whereby the cultural context accentuates or dampens the impact of intelligence on outcomes.

Intelligence in Intercultural Context: Cultural Intelligence

The "intelligence in context" and the "intelligence across cultures" perspectives examine the nature of intelligence in a relatively bounded context. The former examines the abilities required to succeed in a domain of life (e.g., academic, social, and musical), while the latter examines the abilities required to succeed in a particular culture. Both perspectives assume a bounded and stable context that poses clear demands on individuals, which in turn lead to a set of core abilities required for effective adaptation in these contexts.

However, what happens when the context is no longer clearly bounded with distinct demands and cultural "rules"? What if the boundaries of the context are porous and dynamic, as characterized by today's increasingly "flat" (Friedman, 2005) and interconnected world? As Bandura (2001, p. 12) noted, "Revolutionary advances in electronic technologies and globalization are transforming the nature, reach, speed, and loci of human influence." Within this "flatter" world, cultural boundaries are blurred as people comingle in all spheres of life.

The new reality of global interconnectedness implies that intelligence can no longer be examined in specific, bounded cultural contexts. Instead, we need a new form of intelligence that embraces a much broader and diverse context where a confluence of cultures exists. Cultural intelligence (Ang & Van Dyne, 2008; Earley & Ang, 2003) offers a third perspective of intelligence that shifts the focus from a cross-cultural comparative approach to one that emphasizes intercultural interfaces.

Soon Ang first recognized the need for a new intelligence in the 1990s in the wake of the impending "Y2K" bug (Ang, 2021). As huge numbers of programmers were needed, she helped organizations select programmers from different countries, including Australia, China, India, Malaysia, the Philippines, Vietnam, and others. Yet, despite being selected for their technical competence, cognitive ability, and practical intelligence, the programmers failed to work effectively with one another. Differences in cultural norms and habits created huge conflicts between local managers and programmers, as well as among the programmers from different countries. The powerful yet invisible role of culture was striking, and it became clear that having a knowledge of cultural differences was not enough. This experience and realization sparked the journey into conceptualizing and measuring this new form of intelligence.

Conceptualization of Cultural Intelligence

The concept of cultural intelligence (CQ) was first introduced in Earley and Ang's (2003) book, published by Stanford University Press. Defined as an individual's capability to function effectively in contexts characterized by cultural diversity, CQ aligns with the widely accepted definition of intelligence as an ability to adapt to the environment, with several important nuances and assumptions.

First, CQ emphasizes a *capability* rather than an ability. The APA dictionary defines ability as an "existing competence or skill to perform a specific physical or mental act" and capability as "an ability, talent, or facility that a person *can* put to constructive use" or "a characteristic that *can* be developed for functional use" (emphasis added). These definitions reveal a subtle but important distinction: ability connotes demonstrated performance, while capability emphasizes the potential for performance. We view intelligence as a potential for performance rather than demonstrated performance to avoid confounding the criterion (adaptation/performance) with the predictor (intelligence).

Second, we use the phrase "function effectively in culturally diverse contexts" to suggest that intelligence goes beyond merely adapting, or changing oneself to fit the context (Sternberg, 2019). Here, we concur with Sternberg's more expansive view of adaptation that includes shaping the environment and finding new environments. We argue that to succeed in culturally diverse contexts where the "rules" for interactions are varied and even conflicting, individuals need the meta-intelligence as well as skills to enact one of these options: to adapt, to adhere to one's culture, or to create a new culture.

Third, we view CQ as malleable, which means it can be developed through experience, education, and training. This is consistent with Gardner's (1993) argument that for a construct to qualify as an intelligence, it must show a definable developmental history. There is growing empirical evidence that CQ can be developed. For instance, Raver and Van Dyne (2017) reviewed 28 studies on CQ training interventions and found that training enhanced all four factors of CQ, although effects tend to be stronger for cognitive and metacognitive CQ, than for motivational CQ and behavioral CQ.

Fourth, our conceptualization of CQ as a multidimensional construct clearly supports the view of intelligence as going beyond cognitive abilities. Specifically, we draw on Sternberg's (1986) "multiple loci" of intelligence argument to highlight the importance of motivation, cognition, metacognition, and behavior for a more comprehensive definition of intelligence. CQ is therefore an aggregate multidimensional construct that comprises four dimensions: (1) motivational CQ—one's energy and effort directed toward functioning effectively in intercultural situations; (2) cognitive CQ—one's knowledge about cultural similarities and differences; (3) metacognitive CQ—one's level of conscious cultural awareness during intercultural interactions; and (4) behavioral CQ—one's repertoire of verbal and nonverbal behaviors for intercultural interactions (Ang & Van Dyne, 2008; Ang et al., 2007).

In a major conceptual refinement, Van Dyne et al. (2012) advanced more granular subdimensions to allow for a better-articulated conceptual space for each CQ factor. Specifically, metacognitive CQ comprises subdimensions of planning, awareness, and checking. Cognitive CQ includes both culture-general and culture-specific knowledge. Motivational CQ includes intrinsic interest, extrinsic interest, and self-efficacy for intercultural encounters. Behavioral CQ includes subdimensions for repertoires of verbal behavior, nonverbal behavior, and speech acts.

Specifying subdimensions of the four broad CQ factors facilitates (a) more nuanced theorizing, especially in terms of explicating underlying processes of CQ effects; (b) more precise matching of cultural intelligence predictors and outcomes; and (c) identifying concrete ways to train cultural intelligence (Ang, forthcoming). Importantly, the distinction between culture-general and context-specific knowledge in cognitive CQ enables a more contextualized application of CQ to different domains. Culture-general knowledge refers to understanding of universal (etic) elements of culture, as measured in the original Cultural Intelligence Scale (CQS). By contrast, context-specific knowledge assesses understanding of domain-specific (emic) norms and expectations of a specific group of people. Domains could be a country, a specific subculture based on professions (e.g., business managers, teachers, and diplomats), or demographic groupings (e.g., age and gender). Incorporating context-specific knowledge offers a “plugged and played” source for more precise predictions in different contexts.

CQ Versus Other Intelligences

How does CQ relate to other forms of intelligence, such as IQ, EQ, practical intelligence, and social intelligence? According to the “intelligence in context” argument, CQ differs from other forms of intelligence by its context. As described earlier, IQ tends to focus on academic contexts, EQ and social intelligence on social contexts, and practical intelligence on real-world problem-solving contexts. CQ, by contrast, focuses on a context characterized by diverse cultures. Although CQ and EQ involve interpersonal interactions, EQ focuses on the ability to perceive and manage emotions without consideration of the cultural context, whereas CQ explicitly addresses the role of cultural context (see review by Ang et al., 2020b). Moreover, CQ’s four factor structure, derived from Sternberg’s (1986) multiple-loci argument, is unique and distinct from the other intelligences.

Empirical research has supported the conceptual distinctiveness of CQ from cognitive ability (e.g., Rockstuhl et al., 2011) and EQ (e.g., Groves et al., 2015). In addition, empirical evidence suggests that CQ has incremental predictive validity over cognitive ability and EQ in predicting cross-border leadership effectiveness (Rockstuhl et al., 2011) and negotiation effectiveness (Groves et al., 2015).

Contributions of CQ to Research and the Real World

In a reflection piece on the future of intelligence research, Hunt (2011) noted that "the biggest challenge (and opportunity") will be to expand research…from observations within the conventional testing paradigm to … understanding how intelligence is used in the workplace and in everyday life" (p. 882). CQ, developed at the turn of the twenty-first century, represents a concerted effort to understand and tackle a grand challenge and opportunity for humankind—globalization.

CQ advances research on intelligence by integrating the "intelligence across cultures" and "intelligence in context" perspectives to address new demands posed by our increasingly global environment. Whereas the "intelligence across cultures" perspective proposes culture-specific conceptualizations of intelligence, the CQ perspective advances a new, culture-general intelligence that transcends cultural boundaries (Ng & Earley, 2006). In essence, CQ offers a form of "meta-intelligence in context," where the context is composed of diverse cultural settings.

CQ also advances empirical research on intelligence through validated report-based (Ang et al., 2007; Van Dyne et al., 2008, 2012) and performance-based measures (Ang et al., 2014; Rockstuhl et al., 2015; Rockstuhl & Lievens, 2021). Report-based measures involve self- and/or observer ratings of CQ, while performance-based measures assess a person's CQ through a series of multimedia situational judgment tests (SJTs).

To date, most empirical research on CQ uses the report-based, 20-item CQS developed and validated by Ang et al. (2007). The CQS has been found to demonstrate factor structure validity and cross-cultural measurement equivalence, two criteria set out by Van de Vijver and Leung (2009) for intercultural instruments (for reviews, see Ang et al., 2020a; Leung et al., 2014). Importantly, CQ has amassed compelling evidence regarding its predictive validity. A meta-analysis involving 167 empirical papers and 199 independent samples (N = 44,155) revealed that CQ relates meaningfully to a diverse range of outcomes (Rockstuhl & Van

Dyne, 2018). Examples of outcomes include (1) sociocultural adjustment (e.g., Chen et al., 2010); (2) cultural judgment and decision-making (Ang et al., 2007); (3) job performance, including task (e.g., Chen et al., 2012) and contextual performance (Ng et al., 2019); (4) leadership performance (e.g., Rockstuhl et al., 2011); (5) negotiation effectiveness (Imai & Gelfand, 2010); (6) creativity (Chua & Ng, 2017); and (7) cultural learning (Morris et al., 2019).

The impact of CQ on real-world outcomes is profound (Ang, forthcoming). In terms of research, CQ influences research in as many as 23 academic disciplines, including management, social sciences, economics and finance, arts and humanities, decision sciences, engineering, and medicine. CQ is cited in 763 journals, proceedings, and book chapters (SCOPUS citation report, Sept 2019), and has spawned 1304 doctoral theses in 20 disciplines (ProQuest Dissertation).

Beyond academia, CQ shapes the policies and practices of global human capital across a wide range of industries (including aviation, consulting services, education, finance, high tech, food, real estate, oil and gas, etc.) as well as government and nonprofit sectors (e.g., armed forces, education, mental health, judiciary courts, counseling, public service, and religious missions). To date, more than 100,000 people across 161 nations have received their CQ profile via the CQS (Ang et al., 2007) or the expanded CQS (Van Dyne et al., 2012).

Future Research Directions

As we step into our third decade of research on CQ, it is timely to pause and reflect on what the future of CQ, as well as the broader field of intelligence, could look like. The world is now witnessing some of its greatest environmental, health, economic, and geopolitical crises. We are also seeing a dramatic increase in conflicts arising from social inequalities across the world, including ethnic/racial, religious, and gender discriminations. Against this context, Sternberg's (2019) call for scholars and society to "think more about what they mean by 'intelligence'" (p. 12) is timely. The aim of clarifying and redefining intelligence in the Anthropocene epoch is to identify and teach skills that will sustain our environment and propagate the human races.

The term "Anthropocene epoch" was introduced by the atmospheric chemist Paul J. Crutzen and limnologist Eugene F. Stoermer to describe the growing impact of human activities in shaping geology and ecology on a global scale (Crutzen & Stoermer, 2000). Thus, the term "Anthropocene" recognizes that humans *actively* shape their environment. In this sense, the notion of Anthropocene aligns well with our agentic view of intelligence as a capability to function effectively in a particular environment. Below, we offer three ideas to advance our understanding of CQ and the broader field of intelligence to resolve the global grand challenges in the Anthropocene epoch.

The Role of CQ in Resolving Global-Local Tensions

Despite rising sentiments of nationalism and protectionism, the fates of nations are more intertwined today than ever before. Many pressing issues of our time, ranging from dealing with global pandemics to addressing global climate change, represent inherent dilemmas between global and local concerns. An example is the recent case of vaccine intellectual property (IP) rights in the wake of the Covid-19 pandemic. To boost vaccine supplies in poorer countries, U.S. president Joe Biden mooted the idea of waiving IP rights related to vaccines production at the World Trade Organization. Many European countries however, rebuffed the idea. Pope Francis, who is a staunch proponent of fair access to vaccines, attributed the reluctance to waive vaccine IP rights to a "virus of individualism" (May 8, 2021; Reuters/aj). He continued to describe that "a variant of this virus is nationalism, which prevents, for example, an internationalism of vaccines." Pope Francis astutely pointed out the global-local dilemma underlying the IP waiver issue.

Addressing the global-local dilemma requires leaders to detect and balance local and global demands and do so in a way that is culturally intelligent. This offers exciting opportunities for future research on CQ. One such opportunity would be to shift from variance-based to process-based theorizing in research on CQ. Variance-based theorizing emphasizes how individual differences in CQ relate to outcomes, while process-based theorizing seeks to understand what culturally intelligent individuals do to be effective (Mohr, 1982). In essence, variance-based theorizing focuses on the "what" and "why" questions, while process-based theorizing focuses on the "how." To date, we know much more about the "what" and "why" of CQ (see meta-analyses by Rockstuhl & Van Dyne, 2018; Schlaegel et al., 2021), and much less of the "how." For example, we know little of the actual strategies that leaders use to resolve global-local dilemma, and which strategies are more effective. Should leaders, for instance, toggle between global and local demands, akin to what the literature describes as a frame-switching model (LaFromboise et al., 1993), or combine elements of both global and local demands in a type of fusion model (Janssens & Brett, 2006)?

To answer these questions, we suggest that future research could adopt scenario-based methods to identify effective versus non-effective strategies. For instance, Barros et al. (2020) presented a series of multimedia conflict scenarios to C-suite executives and senior leaders from more than 40 countries and conducted verbal protocol analyses on how they resolved these conflicts. Surprisingly, they discovered that leaders who were rated by their peers as highly effective in conflict management often compromised to resolve conflicts. This finding debunks the hype on win-win strategies and shows that compromises can be an effective, if not a more realistic, conflict resolution strategy in real life. Future studies could adopt a similar research methodology to construct a taxonomy of strategies for resolving global-local dilemmas.

CQ 2.0: From Horizontal to Vertical Differentiation

Diversity is a double-edged sword, depending on the view we take. When we view diversity through a horizontal differentiation lens (Bunderson & Van der Vegt, 2018), where different people have different values, perspectives, and skills sets, we are more amenable to detect and leverage on differences. Even though these differences could create anxiety and uncertainty (Gudykunst, 1993) due to unfamiliar interactions, they can be mitigated and overcome through cultural knowledge and training.

Horizontal differentiation is the dominant lens adopted in cross-cultural competence research. Similarly, CQ research to date has adopted a horizontal differentiation lens, viewing people as different because of their deep-rooted cultural values, worldviews, and practices, and identifying skills to help people detect and resolve differences.

However, when we view diversity through a vertical differentiation lens (Bunderson & Van der Vegt, 2018), where different people are conferred with different power, status, prestige, and privilege, we get embroiled in social injustice, a phenomenon that is inherently negative and potentially explosive. Recent global social movements such as #MeToo and Black Lives Matter underscore an urgent need for managing diversity through a vertical differentiation lens. This offers a fertile ground for future CQ research to address. We term this research as CQ 2.0 to reflect the qualitatively different phenomenon from that which current CQ research is addressing.

The vertical differentiation lens is premised on social injustice, status, and power disparities (Bunderson & Van der Vegt, 2018). Status characteristics theory suggests that evaluations people make of others often result in unequal social interactions. Due to sociohistorical events of colonization, oppression, and marginalization, attributes such as nationality, ethnicity, and gender could evoke inequality and power imbalance during interpersonal encounters (Berger et al., 1980). Interactions characterized by a vertical differentiation lens create different concerns for members of the dominant group versus the minority groups. For instance, research on interracial interactions demonstrates that members of the minority group are concerned with receiving prejudicial treatment (Shelton et al., 2005), while members of the dominant group are concerned with appearing prejudiced (Vorauer, 2006). A study by Dupree and Fiske (2019) shows that in order to avoid appearing prejudiced, dominant group members tend to downplay their self-presentation of competence during interactions with minority group members, which inadvertently results in patronizing behaviors.

Future research could broaden or reconceptualize the dimensions of CQ required to address interactions between dominant and minority group members. Although the existing four-factor framework (i.e., metacognitive CQ, cognitive CQ, motivational CQ, and behavioral CQ) could still hold, the specific nature of each CQ factor would have to incorporate new knowledge bases and skills to detect and manage unequal social interactions often riddled with prejudice, micro-aggressions, discrimination, and victimization.

A New Intelligence for the Anthropocene Epoch

In addition to furthering research on CQ, we offer the idea of a new intelligence for the Anthropocene epoch that extends beyond the capability to function effectively in a culturally diverse context. While CQ specifies a set of knowledge and skills required to adapt to, shape, or make new cultures, what is perhaps missing is a more "spiritual" element. Emmons (2000) defined spirituality as "the personal expression of ultimate concern" (p. 4) and argued that it is a critical capability that facilitates the achievement of goals and problem-solving. Key to the concept of spirituality is the idea of transcendence—"a fundamental capacity of persons that enables a person to sense a synchronicity to life and to develop a bond with humanity" (Emmons, 2000, p. 10).

We define this new form of intelligence as the capability for individuals to create an "overview effect." The overview effect in psychology refers to having an expansive mindset that views humanity as a whole (Shapiro et al., 2019). White (2014) coined the term after discovering that astronauts who returned to earth from their space travel commonly reported a profound "shift in their view of human relations, experiencing the world's troubles as secondary to the Earth as a whole and believing that even significant struggles can be resolved through a more holistic perspective" (Shapiro et al., 2019, p. 361). Astronaut Edgar Mitchell described the experience as an "overwhelming sense of oneness and connectedness …accompanied by an ecstasy" (Hunt, 2015, p. 73).

Global conflicts fundamentally stem from a deep-seated distinction between "us" and "them," as suggested by social identity theory (Tajfel & Turner, 1986). Shapiro (2017) coined the term "tribes effect" to describe a divisive mindset that bifurcates one's identity into an oversimplified in-group–out-group distinction. The capability to create an overview effect is therefore the antithesis to the tribes effect. We suggest that future research on intelligence could define and measure capabilities that will help parties "redefine their identity in the conflict as not purely tribal but also communal, cultivating a broader affiliation that is connective rather than adversarial, compassionate rather than self-righteous, and open to, rather than insulated from, learning new perspectives" (Shapiro et al., 2019, p. 361).

Conclusion

As with many scholars, we view intelligence as a set of capabilities that enable individuals to adapt to their contexts. We argue that intelligence is inherently rooted in contexts, and describe three streams of intelligence research that arise from different conceptualizations of contexts. The first stream of research—intelligence in context—responds to the traditionally narrow focus of intelligence as IQ by defining different intelligences for different contexts beyond academic settings. The second stream of research—intelligence across cultures—adopts an ethnology perspective and examines how views of intelligence are shaped by national cultures. The third stream of research—cultural intelligence—shifts from a comparative approach to examining a capability to function effectively in the context of intercultural interactions (Earley & Ang, 2003). In doing so, CQ integrates the "intelligence in context" and "intelligence across cultures" perspectives to tackle one of the grand challenges that humankind faces—globalization.

Humanity's enduring interest in intelligence testifies to the power of the construct. The biggest challenge for intelligence research, however, is to ensure its relevance to individuals and to humankind in the Anthropocene epoch. To sustain the relevance of intelligence, research on intelligence should endeavor to develop constructs that reflect the changing contexts and demands of the twenty-first century. In this spirit, we offer future research directions to advance CQ research and propose a new form of intelligence to mitigate destructive global conflicts and sustain humankind.

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9

Cultural Change in Africa Under the Pressure of HIV/AIDS: The Adaptive Role of Intelligence

Mei Tan and Elena L. Grigorenko

In an era marked by instability and uncertainty, as exemplified by the increasing violence of climate events in 2021 (hurricanes, floods, forest fires) and a raging pandemic (SARS-CoV-2), understanding cultural

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adaptation and change, historical and ongoing, is now needed more than ever. The human immunodeficiency virus/acquired immunodeficiency syndrome (HIV/AIDS) epidemic in sub-Saharan Africa presents compelling lessons on how cultures may adapt to handle such crises, and how these adaptations are facilitated by indigenous knowledge, skills, and abilities. Spreading explosively in the region, as in the rest of the world through the 1980s and 1990s, AIDS was the cause of over 1.5 million adult and child deaths in sub-Saharan Africa from 1990 to 2005 (GBDCN, 2017; Roser & Ritchie, 2018). This number only tapered off slowly with the gradual introduction of anti-retroviral therapies in the early 2000s.

In this chapter, we discuss two domains of African culture that had to adapt due to the intense effects and after-effects of the HIV/AIDS pandemic. By "African culture," we recognize both a general African culture, as we highlight cultural adaptations that occurred and have been studied in many parts of Africa, as well as local African cultures, which are presented in particular examples. Specifically, adaptations to the system of kinship fostering already in practice in several African cultures needed to be devised; this system facilitates the usually temporary movement of children out of the homes of their biological parents into the homes of relatives or non-relatives for various purposes. In addition, new conceptions and representations of time needed to be adopted to manage the treatment of the disease, despite conflicts with already existing, culturally instilled, deeply held conceptions of time. Adaptations to Africa's kinship system, which absorbed millions of orphans into native communities, were well-supported by culturally fostered competencies. In contrast, adaptations to African time-keeping (i.e., the system of indicators used to determine "when" things should happen), although promoting life-saving health practices, have progressed much more slowly, possibly because such adaptations require the development of new strategies and competencies. In comparing these very different examples of cultural adaptation, we emphasize how socio-historical concepts operate within networks of beliefs, values, and practices. These in turn encourage the acquisition of particular sets of skills and abilities, starting in childhood. These processes of culturally embedded skill acquisition have been well-described within the framework of the developmental niche (Harkness & Super, 1994; Super & Harkness, 1986), which combines anthropological and psychological perspectives to explain cultural differences in children's development. According to this culturally holistic view, core cultural practices contribute to a specific set of skills and abilities that are preserved and nurtured across generations as essential competencies for optimal functioning in that context and culture. These competencies comprise the raw materials—the intelligence, if you will—that drive successful adaptation in times of crisis.

Intelligence in Cultures of sub-Saharan Africa and the Developmental Niche

> Although promising beginnings have been recorded in indigenizing the measurement of human development and calibration of intelligence and other abilities in sub-Saharan Africa, much remains to be achieved in terms of programmatic research in these and other areas…. a universal child development environment does not exist. (Nsamenang, 2015, p. 68)

The late A. Bame Nsamenang, a Cameroonian clinical psychologist, was a strong African voice who sought to bring attention to the skills, abilities, and competencies that emerge from African ways of life and contribute to indigenous facets of intelligence (Nsamenang, 2006). His views were based on the understanding that cognitive skills—the meat of intelligence—develop to support abilities that children need in order to engage positively with their world; cognition develops to fit the "requirements and opportunities of the culture" (Gauvain, 1998, p. 189). The developmental niche framework supports his argument (Harkness & Super, 1994; Super & Harkness, 1986) by proposing that processes of development occur through a series of complex interactions between a child and his or her cultural environment.

Three cultural structures in the environment provide and mediate formative experiences of children's growth and learning: (1) the physical and social settings in which the child lives; (2) culturally regulated customs of child care and child rearing; and (3) the psychology of the caretakers (Super & Harkness, 1986). Together, these form the ecological system through which children learn implicitly the social, affective, and cognitive rules prioritized in their culture. The concepts and customs based on these rules—so commonly exercised and thoroughly integrated within the larger culture—often need neither explanation nor conscious thought in their execution by adulthood; thus, they are generally neither questioned nor discussed. What may appear to be mere social conventions, however, are deeply rooted in cultural values, beliefs, and meanings. Reinforcing patterns of expectation and the answering behaviors over time exert a powerful influence on the development of skills, abilities, and competencies that ultimately inform culture-specific components of intelligence and behavior (Gauvain, 1998; Harkness et al., 2013; Super & Harkness, 1986).

For the past several decades, developmental psychologists working in Africa have observed directly and indirectly the influences of culture on children's acquisition of different cognitive competencies. As early as the 1960s, psychologists working in Africa noted the differential development of cognitive processes in African versus Western-educated children, such as the preferential attention of African children to color versus form (Kellaghan, 1968; Serpell, 1969; Suchman, 1966), and the potential influence of age, education, language, and familiarity with materials on these preferences (Serpell, 1969). Such studies posited the foundational notion that the development of abstract thinking skills depends upon the extent to which a person is required to apply them in everyday life (Kellaghan, 1968). Only a few researchers, however, have sought to devise culturally relevant alternatives to Western assessments. Robert Serpell and colleagues devised the Panga Munthu Test (Kathuria & Serpell, 1998; Matafwali & Serpell, 2014; Serpell & Jere-Folotiya, 2008), a nonverbal assessment of general intellectual competence conceived to be ecologically valid. In this test, the task of modeling a person out of clay draws upon skills that African children actively develop in their daily lives. Similarly, a practical facet of intelligence was explored in an assessment of Luo children's tacit knowledge of herbs frequently used to treat common ailments. In this Kenyan tribe, such knowledge is acquired informally from family members and local healers in the course of daily life (Sternberg et al., 2001). These studies emphasize that measurements of intelligence in any culture need to be informed by local conceptions of intelligent behavior.

To this end, researchers have sought to understand the characteristics of adults and children who are considered to be highly functional and successful in society. For example, working with the Luo in rural Kenya, ratings by peers, teachers, and adults in the community were used to identify four culturally valued indicators of intelligence (in Dhuluo: *luoro*, *rieko*, *winjo*, and *paro*). When analyzed using principal-components analysis, two latent structures of intelligence were suggested: social-emotional competence and cognitive competence (Grigorenko et al., 2001). In other studies, a strong component of learning from elders (*kuteerera vakuru* in Shona), social effectiveness (negotiation, openness, persuasiveness, discretion—*uchenjeri*; Irvine, 1988), and social responsibility (*nzela* and *tumilika* in Chewa; Serpell, 1977; Wober, 1974) feature prominently. An African developmentalist (Mpofu, 2004) describes Zimbabwean traditional-indigenous conceptions of intelligence as emerging from cultural values of social responsibility and benevolence toward the collective (*njere* in Shona and *ukaliphile* in Ndebele). The ability to usefully support others and contribute to tasks in a collective effort for the benefit of many, especially kin, is thus recognized as an important aspect of intelligence (Mpofu, 2004).

In line with these studies, Nsamenang described the African worldview as based on the belief that humans need each other; social responsibility in Africa is part of being fully human, and the sense of self is inextricable from a sense of community and connectedness to others. Consistent with the developmental niche, he framed successful functioning as the achievement of “the physical, cognitive, social and emotional competencies required to engage fully in family and society” (Nsamenang, 2005, 2006). These competencies are instilled very early in life, as African children assume social responsibility in the form, for example, of running errands or caring for other children or adults relatively early in life (Nsamenang, 2006; Ogunaike & Houser, 2002; Tsamaase et al., 2020). Their integration into the functioning of the household, ability to notice and attend to the needs of others, and to give and receive social support (Weisner, 1987) are thus important indicators of intelligence to the adults around them and to their peers. Such skills embody the general ability to develop and foster relationships with kin, an important aspect of African intelligence that has proven crucial in Africa under the pressures of the HIV/AIDS epidemic.

Adaptation Within Africa's Kinship Networks

> AIDS orphans, will increase to between 3.1 and 5.5 million by the year 2000, or between 6 and 11% of all children aged 0–15 [in 10 Central and East African countries]. These large numbers of orphans will overwhelm any and all historic institutional or informal systems of child care in this region. (Preble, 1990, p. 679)

Based on early seroepidemiological studies conducted in East and Central Africa in the mid-1980s, this dire scenario seemed highly likely. The high prevalence of HIV in certain populations, such as truck drivers (35% at a single transport site in Kampala in 1986; Carswell et al., 1989) and pregnant women, signaled the uncontrolled spread of HIV and, as no treatment was yet available, certain adult deaths and rising numbers of orphans (Kagaayi & Serwadda, 2016). Sure enough, orphan rates soared for the next two decades, reaching a peak of about 14 million orphans in eastern and southern Africa in 2005 (Roser & Ritchie, 2018). Yet, according to most accounts of scientists watching the region, informal systems of childcare coped (e.g., Chirwa, 2002; Nyambedha et al., 2003; Nyamukapa & Gregson, 2005; Verhoef, 2005). Although not all orphaned children thrived, many at least survived. This can largely be attributed to the system of kinship and fostering that has historically been a stable component of African cultures throughout history.

Conceptions of kinship emerged from the social sciences, primarily the field of anthropology, to describe the webs of relationships that define families (Block, 2018). Kinship is generally defined by blood ties, yet it is also created through the development and nurturing of relationships and the assignment or taking on of roles beyond those defined by biological relatedness (Cheney, 2016). Such inherent flexibility allows for creativity and the heterogeneity of kinship groups over time. Thus, although rules of kinship are cultural, they may be revised by individuals in response to environmental change, such as demographic shifts and community needs (Block, 2018). Alternative and more elastic mechanisms of social organization and new patterns of social relationships can increase the adaptive capacity of the system (Chirwa, 2002). This has in fact been well-documented with the persistence of HIV/AIDS in sub-Saharan Africa.

One of the adaptive mechanisms cultivated historically within the systems of kinship of sub-Saharan Africa are practices of child fostering: the movement or "migration" of children between households to be raised by someone other than the biological parent (Bledsoe, 1989; Brown, 2009). These movements are usually negotiated, sometimes involving the household of blood relations and sometimes not, and the period of fostering may be a matter of months or a matter of years. Fostering can serve many purposes at many levels (Ansell & Van Blerk, 2004; Foster, 2000; Madhavan, 2004). It may be implemented because an elderly grandparent has requested help, or because the house of an "auntie" is closer to a good school, because of parents' migration to work, or because of divorce (Verhoef & Morelli, 2007). These constitute socially accepted adaptive strategies that can be employed to mitigate stress on households, either the sending one, the receiving one, or both (Cheney, 2016; Goody, 1992; Hosegood et al., 2005). In addition, fostering is frequently framed as mutually benefiting the fostered child also (Bledsoe, 1989). From a traditional Ghanaian perspective, the foster care of children is part of a philosophy of communal childcare in which multiple caregivers, even harsh ones, are part of the proper socialization of a child (Imoh, 2012). A foster family could serve as a training ground for the cultivation of a child's skill in animal husbandry, fishing metal work, or weaving, useful for future livelihood (Goody, 1978). In addition, the effects of fostering are understood to reach beyond individual households; fostering has been described as a social welfare system revolving around kinship (Brown, 2009), whose overarching function is to maintain the stability of a community as a whole (Cheney, 2016). Such traditional or "purposive" fostering underwent a dramatic shift to "crisis" fostering (Madhavan, 2004; Oleke et al., 2006) to care for the vast numbers of orphans produced by the AIDS epidemic in the late 1990s to early 2000s. In this forced shift, conceptions of kinship and rules of fostering were challenged, and individuals were pressed to respond with all of the knowledge, skills, and ingenuity at their disposal. The fluid and flexible nature of the system allowed individuals to adapt rules to address the needs at hand; child outcomes under these varying situations have appeared to range across a broad spectrum. Yet the system allowed families to cope.

Kinship and Fostering Under the Pressure of HIV/AIDS

In the late 2000s, empirical studies (mostly reporting from a Western perspective) appeared to present two dialectical scenarios for AIDS orphans: one of a ruptured or overwhelmed kinship system leading to detrimental child experiences, including abuse and neglect (e.g., Chirwa, 2002); and another of resilience and coping (e.g., Kuo & Operario, 2007), in which family networks facilitated the provision of care to millions of unanticipated orphans (Drah, 2012; Mathambo & Gibbs, 2009).

Of course, the reality was more a spectrum of outcomes resulting from the influence of multiple factors. Abebe and Aase (2007) presented such a spectrum (Fig. 9.1) based on extensive qualitative work carried out in Ethiopia to characterize the prominent features of extended families caring for orphans. Their findings were derived from household observations; repeated in-depth interviews with orphans, social workers, and heads of households; focus group discussions with children; and children's story writing. They revealed differences in three aspects regarding households' capacities and resources to manage orphan care: the practiced culturally derived concepts of care; objective indicators of household capabilities, such as assets, activities, and entitlements; and the presence of reciprocal and resilient care-giving and care-receiving practices. Notably, these independently mirror the structures outlined by the developmental niche. According to Abebe and Aase, it is the varying combinations of these capacities and resources—including both material (economic) and non-material (i.e., social and emotional) affordances—that determine a household's status within the spectrum. Each aspect has

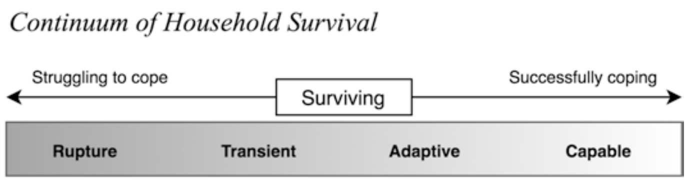

Fig. 9.1 Continuum of household survival. *Note*. Adapted from Abebe and Aase (2007), Mathambo and Gibbs (2009)

the potential to endow orphans with certain strengths to help them cope with their losses (Abebe & Aase, 2007).

At one extreme, *ruptured families* live in chronic poverty and poor living conditions. Their low economic capacity erodes children's access to emotional and social support by depriving all members of the household of time and energy to engage emotionally or socially; a problem that has been called time poverty (Heymann & Kidman, 2009). *Transient families* are not destitute but live within a danger zone of becoming so due to lack of a dependable income source and the necessity of migration to find work; many of these households are female-headed, grandparent-headed, or child-headed. *Adaptive families* have relatively stable household resources and livelihood assets, though often still dependent upon outside entities such as relatives or non-governmental organizations (NGOs). Access to electricity and piped water help decrease children's time spent on chores, giving them more time for socializing and playing with other children. *Capable families* are fully secure in their material and social capacities; they are not dependent upon any external support (Abebe & Aase, 2007).

One key perspective emphasized by this spectrum, as discussed by Mathambo and colleagues, is the dynamic nature of households that is missed by most cross-sectional examinations of households and orphan outcomes. Social rupture perspectives obscure the potential to adapt to or capitalize upon changing conditions or opportunities. This dynamic system allows for rapid adaptation, driven by individuals and collective (family or community) intelligence to support the survival of both children and households. Thus, where a family falls on this spectrum at any moment in time also depends in part upon individual-level competencies and skills instilled culturally long before the HIV/AIDS epidemic and orphan crisis. Though there are no assessments as yet for such forms of intelligence, we can observe how such skills have been exercised in coping strategies: these include proactive behaviors exercised prior to any actual crisis, and the negotiations or manipulations engaged in by individuals afterward. How individuals work within the kinship system, capitalize on it, or deviate from it reflects the practice and extent of skills they learned growing up in it.

Competencies and Strategies for Coping: Adults

Fostering within the African kinship system is always a strategic decision, carried out to create or sustain bonds of mutual benefit in an interdependent fashion (Ankrah, 1993). Although cultivating relationships within family appear to be optimal (Bishai et al., 2003; Case & Ardington, 2006), relationships outside the family could also be strategically formed (Brown, 2009). Developing and deepening positive relationships with others routinely may be considered a kind of forethought or stay against disaster. In interviews about orphan outcomes, social workers emphasized that the quality of the relationship developed over time prior to death between the deceased and adoptive parents played a role in the willingness to extend not only economic, but also social and emotional forms of care (Abebe & Aase, 2007). The type and strength of the relationship between deceased parents and foster parents determine how the latter treat the children in their home (Abebe, 2010; Madhavan, 2004). Moreover, any planning, such as parents' decisions to send their children away before their illness and death, might result in better outcomes for children (Oleke et al., 2006). In a large panel study ($n = 718$) accessing health-and-development survey data collected from 1991–1994 (prior to the children being orphaned), then again in 2004 (after losing one or both parents before the age of 15), it was found that children who had been fostered prior to their parents' death suffered no significantly negative effects on their schooling in terms of years of education completed; however, it should be noted, the reasons for this could not be clearly determined (Beegle et al., 2010). Another form of planning for uncertain futures is parents' efforts to deliberately raise their children as desirable foster children, as illustrated in statements made during a focus-group of mothers:

> When your children are trained to these [domestic] tasks it becomes easier for them to fend for themselves in the event of your death.
>
> If children are not capable of undertaking household chores, if you should die, nobody is keen to foster them.
>
> There is no one who will be happy to foster a child that is lazy. (Hampshire et al., 2015, p. 156)

Strategies enacted after parental deaths take place in negotiations with other relatives, often starting at the funeral. Systems of patrilineality or matrilineality in African cultures establish the rules regarding where children belong when a parent dies; in a patrilineal system, it is the father's side of the family that is responsible for orphans. As the managing director of a small NGO in rural South Africa explained, "Culturally, a child from a married couple belongs to the father's side" (Block, 2014). However, since the rapid growth in numbers of orphans due to HIV/AIDS, these rules appear to be heeded less and less. In a set of families being supported by this NGO, about 75% of such orphans were living with a maternal relative, most often their grandmothers, despite the patrilineal culture (Block, 2014). This is because, by some accounts, maternal relatives strategically argue to receive the children into their care. To do this, they often searched for violations of the patrilineal rules on the part of the fathers' families in order to overturn patrilineal claims to children. In one instance, one grandmother argued that "the children belonged to her since the husband's family 'never sent cows' (*o se hlole o romella likhomo*), or bridewealth (*likhomo*," ibid., p. 718), the payment traditionally sent from the groom's family to the bride's upon the marriage (Block, 2014). Such claims may stem from the love of parents for the deceased daughter, to true regard for a child's well-being, but taking in a child may also be seen as an investment, as infants and toddlers grow quickly into helpful beings in this culture. Thus, fostering is a complex negotiation that may encompass obligation, investment, exchange, and survival; yet, Block (2018) is careful to point out that such strategizing does not necessarily preclude any love, care, and appreciation a fostering adult may feel for their charge. Indeed, it may be difficult to see where love and the highly valued trait of social responsibility begin and end.

Competencies and Strategies for Coping: Children

A broad range of competencies is displayed by children who, allowed by the kinship system, decide to exercise their own agency and leave households that do not care for them well, seek out new households, or decide to head their own households to protect siblings and land inheritance (Evans, 2012). Child-headed households were first described in the late

1980s in Uganda (Foster et al., 1997) as a new strategy being implemented by children as an option for better survival. These households were first defined as being headed by double orphans under the age of 18; however, since then it has been noted that some child or youth heads of household have a living parent, but one who is not able to care for them for one reason or another (Daniel & Mathias, 2012). Studies of child-headed households describe children living in often severe hardship due to lack of food and funds, persecution by family and community members, and loss of the ability to attend school (Daniel & Mathias, 2012; Luzze & Ssedyabule, 2004). However, they also document how young caregivers have ensured the survival of their households and the children in them under challenging circumstances, often with skill and ingenuity (Ruiz-Casares, 2010; Skovdal et al., 2009).

Several strength-based models of coping have been proposed to account for the successful survival of some child-headed households; these highlight the competencies children and youth exercise to successfully head independent households. The salutogenic model of health focuses on individuals' internal and external resources that support their positive well-being (Antonovsky, 1987; Daniel & Mathias, 2012; Mittelmark, 2010). The model posits a "sense of coherence" that allows individuals to discern or comprehend their world as manageable and meaningful, to understand challenges in such a way that they can be faced; this sense is protective against anxiety and hopelessness. To illustrate, Daniel and Mathias (2012) share the example of Joseph, a 16-year old double orphaned since the age of 9, who headed a household in which he cared for a younger cousin. Joseph's understanding of the community systems available allowed him to support their survival. He made bricks to earn money. He also managed to go to school and grow food by negotiating with teachers to get sanctioned days off:

> Sometimes when the planting season collides with school days, I ask permission from teachers to get at least two to three days to prepare and plant my 'shamba'. (Daniel & Mathias, 2012, p. 195)

Already planning to go to secondary school, he owned a flock of goats from which he planned to sell a few each year to pay his school fees and buy school supplies. Good relationships with sympathetic neighbors also helped him; one linked him to a non-governmental organization (NGO), which provided school uniforms for him and his cousin. Knowing how to downplay "adult" roles when negotiating assistance from NGOs or government agencies often helped him to secure aid (Daniel & Mathias, 2012; Evans, 2012).

Kendrick and Kakuru (2012) have approached child-headed household resilience from the concept of funds of knowledge. This concept recognizes the practices and knowledge that have been fostered culturally—such as the socially valued skills surrounding caregiving, food production, and money-making—that support these children's ability to survive, overcome, or thrive (Moll & Greenberg, 1990). In a case study (Kendrick & Kakuru, 2012), a young 12-year old head of household, Ibra, responsible for five other children (ages 10, 8, 6, 4, and 3) cited few supportive relationships with adults in his community: two school teachers, the father of a school friend, and a nearby neighbor. Yet, the children managed to continue their schooling, earn money, acquire and prepare food, and remain together. This appeared to be largely achieved through optimizing the adult relationships they had, and their nurturing important peer connections within their community. For example, upon the advice of teachers, the elder children, Ibra and Winnie, approached the Local Council to receive permission for the children to stay in school despite lack of funds for school fees. This endeavor achieved several important goals: the ability to continue learning in school, where Winnie was among the top students in her class and a year ahead of her older brother; and the ability to remain connected to an important source of helping and sympathetic adults, peer friendships, and a community of belonging. To obtain food, they all had learned to recognize and dig up wild yams and other root vegetables on their small plot of land. They learned how to harvest and sell small amounts of coffee beans growing there. Ibra did casual work for money to buy paraffin. Such tacit knowledge and developing competencies allowed them to survive. One of the children, a 6-year-old boy, was hearing impaired so also could not speak well. To support his becoming a useful and contributing member of the household, his older sister devised ways of teaching him signs for chores, as she had observed being practiced by a mute man who used to reside in the neighborhood. The young boy also learned by observing and mimicking his younger brother to carry out daily activities (Kendrick & Kakuru, 2012). Thus, skills of social learning and a sense of responsibility for each other helped their household stay together.

Finally, peer relationships have proven to be enormously important to children living independently. As children, they still need to be able to play, so weekly football games and learning together in informal study groups with neighborhood children helped Ibra and his siblings maintain some fun in their lives (Kendrick & Kakuru, 2012). Older youth also needed peers as companion, interdependent providers. As Rickson, a 19-year-old youth described a peer:

> We are friends, we stay together, we collaborate on what to do, we ask each other 'how is your life?' We share experiences. [...] We work together [...]. For example, if I have to do weeding in our farm, he comes and helps me, and once we have finished my farm I go to his home and help him as well. For example, during the school holidays, we help each other with different things, like looking for fertilizers. (Evans, 2012, p. 17)

These examples of adaptations to the kinship system effected by children illustrate the skills and abilities acquired early in childhood that some were able to exert to successfully survive.

In the next section, we examine another aspect of African culture—conceptions of time—that has been particularly challenged by the HIV/AIDS pandemic. How individuals resolve conflicts surrounding self-oriented health behaviors that run counter to the social orientation of African cultures highlights the development of new competencies to integrate new ideas with old ones and forge new habits and behaviors.

Adaptation of African Conceptions of Time

What Is Time?

Before jumping into the role of time cognition in the management of HIV, we'll lay some groundwork with a few basic characteristics of time as a concept. First, time is a multi-faceted construct that has been defined and studied from many different perspectives in psychology. For example, there are cognitive neuroscientists who study the brain mechanisms that gauge the perception of time duration (e.g., Meck & Ivry, 2016; Wearden, 2016; Wittmann, 2009, 2016); cognitive scientists who study the relationship between time, space, and language (e.g., Casasanto & Boroditsky, 2008; Núñez & Cooperrider, 2013); and social psychologists who study how notions of time structure societies and human relationships (e.g., Hofstede & Minkov, 2010; Lauer, 1981; Levine & Norenzayan, 1999). Second, time has been defined within different cultures using an array of systems, artifacts, and linguistic structures (such as vocabulary and tense) to represent or encode temporal meaning (e.g., Evans, 2013; Sinha & Gärdenfors, 2014; Strathman & Joireman, 2008). Third, as cultural phenomena, conceptions, and habits surrounding time are transmitted from one generation to the next as implicitly or explicitly taught conventions of habit and language that are acquired at an early age (DeNigris, 2017; Wagner et al., 2016). Given these multiple facets, the concept of time is best understood as a set of relationships; in every culture the notion of time exists conceptually within a network of related ideas, needs, behaviors (Wiser & Smith, 2016). Simultaneously, time may be thought of simply as a culturally devised system for knowing "when" things should happen.

What Is African Time: A sociocultural Historical Perspective

> The traditional African "has virtually no concept of the future." (John Mbiti, as reported by Gillies, 1980, p. 16)

> When time is experienced as sharing and caring, in particular within the community, and if time is viewed as a gift from God, punctuality becomes infinity.
>
> The West can keep their watches. (Cilliers, 2018, p. 130)

There is a rich history of discussing the nature of time as conceived in different cultures, including African ones, in the fields of religion (e.g., Gillies, 1980; Mbiti, 1968; Parratt, 1977), philosophy (e.g., Gale, 1968;

Le Poidevin & MacBeath, 1993), and anthropology (e.g., Bohannan, 1953; Evans-Pritchard, 1939). What they generally reveal is that, as cultural artifacts handed down through generations, conceptions of time are embedded in systems of social practice and serve particular purposes in society; also, whatever dominates or determines time claims a certain status or power. We outline these purposes briefly with examples from anthropology.

In 1927, Polish anthropologist Bronislaw Malinowski published a highly detailed account of the conceptions of time and attendant practices of the inhabitants of the Trobriand Islands, located off the coast of New Guinea. According to Malinowski, the people in the Trobriands tracked time in a systematic way to organize complex work concerning the cultivation of food gardens, fishing, expeditions, and warfare—that is, to carry out many practical activities for daily living (Malinowski, 1927). They also used time-reckoning to organize rituals important for dealing with death, to plan religious festivals, and to set the remembrance of loved ones—what Malinowski calls sentimental purposes. To carry out these time-related functions, Trobrianders defined dates situated in the future, calculated time in the past for several generations, and located events in time within a specific season of the year using various cultural (economic and religious) activities, and meteorological and astronomical events important to them, as time markers. For example, the cycle of the year was defined by the economic cycles of gardening, the activity that seemed most important to the Trobriands; the word for "yam," or *taytu*, was the same as the word used to refer to a year. That is, they developed a concept and system of time that allowed their society to fulfill its needs. Paul Bohannan's ethnographic account of conceptions of time among Tiv in Nigeria (Bohannan, 1953) describes functional aspects of Tiv concepts of time similar to those Malinowski found: that time is marked by recurring events, or simultaneously occurring events such as natural phenomena, and that the events attended to are those relevant to daily living and relationships. Tiv seemed unconcerned with the measurement of time but maintained, much like the Trobrianders, methods of marking time based on the most important things going in their social life and the rhythms of subsistence.

In a more modern example, Rickie Burman studied how time is structured on the island of Simbo in the Solomon Islands in 1978 (Burman, 1981). Unlike Malinowski's and Bohannan's, his study moved beyond functional descriptions of how time is conceived and expressed to analyze how the Simbo culture's temporal constructs may affect other aspects of the culture, such as the social hierarchies temporal constructs may promote (Burman, 1981). In his research, he discovered a formalized calendar in Simbo culture that relied on a keeper responsible for the movement of shells along a string to mark the six months of Penja (the propitious season) and of Raghi (the inauspicious season). This ritual activity gave its keeper certain power as the person who informed others when certain activities should be carried out. These explorations of the power associated with the formal control of time sheds light on the social power structures that might be associated with conceptions of time, and how a keeper of time, either formal (ritualized) or informal, may wield a certain power by determining when things should happen.

These portraits of time-keeping illustrate several of the characteristics that have defined African and other indigenous conceptions of time. First, these conceptions are embedded in and strongly influence the functioning of societies. Second, they are generally devised to track the most important and meaningful events in a culture. And third, conceptions of time may confer a kind of power on the entity or entities that represent time.

African Time in a Modern World

Within modern, functional perspectives on time, African conceptions and habits follow a socially structured time that has often been contrasted with Western systems of clock and calendar time. The anthropologist T. E. Hall (1983) used the terms monochronic (M-time) and polychronic (P-time) to distinguish between structured, scheduled behaviors organized by "tangible" time and a more free-flowing way of doing many things at once without regard to punctuality but being more socially guided (Jones & Brown, 2008). These distinctions are very similar to those made by Levine (Brislin & Kim, 2003; Levine, 2013), in which "clock time" is structured by one's awareness of the hour and by scheduled meetings and events; "event time," in contrast, is governed by social dynamics. Under "event time," an event lasts as long as people are engaged in it. In an example from the business world (Brislin & Kim, 2003), an executive must choose between being punctual for an important appointment and handling an impromptu visit from a work colleague bringing pictures of a new baby of a company employee. In a culture in which clock time is more normally regarded, the appointment must take precedence and the executive excuses himself. Under event time, however, the executive will look at the pictures, exclaim over the baby's good looks, speculate on how proud the grandparents must be, and may even call the mother on the phone to see how she and baby are doing. Only once this baby event ends will the executive turn back to the scheduled appointment. While it must be noted that most cultures operate under both depending upon the activity (e.g., work vs. leisure time), one is usually more prevalent (Adam, 2003). Conceptions of time in rural Africa have been characterized as event time, which is consistent with the African valuation of social responsibility and social relationships. Though clock time is certainly used in many circumstances, particularly with respect to formal jobs in urban areas, its use in health-relevant activities, including the routine use of anti-retroviral HIV/AIDS treatment (ART) medication, has created challenges to people's survival.

Time and HIV/AIDS

While it may seem sensible to assume that anyone can learn to "tell time," use a watch, or adopt a clock-scheduled regimen in place of event time, the slow and often difficult process to do so—even when it involves taking life-saving medications on time—has revealed the fallacy of such assumptions. Given what we understand about event time and its correspondence with social responsibility and other African cultural norms and values, the prioritization of a completely asocial (or even anti-social) entity such as a clock to serve one's personal agenda may appear to run counter to all notions of intelligent behavior in event time. To reconcile these contradictions, new strategies and competencies need to be developed.

While we should make it clear that problems establishing a medication routine are encountered globally, in many cultures and for many different reasons (Ryan & Wagner, 2003; Vaughan et al., 2011), in African settings, conceptions of time appear to interfere with medication regimens and adherence in particular ways. First, tracking time could initially be problematic in regions where clocks and watches are not common. In a 2011 study on social factors affecting ART adherence in rural Zambia, 12% of a sample of 518 adults were classified as non-adherent to their HIV medication if they had missed any ART doses in the past four days. Three social factors, including remembering when to take HIV medication based on the position of the sun, were found to independently contribute to being classified as non-adherent. It was pointed out that, of the recruited sample many were farmers who did not own a watch or use a clock, and thus the inability to know the exact time may have been a barrier to remembering to take medication (Nozaki et al., 2011). Yet, even with the means to access clock time, there seems to be persistent difficulty in establishing a fairly consistent routine that relies on clock time. A study undertaken in Ethiopia conducted semi-structured interviews with 105 adults with HIV to explore factors contributing to drug adherence. It was shown that while most adults (92.4%) were adherent to dosage, only 66.7% were able to remain adherent to dose schedule. That is, they were unable to maintain the prescribed medication schedule (e.g., once at 10 a.m., once at 10 p.m.), often forgetting when they had last taken their medication, or guessing about the time. Some found the emphasis on punctuality in their drug regimens so stressful that they discontinued them (Tiruneh & Wilson, 2016). The habitual reliance upon event-based indicators of time—such as use of the sun, shadow length, or rooster's crow—may be the reason for these difficulties. In other cases, some people simply report difficulty in "keeping time."

For example, in a qualitative study carried out in South Africa on the impact of HIV/AIDS on the lives of elderly people (over the age of 50) affected or infected by the virus, one 72-year old caregiver of an HIV+ child lamented that, "Keeping time of when to take the medicine is tough" (Singo et al., 2015, p. 5). Yet this was not only a problem of old people. In an evaluation of an adherence intervention for HIV+ adolescents (n = 50, aged 10–18) involving weekly scheduled home visits and reminder text messages in Zimbabwe (Chawana et al., 2017), "problem with keeping time" was reported as the reason for missing an ART dose 50% of the time; the most commonly reported reason was "simply forgetting" (62%). The exact nature of "keeping time" is never explicitly explained, but as suggested by this study, it is different from simply forgetting and likely more related to the habit of thinking about and tracking time in hours.

This difficulty of "keeping time" may be more understandable if we think about the long socio-historical nature of African time as a communally based system that is centered on social events. As South African theologian Johan Cilliers tries to explain: "'Now' rather indicates the symbolic value of an event. Understood in this way, the 'present' is transposed into a type of quality of experience that is determined by sharing and communality" (Cilliers, 2018). That is, as Nsamenang and others (Mpofu, 2004; Nsamenang, 2006, 2015) have emphasized, and as exemplified in African kinship, human relationships are prioritized both philosophically and practically. The nature of African time is inextricably tied to the central social tenets of African culture, which have endured through times of missionaries and colonial rule. Thus, although the use of clock time may seem ubiquitous in many parts of Africa, particularly in urban areas where people's jobs depend upon being "on time," these behaviors may be less a true adoption of clock time than a socially driven adaption. That is, the way that many have reconciled clock versus event time is to re-conceptualize clock time events as human-related events. This is interestingly illustrated in a follow-up study to an adherence intervention (Wise-pill Intervention Study; Musiimenta et al., 2018; Ware et al., 2015) carried out in Uganda.

The Wise-pill intervention involved two conditions of medication adherence, monitoring and a control condition. In one condition, electric monitoring of pill-taking linked to a graded delivery of reminder texts: daily reminders were delivered for a month, then weekly for two months, and in the final period of six months, reminder texts were only sent if the "smart" pill bottle was not opened within two hours of the scheduled dose, in which case a text notification was also sent to one or two of the individuals' designated social supporters. In the second condition, participants received a message only if no signal was received from the pill bottle two hours after the scheduled dose, and for the last six months of the study, messages were also sent to social supporters if the dose appeared to be two hours late. In the control group, pill bottle monitoring was used without any system of reminders (Musiimenta et al., 2018). Results of the intervention study showed that adherence significantly improved (by 11%) for participants in the scheduled (daily then weekly) reminder condition (Haberer et al., 2016). In a concurrent qualitative study, interviews were conducted at month three of the intervention, after the first 48-hour interruption of treatment post three months of the study, and at the end of the nine-month study. The aim was to describe how participants experienced and interpreted the intervention. Three themes emerged from the data regarding how participants viewed the intervention: as a reminding and support system for making a habit of adherence; as an opportunity for the patient to show commitment to treatment; and as a feeling of being cared for by the clinic. Thus, the intervention was understood in one sense as a kind of training that helped people learn how to "keep time": "They [text reminders] would come every day and so I learned that behavior of keeping time" (Ware et al., 2015, p. 1290). In another way, participants understood the intervention as a kind of positive and meaningful connection to others:

> You people see that I open my bottle and try to charge it. Then I am sure you know that I was able to get whatever you taught me to do and I am doing it without fail.
>
> I can take my medicine well knowing that I am being watched. When someone is waiting to see if you are taking your medicine, it means that they care and you should also have the responsibility to take your medicine well.
>
> Every time I receive this message I feel encouraged to continue taking my medicine. Knowing that there are people who care about my health. (Ware et al., 2015, p. 1290)

In the follow-up study conducted two years later, in-depth semi-structured interviews were carried out with 28 of the original study participants (13 from condition 1, 10 from condition 2, and 5 from the control condition) about their experiences taking their medicine since the study ended. Three themes emerged from the analysis: learning adherence from the intervention, internalizing the habit of medication adherence, and adapting coping strategies. Although no actual adherence data was collected other than self-report, most participants appeared to have successfully internalized the habits and the positive feelings and associations developed during the intervention to remain adherent after the intervention was withdrawn. Only a few felt abandoned and isolated. By creating and internalizing social relationships to connect with this completely electronic, automated system, individuals were able to generate meaningful conceptions of ART adherence and overcome the challenge of "keeping time." This creative weaving together of two opposing representations of time may be an instructive example of applying a well-established competence—the ability to perceive and use social relationships—in a new way to address a new demand.

Intelligence and Adaption: Change and Survival

In this chapter, we have attempted to illustrate how the development of intelligence is qualitatively linked to and dependent upon the demands of one's physical, cultural, and social environment. Because of this, different cultures foster universal but also unique strengths, and these strengths may constitute the best initial response to successfully adapt to new crises. Competencies for the development of helpful social relationships, negotiation, and exchange supported life-saving extensions of African kinship systems to create unconventional family and household configurations, including child- and youth-headed households. These same competencies, although initially a barrier to crucial HIV/AIDS treatment behaviors, have proven useful in conceptions of clock time for medication adherence. That is, clock time may be a form of socially driven event time; the power lies not in the clock itself, but in the social relations it may also represent. These portraits of intelligence as a driving force for adaptation are lessons in how cultural change for survival may proceed.

We close this chapter with the reminder that intelligence is a cultural universal, but one that may differ across cultures in its particulars, as outlined by the developmental niche framework. Changing conditions, however, push people to extend their culturally acquired competencies or develop new ones to address new problems. This is why different cultures must often find different solutions to the same problem, similar to the way different cultures have responded to and coped differently with the challenges of HIV/AIDS. As we examine how African cultures have adapted by extending (in the case of kinship) or transforming (in the case of time cognition) strong cultural values and behaviors, we see how the adaptations may arise from cognitive strengths fostered by culture. As we now face many new and dire challenges globally, we should strive collectively and collaboratively to do the same: to use our diverse cultural strengths in old and new ways to ensure that future generations survive.

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Part IV

Context, Assessment, and Intellectual Performance

10

Taking an Intelligence Test: Does the Context Matter?

Adrian Furnham

Introduction

People talk about intelligence all the time. Listen to the way they describe others. There are many synonyms and slang words for intelligence: ability, acumen, acuteness, agility, aptness, astuteness, braininess, brilliance, canniness, cleverness, comprehension, discernment, foxiness, insightfulness, giftedness, grasp, gumption, perspicacious, perceptive, quick-wittedness, sagacity, smartness, sharpness, talent, thoughtfulness, whiz.

Many of these terms refer to how people deal with the daily problems of life, which of course differ from time-to-time, and place-to-place. The question is whether the appropriate understanding and assessment of intelligence is, and indeed should be, influenced by culture and history.

In *Intelligence in Context: The Cultural and Historical Foundations of Human Intelligence.* Editors: Robert Sternberg and David Preiss. London: Palgrave

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Is being smart in Wall Street, very different from being smart in Walmart? Is intelligence about adapting to, and thriving in, different environments which have quite different demands and rewards?

Intelligence is a characteristic people quite easily recognize and usually admire. But is the understanding of the concept and the willingness to be tested dependent on time and place? Indeed, is the validity of IQ tests, indeed any form of assessment, completely context- dependent?

This chapter will consider what lay people believe about intelligence and intelligence testing. Do they acknowledge the role of context, and if so, how? How different is the lay view from the standard academic view (if such exists)? And what of alternative voices on this topic, many of which are to be found in this volume?

Some countries and organizational cultures have always favored testing for selection. Most militaries have, and will always use, abilities tests. The same is true of schools and universities. But also, over time, commercial and public organizations have used intelligence and other psychometric tests predominantly in selection. This is how people most frequently have their experiences of tests, though now their availability on the web and usefulness in self-awareness and development exercises mean many more people have experience of tests. However, these popular tests may be very different from the well-known and developed psychometric tests in content, administration, and feedback.

This chapter is divided into three sections. The *first* concerns the difference between one prototypic academic view and the lay view of intelligence. Some academics are strict "universalists" who underplay the role of context in definition and assessment, while others stringently reject this view. It also looks at some recent work on popular beliefs about intelligence and intelligence testing, many of which concur with those of critics of tests.

The *second* concerns issues about the perception and accuracy of intelligence tests, as opposed to other ways of assessment. It demonstrates some of the major problems concerned with using tests in the "real world," and the much about lay beliefs about testing. In short, it shows that may people are skeptical about many famous and current tests and the business of testing.

The *third* section looks at other everyday tests and markers of intelligence and what they mean. If people are skeptical about both concept and measurement of intelligence, are there other ways to measure it? Indeed, do we need to develop different assessments for different skills in different cultures?

A Big Divide?

Are lay people and "psychometrically orthodox experts" on intelligence testing in agreement? What do ordinary people believe about context and how different is this from the classic academic viewpoint?

The strict, orthodox, conservative view about intelligence goes something like this: intelligence can be measured, and intelligence tests measure it well. They are among the most accurate (in technical terms, reliable and valid) of all psychological tests and assessments. While there are different types of tests, they all measure largely the same intelligence, as psychometrically defined. IQ is strongly related, and probably more than any other single measurable human trait, to many important educational, occupational, economic, and social outcomes. A high IQ is an advantage in life because virtually all activities require some reasoning and decision-making. The odds for success in our society greatly favor individuals with higher IQs. That said, there are some confounding factors in measurement, because people with higher IQs often are given more opportunities in life, and hence society gives them more opportunities to achieve.

Some still argue that today intelligence tests are not culturally biased; rather, IQ scores predict about equally regardless of race and social class. Indeed MENSA, the high IQ society, still uses a test developed over 70 years ago to be "culture fair" (Cattell, 1949), although it is not really culture-fair. No test is, because taking a test itself is a cultural act. This test was an attempt to measure cognitive abilities devoid of sociocultural and environmental influences. This, of course, is highly contested, as this volume suggests. Many would argue passionately that social class and culture have a huge impact on educational opportunities and general socialization, which would influence how people approach and succeed in standard, Western-based, timed tests. The skills required to survive and thrive in one society are clearly very different from one another. In this sense, this orthodox view is misleading.

In other words, this standard view suggests that intelligence is a fixed entity, conceptually represented by *g* and its subfactors, or by IQ, and operationalized by conventional intelligence tests. Further, intelligence is static—fixed across time and culture. Thus, although intelligence tests may need to be modified over time and place, the basic nature of intelligence does not change. The view is not fully adequate, but has generated a great deal of theory and assessment. In the end, no one view, at least currently, is "fully adequate" to explain and measure the clearly complex concept of intelligence.

Work psychologists argue that the single best predictor of success in complex, changing managerial jobs is intelligence. Brighter people learn faster, they have a greater store of knowledge, and they often tend to be intellectually more self-confident. They analyze problems more efficiently. Often, they are more open to new experiences. Moreover, the experts on selection argue that tests are useful, cheap, fast, easy, versatile, scorable, and understandable (Gatewood et al., 2015).

Dilchert (2018) wrote: "*It is the responsibility of IWO* [industrial, work, and organizational] *psychologists to make such evidence available and help organizations make the most responsible decision in a given context. Cognitive ability tests are among the most powerful weapons in the IWO psychology arsenal. The analogy might be crude, but it is apt. We must weigh a variety of factors regarding their deployment: effectiveness, efficiency, and consequences (including applicant reactions and workforce diversity). However, we must also consider the consequences of not deploying a reliable and valid predictor tool at our disposal—including reduced objectivity, lowered productivity, and insufficient societal benefit—especially when resources to be distributed (educational opportunities, jobs) are scarce*" (p268).

However, it is possible to argue that this is a very white, privileged-class view. How much are test scores influenced by growing up in Appalachia or inner-city Newark, NJ; rural Romania versus inner London? The experience of actually trying to assess people in different cultures and different experience is salutary and will be discussed later.

There are, however, a large number of scholars who strongly challenge these assumptions. There are those who write about culture and intelligence (Berry, 1974; Serpell, 2000) who have data from many very different countries that demonstrate how the concept of intelligence and its appropriate assessment are time- and culture-bound.

Change in Intelligence

The Flynn effect—a worldwide increase of 30 points of IQ during the twentieth century—has caused a great debate as to why intelligence levels have been rising (Flynn, 2010, 2012; Trahan et al., 2014). Many of the arguments are contextual. Furnham (2008) summarized various ideas to account for the Flynn effect.

Education: In most countries, with every generation, people are spending longer at school and with better facilities. Schooling is compulsory and people from all backgrounds are used to learning and being tested. Intelligence is related to learning so as education is better and more widespread, scores get higher. This of course differs from country to country: hence strong context effects. These ideas are reviewed by Baker et al. (2015).

Nutrition: People are now, at least in the developed world, better nourished, particularly in childhood, which reduces the incidence of "backwardness" in the population. There are fewer people who have poor nutrition in youth, so the bottom end of the distribution is removed. This means the IQ scores are linked to the calorie counts. This issue has been discussed by Bratsberg and Rogeberg (2018).

Social trends: In the West, people are all now much more used to timed tests and performing against the clock. People are familiar with tests and testing and so do better overall. The experience of test-taking, however, is not true in many developing countries.

Parental Involvement: The idea is that parents provide richer home environments for their children and express a greater interest in their education than they used to. They have higher expectations and get involved more. The trend, but only in developed countries, is to have smaller families where parents invest more in their children may also be an important factor.

Social Environment: The world is more complex and stimulating. Modernization and new technology mean people have to manipulate abstract concepts more, as well as speedily process and store information which is essentially what traditional intelligence tests often measure. However, this inevitably differs dramatically from country to country (compare China, Chile, Cuba, and Cambodia), and may in part explain national differences when they occur.

"Experts" and the Public

But what do lay people think? And what evidence is there to suppose the experts (at least some of them) are right? There have also been a number of studies on lay theories of intelligence. What has surprised some academic researchers on intelligence is the difference between their assumptions and beliefs and those of "laypeople." There are a number of early studies on this topic (Wellman, 1944) and now an extensive, but scattered, literature on myths and misunderstandings about intelligence (Räty, 2015; Räty et al., 1993).

Sternberg (1985, 1990) proposed that the general population has a different conception, or different implicit theories, of intelligence from most experts. That is, "what psychologists study corresponds to only part of what people mean by intelligence in our [Western] society, which includes a lot more than IQ test measures" (Sternberg et al., 1981, p35). Sternberg (1996), in fact, wrote a paper entitled "Myths, Countermyths and Truths about Intelligence" in response to the reactions to "Bell Curve." He discussed various questions such as, "Can intelligence be taught to any meaningful degree?" and "Do intelligence tests measure pretty much all it takes for success in school and on the job?"

Over the years there has also been a particular interest in cross-cultural studies of lay, or implicit theories of intelligence (Beyaztaş-İlhan & Hymer, 2018; Yamazaki & Kumar, 2013) as well as studies of particular groups, such as gifted children, and of experts (Rindermann et al., 2017). In one cross-cultural study, Swami et al. (2008) asked students from three countries to rate 30 items for agreement about the nature, measurement, between-group differences, and practical importance of intelligence. This was a 30-item scale derived from a summary of psychological research on intelligence signed by 50 (Western) experts in intelligence and allied fields (reprinted in Gottfredson, 1997). Nearly all the statements were backed by these scientific experts, though a significant number of world-renowned experts disagreed with many of the statements, which they considered misleading. An example of some items were: “IQ is strongly related, probably more so than any other single measurable human trait, to many important educational, occupational, economic and social outcomes,” “Intelligence can be measured and intelligence tests measure it well,” “While there are different types of intelligence tests, they all measure the same intelligence,” “Intelligence tests are among the most accurate (in technical terms, reliable and valid) of all psychological tests and assessments.” Again, it should be stressed that this is not a universal view, with a number of contributors to this volume disagreeing vociferously.

An exploratory factor analysis revealed three factors: (1) stability, reliability, and validity of intelligence tests, (2) practical importance of intelligence, and (3) origin and stability of within-group intelligence (i.e., why there are differences in the same group like all men) (Swami et al., 2008). They found their participants agreed strongly with general statements about intelligence being a broad and deep mental capability but the participants appeared to disagree most strongly with items that suggested between-group differences in intelligence and those that suggested that intelligence tests were valid and reliable. In short, they disagreed with many, but by no means all, experts in the field.

Recently, Warne and Burton (2020) devised 85 questions about intelligence and classified the questions into seven groups: (1) existence of intelligence, (2) components of intelligence, (3) biology of intelligence and life outcomes, (4) education and intelligence, (5) interventions to permanently raise IQ, (6) group differences, and (7) plausible causes of group differences. These were supposedly based on the academic literature, though it must be stressed that many are debatable.

They compared American teachers and non-teachers and found participants’ responses were generally aligned with research findings regarding the components of intelligence. There was, however, disagreement regarding the broader sense of what intelligence is and what IQ scores represent, yet great confidence in the impact of interventions to raise

IQ. The authors concluded that empirically unsupported beliefs about intelligence were widespread and that people are generally unaware of many of the empirically supported findings from intelligence research. They also noted that one consequence is what the researchers believed to be erroneous beliefs about intelligence, which could result in decreased support for gifted programs, unrealistic expectations for interventions, or incomplete/inaccurate theories of giftedness.

In a recent book, Warne (2020) outlined 35 alleged "myths" about intelligence. Again, many established researchers in the field disagree passionately that they are well expressed or should be called myths. Furnham and Horne (2021) recently tested a number of lay people on Warne's list. They indicated whether they thought each statement was definitely or probably true or false, or whether they did not know. This followed the work of those interested in alleged psychological myths, as documented by Lilienfeld et al. (2010) and tested by Furnham and Hughes (2014).

The results are shown in Table 10.1.

Six statements (1, 11, 12, 23, 34, 35) showed that a majority believe the statement was probably false, which according to the psychometrically orthodox view is correct. These referred to the genetic components of intelligence, as well as to the social consequences of intelligence research, which may please some of those working in the field. In fact, the average total score of "definitely" plus "probably false" was 12.48 (12/35 items), almost exactly a third of the statements.

Many of the items that were thought of as true (namely, supposedly myth-endorsing) concerned IQ testing (2, 7, 8, 9, 22, 27). There also remains the widespread belief that tests are neither reliable nor valid, despite the fact that many psychometricians argue the intelligence tests are amongst the most robust and useful in the whole of psychology (Eysenck, 1998; Furnham, 2021). Study after study show the same thing: people do not trust tests. They are seen as being too narrow; to favor those with education and privilege rather than "actual" intelligence; and to measure something that is not that important.

One statement that attracted a high level of "don't know" responses and a wide spread of reactions was statement 10, which maintained that tests were/are biased against minority groups. There was also evidence that the participants accept the multiple/emotional/practical intelligences

Table 10.1 Frequencies of each answer across Intelligence Myth items. Total *N* = 275

	Definitely False	Probably False	Probably True	Definitely True	Don't Know
1. Intelligence is whatever collection of tasks a psychologist puts on a test	(28%)	**(31%)**	(25%)	(7%)	(8%)
2. Intelligence is too complex to summarize with one number	(1%)	(7%)	(26%)	**(64%)**	(2%)
3. IQ does not relate/ correspond to brain anatomy or functioning	(5%)	(22%)	**(36%)**	(25%)	(13%)
4. Westernized views on intelligences are not relevant in non-Western cultures	**(34%)**	(24%)	(18%)	(7%)	(16%)
5. There are multiple intelligences in the human mind	(1%)	(6%)	(27%)	**(63%)**	(4%)
6. Practical intelligence is a real ability separate from general intelligence	(1%)	(8%)	**(42%)**	(37%)	(12%)
7. Measuring intelligence is difficult	(4%)	(8%)	(25%)	**(60%)**	(4%)
8. Content on intelligence tests is trivial and cannot measure intelligence	(2%)	(25%)	**(40%)**	(22%)	(12%)
9. Intelligence tests are imperfect and cannot be used or trusted	(2%)	(26%)	**(41%)**	(21%)	(9%)
10. Intelligence tests are biased against ethnic minorities/diverse publications	(22%)	(23%)	(19%)	(12%)	**(24%)**
11. IQ only reflects a person's wealth and social status	**(43%)**	(31%)	(14%)	(4%)	(8%)
12. Intelligence's strong genetic links (through heredity) mean that raising IQ is impossible	(24%)	**(36%)**	(18%)	(8%)	(14%)

(*continued*)

Table 10.1 (continued)

	Definitely False	Probably False	Probably True	Definitely True	Don't Know
13. Genes are not important for determining intelligence	(18%)	**(41%)**	(24%)	(8%)	(8%)
14. Environmentally driven changes in IQ mean that intelligence is changeable/malleable	(1%)	(12%)	**(46%)**	(23%)	(17%)
15. Social interventions can drastically raise IQ	(2%)	(16%)	**(46%)**	(19%)	(17%)
16. Brain training programs can raise IQ	(2%)	(9%)	**(50%)**	(27%)	(11%)
17. Improvability of IQ means intelligence can be equalized	(4%)	(21%)	**(38%)**	(11%)	(27%)
18. Every child is gifted	(13%)	(24%)	**(26%)**	(25%)	(11%)
19. Effective schools can make every child perform well/proficient academically	(6%)	(20%)	**(47%)**	(25%)	(4%)
20. A pupil's environment and personality have powerful effects on academic achievement	(0%)	(7%)	(32%)	**(56%)**	(5%)
21. Admissions tests are a barrier to college for underrepresented students	(5%)	(16%)	**(44%)**	(21%)	(13%)
22. IQ scores only measure how good someone is at taking intelligence tests	(3%)	(15%)	**(40%)**	(33%)	(9%)
23. Intelligence is not important in the workplace	(30%)	**(41%)**	(17%)	(7%)	(4%)
24. Intelligence tests are designed to create or maintain a current power system	(17%)	(23%)	**(27%)**	(10%)	(24%)

(*continued*)

Table 10.1 (continued)

	Definitely False	Probably False	Probably True	Definitely True	Don't Know
25. Very high intelligence is not more beneficial than moderately high intelligence	7%)	(24%)	**(39%)**	(17%)	(13%)
26. Emotional intelligence is a real ability that is helpful in life	(1%)	(7%)	(26%)	**(59%)**	(7%)
27. IQ scores are distributed evenly between men and women	(7%)	(20%)	**(28%)**	(16%)	(28%)
28. Racial/Ethnic group IQ differences are completely environmental in origin	(8%)	(22%)	**(30%)**	(11%)	(29%)
29. Unique influences operate on one group's intelligence test scores	(1%)	(16%)	**(40%)**	(9%)	(33%)
30. Stereotype threat explains score gaps among demographic groups	(6%)	(17%)	**(35%)**	(12%)	(29%)
31. Controversial or unpopular ideas should be held to a higher standard of evidence	(8%)	(19%)	**(40%)**	(12%)	(21%)
32. Past controversies taint modern research on intelligence	(5%)	(18%)	**(41%)**	(14%)	(22%)
33. Intelligence research leads to negative social policies	(12%)	**(29%)**	(24%)	(11%)	(24%)
34. Intelligence research undermines the fight against inequality	(14%)	**(28%)**	(23%)	(9%)	(26%)
35. Everyone is about as smart as I am	(26%)	(25%)	**(26%)**	(8%)	(15%)

Numbers in bold represent the highest number of responses in that category model (items 5, 6, 26). Around two thirds rejected the concept of "g" being a parsimonious and accurate summary variable, although they accept the fact that measurement is difficult. Two statements accepted as "probably" or "definitely true" were 5 (90%) and 26 (85%), both of which referred to multiple (emotional) intelligences, which has excited great debate among intelligence researchers for over 20 years.

Most of all, they appear to embrace Dweck's growth model, which suggests you can increase your intelligence by a variety of interventions (items 14 to 19) (Dweck, 2006). This is a very complex concept, namely, whether intelligence changes over time (i.e., through childhood and adulthood) and, if so, what can cause it to increase. It seems that many people want to, and do, believe in the "plastic" rather than in the "plaster" hypothesis about change, namely, that it is possible to actually raise/increase intelligence (as opposed to simply getting higher IQ test scores). It is not certain this refers to fluid as opposed to crystallized intelligence, which is important, as some experts would suggest it is easier to raise the latter as opposed to the former type of intelligence (Furnham, 2021). Also, we know that fluid intelligence changes a lot over age, peaking in the twenties and thirties and showing dramatic decline after the age of 60 (Deary, 2001).

However, as Furnham and Horne (2021) note: "*There remains, however, one very serious issue: namely that the statements are rated as 'false' by Warne as there is no necessary agreement about this, even from experts. It is possible that academics, in some disciplines, actively promote these falsehoods (both in their courses and publications) as if there was incontrovertible evidence to that effect. That is, some myths and misconceptions cannot be an either/or proposition:* i.e., *some myths are only partially false. As regards the myths in this study it may be that many experts would want to caveat many of them with suggestions as to more specific context in which they apply. Further, it could be that many participants were not familiar with a number of issues yet loath to report 'Don't know'. Similarly, some of the items were also nearly tautological like item 21.*"

The results of this study, indeed, like many others in this area, pose the question as to why the public and the more orthodox experts disagree. There have been over the years many "popular" books written by academic psychologists trying to explain the theories and data on intelligence, particularly, nature-nurture and group differences (particularly race and sex) (Deary, 2001; Plomin, 2018; Ritchie, 2015). Many of them tend to underplay the role of culture, context, and history, favoring a biological and universalist perspective. Some would argue that on many, though not all of these concepts, lay people are essentially correct, given a wider definition of the concept of everyday intelligence.

Indeed, it is important to state some important caveats about experts. First, experts disagree among themselves. Second, that their classic psychometric view is not necessarily the "correct" view. There are disagreements as to whether there even is a correct view. Third, ideas and opinions about intelligence change, as new data is obtained and processed.

Fairness and Accuracy

How accurate and fair are tests? Are they only accurate in the culture in which they were created? Is the use of them fair? Testing is a very "hot" issue, as demonstrated by the increasing number of court-cases where they are cited (Gatewood et al., 2015).

There is a considerable literature on the perception of test accuracy, which includes IQ tests. Many have been interested primarily in applicants' fairness perceptions of different selection methods (Truxillo et al., 2006), including cognitive ability tests (Chan et al., 1997). Results consistently indicate that applicants tend to favor, and rate as fair, work samples and interviews over paper-and-pencil test methods (Nikolaou & Judge, 2007). Further, cross-cultural replications (Moscoso & Salgado, 2004) demonstrated that applicants universally rate work-sample methods and interviews as the fairest types of selection methods.

Fairness perceptions of selection methods do have an impact on various outcomes, including applicant self-efficacy and self-esteem, job-acceptance intentions, motivation to pursue employment, likelihood of recommending the organization to friends, and test-taking motivation (Sanchez et al., 2000).

In one illustrative study, Furnham and Chamorro-Premuzic (2010) asked students to rate the *Fairness and Accuracy Perceptions* of 17 different selection methods, indicating how well they thought each method assessed eight different characteristics which universities seek in potential students (bright, conscientious, mature, co-operative, initiative, community service, work experience, and communication skills). For example, participants rated how accurately a face-to-face interview measured brightness, conscientiousness, maturity, etc. A 9-point Likert type scale, ranging from 1 being "extremely accurate" to 9 being "extremely inaccurate," was used. They made two ratings, one for fairness and the other for accuracy.

The results are shown in Tables 10.2 and 10.3. Three things are of interest. The *first* is the close relationship between the two ratings; people certainly believe that what is accurate is fair; in the sense that if tests provide accurate scores of abilities, they *may* be fairly used in assessment. *Second,* the relatively small standard deviation shows considerable agreement between the participants. Third, intelligence tests were rated very low on both criteria. Participants think tests of power are *relatively unfair and inaccurate* while tests of preference are fair. This again illustrates the widespread and long-lasting distrust of the validity of intelligence tests among the general public. This view, of course, is contrary to that of those who create and utilize the tests (Furnham, 2008).

Table 10.2 Descriptive statistics and Cronbach's alphas for all assessment methods—accuracy

Selection method	Cronbach's alphas	*M*	SD
Face-to-face interview	0.79	25.69	8.65
Outdoor leadership exercise	0.76	26.59	9.34
References	0.89	27.43	11.7
Panel interview	0.80	27.64	8.91
Observed group discussion	0.78	28.62	8.56
Oral presentation	0.78	30.78	9.11
Personality test	0.68	32.93	8.21
Telephone interview	0.87	33.77	10.94
Video	0.82	34.54	10.43
Exam condition essay	0.79	35.17	10.39
Situation exam	0.83	35.54	10.78
Assessment center	0.87	36.45	10.97
Unseen course-related exam	0.84	36.45	10.31
Application form	0.86	38.46	12.89
General knowledge test	0.86	42.60	11.81
Intelligence test	0.83	44.08	11.11
Drugs test	0.92	52.17	15.84

Scale: Most accurate 8–Least accurate 72
Note: 10*N* ranges from 185–322

Table 10.3 Descriptive statistics and Cronbach's alphas for all assessment methods—fairness

Selection method	Cronbach's alphas	*M*	SD
Face-to-face interview	0.88	33.28	12.97
Outdoor leadership task	0.76	30.66	10.38
References	0.90	27.49	12.34
Panel interview	0.83	30.18	10.78
Discussion	0.81	30.65	9.84
Oral presentation	0.85	32.26	11.09
Personality test	0.87	35.30	12.03
Telephone interview	0.87	34.93	11.88
Video	0.84	35.37	11.09
Essay	0.85	35.89	11.76
Situation exam	0.88	36.86	12.63
Assessment center	0.89	38.74	12.82
Unseen course-related exam	0.86	42.04	12.53
Application form	0.88	37.42	14.17
General knowledge test	0.90	42.94	13.99
Intelligence test	0.88	43.28	12.97
Drugs test	0.93	54.08	15.89

Scale: Most fair 8–Least fair 72

This area of research on the perceived accuracy of assessment techniques reveals again the gap between many (but by no means all) academic experts and the lay public with regard to IQ tests. The question is the cause. Some academics would say it is the result of ignorance (most people have not seen or understood the data) or that laypeople are being defensive, particularly those who do not score highly. This view, of course, may be seen as condescending and patronizing. That is, the results shown in Table 10.2 and 10.3 may be simply wrong. Lay people may respond by saying that this data is based on their personal experience. This is an important issue that will not go away.

Everyday Tests and Playing Games

But what is, and is not, a marker of intelligence that could be considered an intelligence test? Many people complete intelligence-type tests everyday: crosswords, Sudoku, etc. Many daily newspapers have a page dedicated to quizzes and games, which editors know are popular with readers. Some people literally become addicted to these tests and form clubs and take part in competitions. Are these really intelligence tests? Is Sudoku simply a test of fluid intelligence and crosswords of crystallized intelligence? Do you get much better with practice? Or is it only the talented who get obsessed? Why are some cultures more “addicted” to some games rather than to others?

Others play games like Bridge, Chess, Scrabble, etc., which have been popular for years and are intellectually demanding. Are they essentially intelligence tests? The question is what is, and what is not an intelligence test in the sense that scores correlate with psychometric tests. Or is that both a deeply conservative and misguided view, if the current tests are themselves inaccurate and invalid?

It has been suggested for many years that “strategic games are an invariant expression of certain universal intellectual traits” (Spitz, 1978). Researchers have suggested that various games and tasks, not formally described as intelligence tests, are actually very good measures of intelligence. Ideally, these measures should be simple, robust, and culturally valid, because they may differ across cultures. The question remains however: does being good at cross-words or Sudoku mean you have “street-smarts” and make wise decisions for yourself and others?

Thus, a test of proofreading has been found to be good substitute for measures for intelligence (Furnham, 2010), whereby participants are tasked to correct errors on a page as quickly and accurately as possible. Indeed, there has been a great deal of interest in the development of new tests to measure both intelligence and personality (Ihsan & Furnham, 2018).

Some researchers have suggested that many computer games that exist, but were designed primarily as entertainment, could serve as an excellent proxy for intelligence tests, as they often measure efficiency of information processing (Foroughi et al., 2016; Gnambs & Appel, 2017). They may offer more accurate results because people respond differently when asked to play a game rather than take a test. The latter usually sounds more complex, serious, and therefore anxiety-provoking, and this provocation of anxiety may have potentially serious consequences; this could induce test anxiety and lower performance (Furnham, 2008). On the other hand, it is also possible that if a task is described as a game, the participant may not fully engage their abilities, and thus not show their full abilities. The issue is the effect on motivation and performance when a cognitive ability task/test is described as a game or a test or something else.

There has been growing interest in the prospective functions of games aside from entertainment, such as their instructional value (Garris et al., 2002), clinical applications (Griffiths, 1997), and how they can contribute to the understanding of cognitive capacity, plasticity, and other processes (Boot, 2015). The Learning Strategies Programme developed a video game that has been used as a research tool, designed to involve skills such as attention, memory, and multi-tasking (Mané & Donchin, 1989). Sajjadi et al. (2017) have provided evidence for the mapping between dimensions of Gardner's Multiple Intelligences and game mechanics, suggesting that games can be designed using empirical data to suit players with certain abilities and inclinations.

Furthermore, games have the advantage of eliciting greater engagement and intrinsic motivation to perform. Hoffman and Nadelson (2010) found that greater motivational engagement in gaming was partly influenced by more positive responses to failure, particularly in multiple-level games that become increasingly complex and challenging as the player progresses.

A number of recent studies have demonstrated how good computer games are at measuring general intelligence. Quiroga et al. (2015) reported extremely high correlations (r = 0.93) between latent factors from video games and intelligence on a range of different tests. Foroughi et al. (2016) reported correlations of r = 0.65 (N = 35) between a video game and the Ravens Progressive matrices, and r = 0.78 (N = 100) between the video game and latent variable measuring of fluid intelligence. They concluded that it is feasible to create measures of fluid intelligence using their test. Sin and Furnham (2018) got 112 participants to complete a standardized intelligence test along with one spatial and one verbal game to determine the relationship between cognitive ability and game performance. Both games were significant correlates of intelligence, though differences were found in the strength of correlations and contribution of other factors between the two tasks.

The two game tasks chosen were vastly different in terms of the specific skills required for each, yet both tasks correlated with intelligence.

Nevertheless, the results confirm previous findings in that game performance can be a reliable predictor of fluid intelligence.

Of course, there are at least two interpretations of these results. The first is that video games are a good measure of intelligence. The other is that intelligence tests are, as some investigators have suggested (e.g., Sternberg, 1997), measures of a certain kind of game-playing—that the people who are good at them are people who are good at playing games, but maybe not as much else as one might have hoped.

The relationship between game performance and cognitive ability has meaningful implications, both for the understanding of cognitive ability and the value of games. The possibility of using games as a measure goes beyond measuring intelligence and increasing engagement, but also as a dynamic method of assessment that allows greater insight into one's problem-solving strategies, situational behavior, and ability to adapt to novel situations. Granic et al. (2014) argued that video games are becoming increasingly sophisticated and serve functions beyond entertainment. If games can improve existing skills, it is plausible that they could also serve as a measure of such skills and other latent factors. Furthermore, it could be worth making the distinction between describing and guessing ability, as they can be considered two distinguishable tasks.

Would the participants have played the games differently had they known they were being tested? In this study, participants were given no explicit information that the games were a measure of ability, though they were aware that their performance was being measured. However, the adaptation of games in institutional settings may risk violating the voluntary, playful element of games which are central to their engagement, a tension that has also been identified by other researchers of the serious functions of games.

The more important question is not how well the games measure intelligence, but how well they predict outcomes that are relevant to the selection criteria. Future research should also consider the effectiveness of games through its relationship to other more salient outcomes, including occupation-specific performance indicators, using longitudinal designs. Instead of simply examining whether game performance predicts intelligence, we can then examine whether game performance can predict relevant outcomes even better than intelligence can.

Yet, some still argue that this whole enterprise is biased and misleading because all the new tests are validated against current intelligence tests, which themselves are flawed. We need to start again with a much more inclusive definition of intelligence.

Conclusion

Of all the topics in psychology, intelligence is one of the hottest, particularly if group (gender, culture, age) differences are considered as well as the nature-nurture issue. Yet there are a growing band of researchers who take a different view, more aligned with what lay people think.

Few, if anyone, would deny the importance of being intelligent (bright, smart). After all, life is an IQ test, though in the broadest sense. Equally people know from personal experience that it might be necessary, but far from sufficient, to guarantee health, happiness, and success in life. As a consequence, most people take a wider view of intelligence than the sort that most tests measure. Many are skeptical, indeed cynical, about tests because their face validity seems not to match up to their understanding of what intelligence means. But in a rapidly developing world the way in which we store and access knowledge has changed and we need new ways to assess how best to thrive in this world. It will be interesting to see whether new and culturally sensitive intelligence tests will be proven to be both valid and reliable and whether, indeed, people who take them have more faith in their accuracy.

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11

A Contextual Approach to Research on Intelligence and Complex Task Performance

David Z. Hambrick

Over a century of research has convincingly established that scores on standardized tests of intelligence meaningfully predict certain real-world outcomes. This includes measures that reflect *complex task performance*—performance in tasks involving higher-level cognitive functions such as problem solving, decision making, and reasoning. Job performance is a case in point. As established in meta-analyses involving hundreds of studies, scores on tests like the Armed Services Vocational Aptitude Battery and the General Aptitude Test Battery positively predict job performance. Correlations between scores on such tests and job performance average around 0.30, and around 0.50 after correction for downward bias due to measurement error and range restriction (Salgado & Moscoso, 2019; Schmidt & Hunter, 2004). Measures of intelligence are even stronger predictors of academic performance (Deary et al., 2007).

There is no universally agreed-upon definition of *intelligence*. However, most definitions include the *ability to solve novel problems* and the *ability to learn from experience* as core characteristics (Detterman & Sternberg,

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1986; Gottfredson, 1997; Thorndike, 1921). Accordingly, intelligence is typically measured with problem-solving tests where the content and items are assumed to be relatively unfamiliar to all test takers, as well as tests designed to measure knowledge and skills acquired through experience. The most famous example of the former type of test is Raven's Progressive Matrices (Raven et al., 1998). Each Raven's item consists of series of geometric patterns; the test taker's job is to choose a pattern that logically completes the series. Examples of tests of acquired knowledge are vocabulary and general information tests. Intelligence test batteries ("IQ tests") such as the Stanford-Binet Intelligence Scales and the Wechsler Adult Intelligence Scale include multiple subtests to measure these two types of cognitive ability (see Hunt, 2010).

Critics of standardized tests have argued that correlations between scores on intelligence tests and real-world outcomes are too small to matter. For example, a correlation of 0.30 might be dismissed on the grounds that it indicates intelligence explains "only" 9% of the variance on the outcome. To be sure, what value of a correlation is *practically significant*—large enough to matter for applied purposes—depends on the situation. However, small effect sizes can translate into large practical effects. This point was made long ago by Taylor and Russell (1939), who noted that interpreting the practical importance of correlation coefficients based on methods involving r^2

> has led to some unwarranted pessimism on the part of many persons concerning the practical usefulness in an employment situation of validity coefficients in the range of those usually obtained. We believe that it may be of value to point out the very considerable improvement in selection efficiency which may be obtained with small correlation coefficients. (p. 571)

This point can be illustrated with a hypothetical *utility analysis* using a set of tables published by Taylor and Russell (1939), which are still consulted by organizational psychologists. Assume that the Acme International receives 1000 applications for 100 data analyst positions, and 90% of employees currently in the job perform at a satisfactory level. In more technical terms, the *selection ratio* is 0.10 and the *base rate* is 0.90. Furthermore, assume that Acme plans to use an intelligence test with established validity of 0.30 to screen applicants. Per the Taylor-Russell tables, an estimated 95% of new employees will perform at a satisfactory level—an improvement of 5% over the base rate. Now, however, assume that the selection ratio is 0.10 but the base rate is 0.50, meaning that only 50% of employees perform at a satisfactory level. In this situation, selection based on scores on the test with validity of 0.30 will increase the expected pass rate to 64%—an improvement of 14%. Depending on the cost of replacing or retraining an under-performing employee, savings to Acme International could be enormous. The benefits of selection based on intelligence test scores must be weighed against costs, and especially potential adverse impact. However, as this example illustrates, relatively small effect sizes can, under some if not all circumstances, translate into large practical effects.

Critics of standardized tests have further argued that intelligence tests capture nothing important, or at most skills useful only in the classroom. This view has been expressed both in popular media and in the scientific literature, especially in relation to college admissions tests, which Gardner (1999) characterized as "thinly disguised intelligence tests" (p. 69). Standardized testing critic Joseph Soares (2011) asked, "Are the best and the brightest the ones who can check off the most correct boxes on a standardized multiple-choice exam? Or do we need other ways of measuring ability and promise?" (p. 1). And in a recent *New Yorker* article (Lemann, 2021), Pomona College president Gabrielle Starr was quoted as stating, "I do not believe in those tests as predictive." The argument that scores on standardized intelligence tests are essentially meaningless—or "just a number"—is contradicted by scientific evidence. Some of the most compelling evidence comes from the field of *cognitive epidemiology*, which focuses on the link between intelligence and health outcomes. Drawing on data from the Scottish Mental Surveys, Ian Deary and colleagues have established in large samples that intelligence test scores (IQ) from childhood predict longevity (see Deary & Whalley, 2001). People who do well on intelligence tests early in life tend to live substantially longer lives and to be healthier than people who do less well. This finding has been replicated in numerous longitudinal studies (see Calvin et al., 2011), and holds even after controlling for various indices of socioeconomic status (Hart et al., 2003). It is still unclear what, exactly, accounts for this relationship. Although the

IQ-longevity relationship has been found to remain significant after controlling for socioeconomic (SES) status, differential opportunity is one possible explanation: a score on an intelligence test is a proxy for advantages that translate into a longer, healthier life, beyond what is captured by relatively coarse indicators of SES (e.g., parental income). However, even if this is true, it is possible that the psychological trait that intelligence tests capture is a *cause* (rather than a consequence) of such advantages. Along these lines, Deary and colleagues have hypothesized that life is a problem-solving task on grand scale, and that more intelligent people make better decisions about their health and more readily acquire health-relevant knowledge than less intelligent people do. Consistent with this possibility, in the Scottish data, there was no relationship between IQ and smoking behavior in the 1930s and 1940s, when the health risks of smoking were unknown, but after that, people with higher IQs were more likely to quit smoking (Gottfredson & Deary, 2004).

A person's score on an intelligence test does not determine how they will perform in real-world settings. A test score is prediction, not a prophecy. However, a person's score on an intelligence test does provide information about the level of cognitive skills that have an influence on success in certain real-world settings.

Context and Intelligence

To sum up, scores on intelligence tests (1) meaningfully predict outcomes reflecting complex task performance, and (2) capture skills that are important in some real-world situations, and particularly those that require cognitive skills of the type acquired through formal schooling in industrialized countries (e.g., mathematics, formal reasoning). Nevertheless, in two ways, research on intelligence has often been conducted in a largely *acontextual* fashion, where I use *context* to refer to the myriad factors *other than intelligence* that could influence outcomes of interest.

First, most studies focusing on the role of intelligence in complex task performance focuses *only* on intelligence, ignoring other individual difference characteristics. The issue here is that no measure of intelligence can reasonably be expected to explain all, nearly all, or even most of the variance in the outcomes it predicts. Furthermore, and related, the relationship between a measure of intelligence and an outcome may vary depending on the level of other factors that predict that outcome.

Second, research on intelligence has been acontextual is that it has largely ignored the environment in which outcomes it predicts occur. The relative importance of intelligence may change based on various features of the environment. For example, whether a measure of intelligence will predict success in a particular job depends on whether external support is provided in the job environment. Take the job of cashier. If the job requires the cashier to count change back to the customer, then a measure of arithmetic reasoning will likely predict job performance, at least initially. On the other hand, if the cashier is only expected to read the amount of change due on a register display and hand that amount back to the customer, then there is no good reason to think that a measure of arithmetic reasoning will predict job performance.

The consequence of ignoring context in research on intelligence is twofold. First, theoretical understanding of the role of intelligence in complex task performance is necessarily incomplete. The situation is not unlike if evolutionary biologists tried to understand characteristics of different animals (their markings, etc.) ignoring the varied environments in which those creatures live. Ideally, a theory of intelligence should capture how cognitive functions that intelligence comprises are used in different environments. Second, from an applied perspective, prediction of performance using measures of intelligence is limited. As the cashier example illustrates, maximum prediction can be achieved only if the measure of intelligence is appropriate for the outcome.

In this chapter, expanding on ideas first presented in a chapter by Hambrick et al. (2020), I sketch out a contextual view of intelligence that distinguishes between the *person* and the *environment*. The person encompasses traits, states, and other characteristics that exist within individuals, including intelligence, but also personality, motivation, emotions, attitudes, preferences, and so on. The environment encompasses the "habitats" in which behavior occurs, such as the workplace and the classroom. My goal is to discuss intelligence in terms of the relationship between person and environment, and to offer examples of intelligence research that takes this perspective.

The Person

Historically, one of the major goals of psychometric research on intelligence has been to investigate relationships among measures of cognitive ability and their organization in a “nomological network” of statistical factors (Carroll, 1993). A widely replicated finding from this research is that there is a general factor of intelligence, or psychometric *g*. First documented by Spearman (1904), *g* reflects the fact that scores on tests of cognitive ability correlate positively and moderately with each other (Jensen, 1999). In other words, a person who does well relative to other test takers on one test of cognitive ability—say a test of arithmetic reasoning—will also tend to do well on tests of most other cognitive abilities. In more technical terms, when the scores on the tests are entered into a factor analysis, the first factor loads positively on all the tests, and the first factor accounts for a much larger proportion of the variance than any other factors.

Given a reasonably large and diverse sample of participants, *g* nearly always emerges. This is one of, if not the, most widely replicated findings in the field of psychology. However, *g* is not all there is to human intelligence. While all measures of cognitive ability tend to correlate positively with each other, measures of certain abilities correlate more highly with each other than with measures of other abilities, giving rise to “group” factors. There are two major group factors. The first is for tests of reasoning, memory, spatial visualization, problem solving, and so on that measure the efficiency and effectiveness of cognition at the time of assessment. The second factor is for tests that reflect knowledge and skills acquired in the past. Cattell (1943) labeled these group factors *fluid ability* (Gf) and *crystallized ability* (Gc). “Fluid ability,” he explained, “has the character of a purely general ability to discriminate and perceive relations between any fundaments, new or old,” whereas “[c]rystallized ability consists of discriminatory habits long established in a particular field, originally through the operation of fluid ability, but not [sic] longer requiring insightful perception for their successful operation” (Cattell, 1943, p. 178). Other theorists have distinguished between *Intelligence A* and *Intelligence B* (Hebb, 1942), *cognitive mechanics* and *cognitive pragmatics* (Baltes, 1987), and *intelligence-as-process* and *intelligence-as-product* (Ackerman, 1996). These alternative terms describe similar, if not identical, constructs to Gf and Gc. For example, Ackerman's intelligence-as-product is broader than Gc, including not only general cultural knowledge, but knowledge across diverse domains (science, arts, technology, etc.).

Decades of factor-analytic research support the distinction between Gf and Gc. Gf loadings are highest for nonverbal reasoning measures such as Raven's, while Gc loadings are highest for measures reflecting acculturated learning, including vocabulary and general information. In a landmark project, Carroll (1993) compiled and reanalyzed the results of over 460 factor-analytic studies and found that cognitive abilities can be arranged into a hierarchy that includes three levels, or "strata." At the highest level of the hierarchy (Stratum I) is *g*, representing what all tests of cognitive ability share. At the next level (Stratum II) are "broad" cognitive abilities. And at the lowest level (Stratum III) are "narrow" cognitive abilities, representing demands unique to particular tests. The Carroll-Horn-Cattell (CHC) model integrates Carroll's three-stratum theory and Cattell and Horn's Gf-Gc theory (Horn & Cattell, 1967). In this model, Gf and Gc are Stratum II abilities, along with other abilities such as *general learning and memory ability* (Gy), *general short-term memory* (Gsm), *general long-term storage and retrieval* (Glr), and *general visual processing* (Gv; see McGrew, 2009). The CHC model is considered a "consensus" model of intelligence in the scientific literature (see McGrew, 2009) although there is still debate about the number and identification of broad cognitive abilities subsumed by *g* (e.g., Johnson & Bouchard, 2005).

The Broader Context

Both *g* and more specific cognitive factors predict certain real-world outcomes to both a statistically and practically significant degree (Hunt, 2010; Ritchie, 2016). However, as already mentioned, this research has seldom simultaneously considered the influence of *other* factors that may influence performance. When a researcher focuses on the effect of a single predictor variable (e.g., intelligence) on an outcome variable (e.g., job performance), the implicit assumption is that the predictor-outcome relationship will be unaffected by the excluded predictor variables, such as personality factors that have been shown to predict the outcome (e.g., conscientiousness). Yet, this assumption may not be justified, on either theoretical or empirical grounds. For example, as we discuss in more detail below, how well a measure of intelligence predicts complex task performance may vary, depending on the individual's expertise in the task.

In our own research, we have focused on the interplay between intelligence and *domain knowledge* in complex task performance. Domain knowledge refers to specialized knowledge acquired through different forms of experience with a particular task (or class of task): the representations, skills, heuristics, and strategies that people bring to bear on the task. Possessing a high level of domain knowledge is a necessary, but not sufficient, condition for demonstrating a high level of expertise in a domain. For example, a person may acquire encyclopedic knowledge of chess strategy (declarative knowledge) by reading books about chess, but if she never actually plays chess, she will almost certainly not play the game at a high level. At the same time, there is no question that a chess player must possess a large amount of knowledge about chess strategy to achieve grandmaster status.

Not surprisingly, domain knowledge explains large amounts of between-person variance in domain-relevant tasks. In a classic study, Chase and Simon (1973) found that chess expertise facilitated recall of actual chess positions but not random configurations of pieces. This skill × structure interaction has been replicated using a wide range of stimuli, including bridge hands (Engle & Bukstel, 1978), architectural plans (Akin, 1980), computer programs (Adelson, 1985), maps (Gilhooly et al., 1988), X-rays (Lesgold et al., 1988), and music (Meinz & Salthouse, 1998), to name just a few examples. Other research has demonstrated the necessity of a long period of *deliberate practice*—training designed specifically to improve performance in a domain—for achieving a high level of expertise (Ericsson et al., 1993).

In our own work, my colleagues and I have found that domain knowledge explains large amounts of variance in performance in various complex tasks. For example, in a study we discuss in more detail later in this chapter, we found that knowledge of esoteric vocabulary accounted for nearly all the variance in number of clues solved in difficult crossword puzzles (Hambrick et al., 1999). As another example, Meinz et al. (2012) found that a measure of poker knowledge accounted for anywhere between 24% and 43% in a sample of poker players' performance on tasks such as evaluating Hold'em hands and remembering plays in games. Simply put, domain knowledge is a major source of "power" in complex task performance (Feigenbaum, 1989), even if it can be an impediment to creative thinking in some situations (Frensch & Sternberg, 1989; Weisberg, 2006).

A specific focus of my research with colleagues has been to investigate the interplay between *working memory capacity* and domain knowledge in complex cognitive tasks. As defined by Baddeley and Hitch (1974), working memory (WM) is a system where information can be simultaneously stored and processed, such as when solving a mental arithmetic problem that involves a carry or integrating information from one sentence to the next when reading a novel. Research on individual differences in working memory capacity took off in the early 1980s with introduction of Daneman and Carpenter's (1980) *reading span*. Designed to measure the trade-off between storage and processing, reading span requires participants to read a series of sentences, judging whether each makes sense, while remembering the final word of each sentence for later recall. Daneman and Carpenter reported high positive correlations between reading span and various measures of language comprehension. Later, Turner and Engle (1986) introduced the *operation span* task (solving math equations while remembering words), and Shah and Miyake (1996) introduced *rotation span*, a visuospatial working memory task (judging whether letters are mirror-imaged while remembering the orientation of each). At the latent level of analysis, working memory capacity correlates highly with *g*, and more particularly, Gf (e.g., Ackerman et al., 2005; Conway et al., 2002; Kane et al., 2004; Kyllonen & Christal, 1990).

The Differential Approach

So, both domain knowledge and working memory capacity explain sizeable proportions of variance in complex task performance. The question my colleagues and I have sought to answer is how best to characterize the interplay between the factors—their joint effects on complex task performance. We have used two methodological approaches to investigate this question. The goal of the *differential approach* is to examine how domain knowledge and working memory interact with each other in the prediction of complex task performance. We have focused specifically on testing what we call the *circumvention-of-limits hypothesis* (Hambrick & Meinz, 2011). This hypothesis holds that as performers acquire domain knowledge through training, it becomes possible to circumvent or "bypass" general constraints on performance such as the limited capacity of working memory. As illustrated in Fig. 11.1, the hypothesis predicts that the effect of working memory capacity on performance is smaller at high levels of domain knowledge than at lower levels (i.e., an under-additive interaction). Alternatively, if domain knowledge is treated as a group variable (i.e., low knowledge vs. high knowledge), then the prediction is a larger correlation between working memory capacity and complex task performance in the low knowledge group than in a high knowledge group.

The circumvention-of-limits hypothesis implies that performance limitations associated with working memory capacity can be overcome through the acquisition of domain knowledge. In our first attempt to test

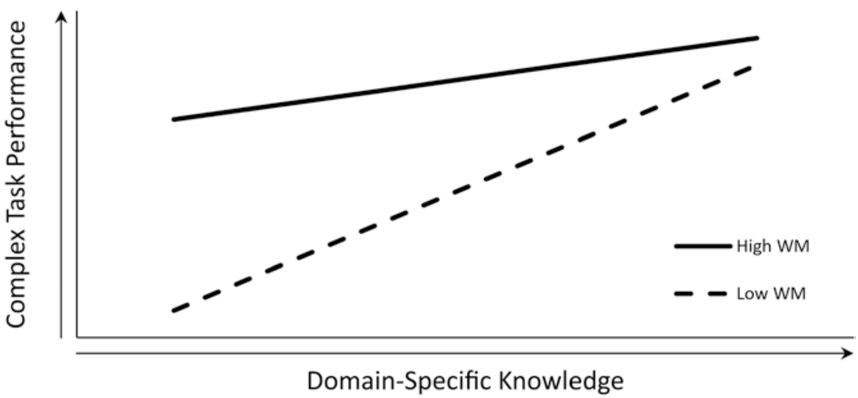

Fig. 11.1 The interaction between working memory (WM) and domain-specific knowledge on complex task performance predicted by the circumvention-of-limits hypothesis. Figure from Hambrick et al. (2020); used with permission of Oxford University Press (to be requested)

this hypothesis, we (Hambrick & Engle, 2002) had participants representing a wide range of knowledge about the game of baseball who listen to and attempt to remember information from fictitious (but realistic sounding) radio broadcasts of baseball games, including the sequence of events in each half-inning (i.e., which bases were occupied after each at-bat), as well as game-relevant details (e.g., the batting averages of the players), and non-game-relevant details (e.g., the size of the crowd). Effects of working memory and baseball knowledge were additive when predicting memory for game sequences, and over-additive when predicting memory for game-relevant details. Thus, there was no evidence that a high level of domain knowledge reduced, much less eliminated, the effect of working memory on memory performance.

More recently, we carried out a systematic review of evidence relevant to the circumvention-of-limits hypothesis (Hambrick et al., 2019), conducting systematic searches for relevant articles in the literature on expertise in six domains (games, music, science, sports, surgery/medicine, and aviation), as well as the literature on job performance. Altogether, we searched approximately 1300 documents. The findings can be summarized briefly. On balance, evidence from the expertise literature does not support the circumvention-of-limits hypothesis. To be exact, 3 of 15 studies provide support for the hypothesis, in the form of either significantly different ability-performance correlations across skill groups or significant cognitive ability × skill interactions on performance. What might be regarded as the strongest evidence comes from one of our own meta-analyses (Burgoyne et al., 2016). We found that the correlation between Gf (as measured by tests of reasoning ability) and chess expertise was significantly higher for less-skilled chess players than for more-skilled players. However, as we urged, this finding must be interpreted cautiously, because the measure of chess skill was highly confounded with age (i.e., the more-skilled players were adults, the less-skilled players were children).

In another recent study, we investigated the circumvention-of-limits hypothesis in the context of job performance (Hambrick et al., 2021). The question was whether the relationship between *g* and job performance varies across different levels of job experience. The dataset included 31 military occupation specialties (MOSs) and a total sample size of 10,088 military personnel representing wide ranges of cognitive ability and job experience. For each job, the measure of *g* was the Armed Services Qualification Test score from the Armed Services Vocational Aptitude Battery and job performance was measured with a hands-on test assessing performance in critical tasks. Effects of *g* and job experience on job performance were positive and generally moderate in magnitude, but the *g* x job experience interaction was statistically significant for only 1 of 31 MOSs. Furthermore, although this interaction was statistically significant in a meta-analysis, it was minuscule, accounting for less than 0.5% of the variance. Overall, there was essentially no evidence to support the circumvention-of-limits hypothesis: the positive effects of *g* and job experience on job performance were additive rather than interactive.

The overall conclusion from the studies just reviewed is that effects of intelligence and domain knowledge/skill on complex task performance are usually independent rather than interactive. This finding might seem like a justification for the acontextual approach in intelligence research—that is, examining intelligence by itself as a predictor of complex task performance. However, this conclusion was not preordained. The results could have just as easily supported the circumvention-of-limits hypothesis, and it remains possible that it will be supported in other domains or areas.

Consider the example of productivity in academia. Research has established that Gf declines precipitously and linearly with advancing age in adulthood, beginning as early as the twenties. It was once thought that cross-sectional designs lead to overestimates of decline relative to longitudinal designs, but once practice effects are considered in the latter studies, estimates of decline across the two types of studies are quite similar (Salthouse, 2010, 2019). Yet, scholarly output peaks at a later age in some disciplines than in others. For example, the peak is in the mid-twenties for mathematicians and late thirties for historians (Simonton, 1997). One possible explanation for this difference is that Gf is more important in science and mathematics, whereas domain knowledge is the stronger predictor of output in the humanities.

The Experimental Approach

The second approach we use to investigate the interplay between intelligence and domain knowledge in complex task performance is an experimental approach. In this approach, we use experimental manipulations to activate domain knowledge in laboratory tasks. The goal with this *knowledge-activation* approach is to "add knowledge" to a participant's mind in a tractably short amount of time before his or her performance is assessed. In the study that introduced this approach (Hambrick & Oswald, 2005), participants performed a memory task in which they attempted to remember the movements of spaceships that "flew" from planet to planet in a solar system. Unbeknownst to participants, the spaceships flew in the same manner that baseball players run around a baseball diamond. Participants then performed an isomorphic task in which a baseball diamond replaced the solar system and baseball players replaced the spaceships. Finally, participants completed tests of working memory capacity and knowledge of baseball. The relationship between baseball knowledge and performance was greater in the baseball condition than in the spaceship condition, indicating activation of domain knowledge in the baseball condition. However, the relationship between working memory capacity and performance did not differ across conditions. That is, contrary to the circumvention-of-limits hypothesis, the relationship between working memory capacity and performance was as large in the baseball condition, where task-relevant knowledge was activated, as in the spaceship condition, where it was not.

More recently, my colleagues and I used the knowledge activation approach to test the circumvention-of-limits hypothesis in a "placekeeping" task (Hambrick et al., 2018). An aspect of cognitive control, placekeeping, is the ability to perform a sequence of operations in a specified order (see Altmann et al., 2014). Examples range from the mundane—making a pot of coffee—to the critical—performing CPR on a person who has gone into cardiac arrest. The placekeeping task we used is called *UNRAVEL*. Each letter in the acronym UNRAVEL corresponds to a different two-alternative forced choice (2AFC) task that the participant must perform on a multidimensional stimulus. Every so often, the participant is interrupted by a distractor task. Afterward, they must return to the UNRAVEL procedure at the place where they left off. Performance is measured based on participants' accuracy and response time for each trial.

In the knowledge-activated condition of the placekeeping task, participants were instructed to use the mnemonic “UNRAVEL” to remember the order of the steps/tasks in the procedure. In the knowledge-not-activated condition, no mnemonic was given, and the use and discovery of mnemonics was frustrated by reversing the terms of some of the 2AFC tasks so that their first letters spelled the nonword “UNRBCEL.” Participants also completed tests of Gf, Gc, and perceptual speed. The key finding was that the positive effect of cognitive ability on placekeeping performance did not differ across conditions. That is, contrary to the circumvention-of-limits hypothesis, cognitive ability was as predictive of performance when domain knowledge was activated as when it was not.

Taken together, the preceding findings converge on the conclusion that domain knowledge does not necessarily mitigate performance limitations associated with intelligence, and especially working memory capacity. In more concrete terms, this evidence indicates that intelligence may influence complex task performance even at high levels of domain knowledge (in the differential approach) or when domain knowledge is activated in a task (in the experimental approach). However, another important consideration is the external environment of a task: the degree to which the environment affords strategies for task performance that offload processing demands of the performer.

The conclusions from this work are largely limited to a narrow range of tasks. Accordingly, an important goal for future research is to investigate the circumvention-of-limits hypothesis in a wider range of complex tasks and under different task and environmental conditions. Findings from this work will inform understanding of when domain knowledge mitigates or eliminates the effects of *g* and more specific cognitive factors, and when it does not.

The Environment

A critical, if unstated, assumption in research on intelligence is that the cognitive system supporting people's performance on tests of cognitive ability operates independent of the external environment. Reflective of this assumption, intelligence tests are administered under standardized conditions to minimize the influence of external factors that may aid or otherwise influence performance. However, cognition does not happen in a vacuum. Rather, it unfolds in environments, which include *artifacts* associated with specific tasks (see Cole & Derry, 2005). This includes "tools of the trade" and other objects associated with the task domain, along with what Norman (1991) termed cognitive artifacts: "artificial device[s] designed to maintain, display, or operate upon information in order to serve a representational function" (p. 17). The environments in which complex tasks are performed also include other individuals: team members, opponents, evaluators, and observers, among others. In the case of team members, these individuals can also serve a representational function like cognitive artifacts. Finally, environments may also include myriad *stressors* (e.g., atmospheric conditions) and *distractors*: objects and information that are irrelevant to the task and which may even lead to competing (and incorrect) responses.

Consider the task of driving a car equipped with driver-assist technology. The driver's (person's) characteristics include all the knowledge, skills, and abilities that he or she can apply to the task of driving the car, including skill in driving the car and cognitive abilities involved in making decisions of various sorts (e.g., whether to try to beat a red light). The environment, on the other hand, is the car's dashboard and other displays, which includes monitors that display information about the performance of the car (e.g., speed, fuel level) and the location of other cars. The environment also includes the physical environment (e.g., whether it is day or night, whether the road is dry, wet, or icy) and may also include passengers. Finally, the environment includes many different types of distractors, including everything from music playing on the radio, to phone and text messages, to signs along the road. Any (or all) of these objects and inputs may influence the driver's ability to drive the car.

Another implicit assumption of most intelligence research is that people approach intelligence tests in the same way they approach real-world tasks that are hypothesized to involve whatever cognitive ability is being assessed. However, as Logie (2018) commented, "people may use their cognition in different ways to perform the same task in the laboratory and in everyday life" (p. 471). Through experience, people may devise strategies to manage the information processing demands of a task that are inextricably tied to the task environment. For example, working memory tasks administered in the lab require the participant to hold some information in mind (e.g., a running string of letters) while performing some other task (e.g., solving arithmetic equations). Participants are not allowed to use external aids, although in everyday situations people routinely use external aids (notepads, computers, etc.) to perform working memory tasks.

Fisk and Kirlik (1996) captured this critical point about the context in which cognitive activity occurs as follows:

> The endeavor of understanding the environment in which cognitive activity will take place may be as important as understanding the overarching task in which the cognitive activity of interest is embedded. Thus, one must focus on determining under what environmental conditions various cognitive activities will be activated, and required, for effective task performance. The issue is not only to understand cognitive processes such as problem solving, working memory, or skill acquisition but also to determine in what context problems must be solved, when decisions must be made and what factors affect their outcome, what task characteristics lead to working memory demands, or what skills must be acquired given various environmental constraints. (p. 6)

An observational study by Kirlik (1998) illustrates this idea nicely. Nearly a century old, the Majestic Diner is an Atlanta institution (see also Kirlik, 2005). At peak hours, a short-order cook at the Majestic is responsible for a dozen or more orders, which he must manage simultaneously. Kirlik identified three strategies the cooks used for cooking steaks to order (rare to well-done). In the *brute force* strategy, the cook places steaks on the grill in random locations and attempts to remember how each should be cooked. In the *position control* strategy, the cook places steaks on areas of the grill designated for different temperatures (left for rare, middle for medium, right for well-done). Finally, in the *position + velocity control* strategy, the cook partitions the grill both horizontally and vertically. The back of the grill is for well-done, the middle for medium, and the front for rare; in addition, within each horizontal band, right is for well-done, the middle for medium, and left for rare. Within each horizontal band, the cook keeps the steaks moving right to left at a constant velocity, flipping each at the middle of the grill and removing it when it reaches the left edge.

Kirlik (1998) explained that "each of the three strategies above are (approximately) functionally equivalent: to the extent they are implemented satisfactorily, each cook will succeed at the task" but that "the cognitive demands associated with implementing the various strategies are quite different" (p. 22). Using the brute force strategy, the cook's task is not unlike performing a laboratory working memory task; the goal is to remember some unstructured information. However, the nature of the task changes when the other strategies are used. Using the position control strategy, the cook must remember the temperature of each position on the grill and how long each steak has been cooking for. However, using the position + velocity strategy, there is no need to remember how a steak is to be cooked once it is placed on the grill. The cook need only keep the steaks moving from the right to left at a constant velocity (Fig. 11.2).

Another illustration of how the environment is used in complex task performance comes from a study of bartending skill. Beach (1993) set up a mock bar in his laboratory and compared the performance of two groups in a simulated bartending task: bartending students (novices) and recent graduates (experts). In each trial, the participants were given four drink orders, and their task was to fill them as quickly and accurately as possible. In the first three trials, the glasses were shaped differently for different drinks (Collins, cocktail, rock, and champagne), as they would be in a real bar. In the last three trials, the glasses were black, opaque, and of the same shape for all drinks. The expert bartenders outperformed the novices in the first condition. However, in the second condition, the

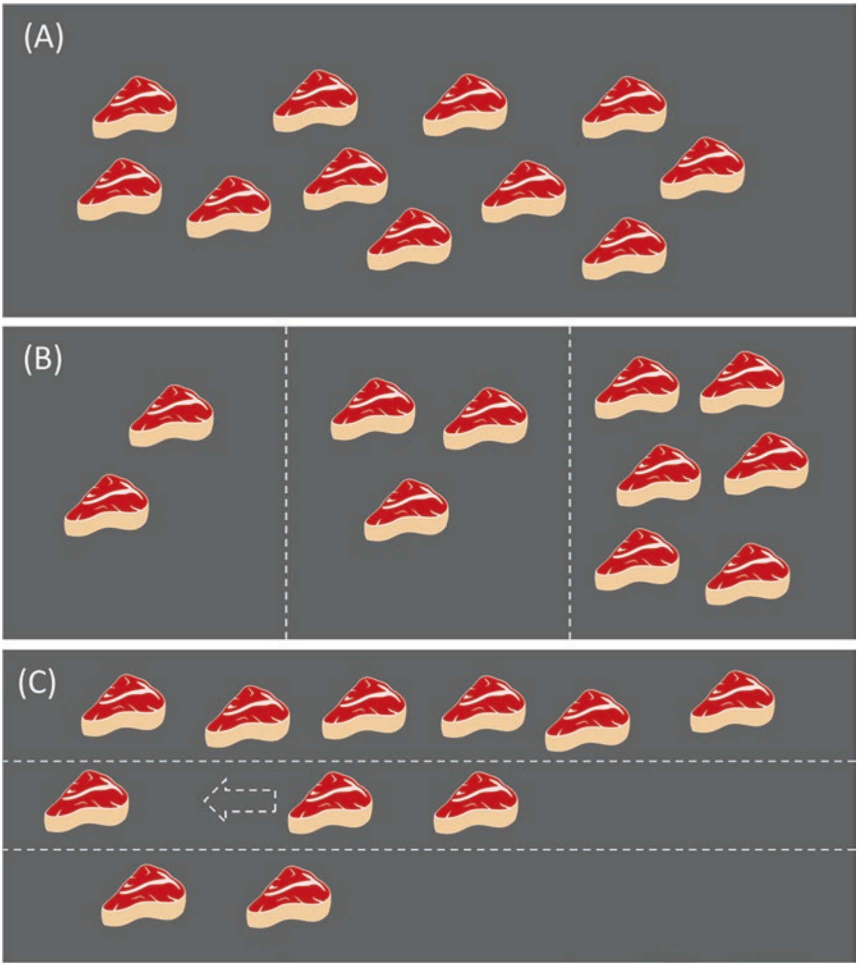

Fig. 11.2 Illustration of three strategies for cooking steaks used by short-order cooks at the Majestic Diner (Kirlik, 1998). (**a**) brute force strategy, (**b**) position control strategy, and (**c**) position + velocity control strategy. Figure from Hambrick et al. (2020); used with permission from Oxford University Press (to be requested)

experts made substantially more errors than before, whereas novices' performance was unaffected.

Beach's (1993) study uncovered a strategy used by expert bartenders that offloaded working memory demands of drink orders to the environment. As an order was placed, experts could select the appropriate glass and use it as a retrieval cue for the drink order. With a transparent glass, a bartender could keep track of which ingredients had already been added by judging the color and amount of liquid in the glass. However, this strategy was stymied when the participants were forced to use black, opaque, identical glasses for all drinks, and the experts' bartending advantage was reduced as a result. The use of the environment in this way is part and parcel of developing skill in practically any complex task.

Thus, for the skilled bartender, working memory for drink orders is supported by both internal representations and external representations. Internal representations include knowledge about how to mix particular drinks and what glasses to use for the drinks. External representations include cues created by the glasses as the bartender sets them out, and possibly other cues, including "regulars" who always order certain drinks. A bar "remembers" its regulars and their drinks, and whether working memory will bear on a bartender's performance will depend on whether that bartender is attuned to these cues. As another relevant example, Ceci and Bronfenbrenner (1985) had children bake cupcakes in either a familiar setting (at home) or an unfamiliar setting (in the lab). Strategic clock monitoring was greater at home than in the lab. As Kirlik (2005) stressed, *environmental differences* are as important to consider in psychological theories as are individual differences.

More generally, the influence of intelligence (and other predictor variables) on complex task performance depends on the structure of tasks and of the environments in which those tasks are performed. Table 11.1 presents a list of ten such factors (the task factors are drawn largely from Hoffmann et al., 2013). The list is not exhaustive, but rather is intended to highlight the types of task/environment factors that could be important to consider in intelligence research. Note that although some of the factors are characterized as binary (one state vs. another), they may be continuous. For example, a task could be entirely consistent in that all of the rules are fixed, or entirely variable in that all of the rules change. However, a task could be more or less consistent or variable if only some of the rules change. Note also that the environment not only includes external conditions (e.g., noise, temperature), but also internal environment (i.e., physiological states).

Table 11.1 Task and environment factors relevant to complex task performance

Task factor	**Consideration**
Consistent vs. variable	Are the rules of the task fixed or changing?
Discrete vs. continuous	Is the task performed in discernable steps?
Separable vs. interactive	Are subtasks performed in isolation?
Sequential vs. simultaneous	Do subtasks occur one at a time or at the same time?
Static vs. dynamic	Are task-critical situations captured by a "snapshot" or do they unfold over time?
Environment factor	**Consideration**
Distraction	Is there extraneous sensory stimulation (e.g., noise)?
Environmental stressors	Under what conditions is the task performed (e.g., temperature)?
Physiological stressors	What is the physiological state of the performer (e.g., fatigue, arousal)?
Social interaction	Are other individuals present, and if so, what is their role (e.g., collaborator, audience)?
Support/aid	Do artifacts provide support for task performance (e.g., interfaces, memory aids)?

A further consideration is the roles that people play in the respective environments in which they perform complex tasks. As work by Scribner demonstrated through studies that combined observational, ethnographic, and experimental techniques, actions that people perform in settings such as the workplace influence the knowledge that they acquire. In one study, Scribner (1985) investigated product knowledge of different types of workers at a dairy. What people knew about the products was directly related to how they interacted with the products in their jobs—the actions they performed in their jobs. As a case in point, in a sorting task, warehouse order assemblers grouped products according to storage location. These workers had extensive knowledge of product location. An important implication of this finding is that, when evaluating whether domain knowledge interacts with an intelligence factor such as working memory capacity on performance of a complex task, the measure of domain knowledge must capture the knowledge that people acquire in the environments in which they perform the task. As Scribner (1985) wrote, "Even when we are concerned with a domain of common knowledge in our society, we cannot assume that the richness of such knowledge or the attributes by which it is organized are uniform across population groups" (p. 203).

A Contextual Approach to Research on Intelligence

How can research be conducted that considers the influence of both person factors and environment factors on complex task performance? After selecting a domain as the venue for research, there are four major steps. The first step is to identify constructs that might be expected to predict individual differences in performance. The second step is to develop measures of these factors, as well as measures of criterion task performance. The third step is to delineate task/situational characteristics that could moderate the influence of the individual-difference variables on performance. The final step is to recruit a sample of participants to complete the tests.

A study of crossword puzzle-solving skill I conducted with colleagues Timothy Salthouse and Elizabeth Meinz illustrates this approach (Hambrick et al., 1999). Skill in solving crosswords would seem to depend on the solver's fund of knowledge (Gc), but also their ability to reason about tricky clues (Gf), especially in more difficult puzzles such as the Saturday *New York Times* puzzle. With this in mind, we assembled a battery of predictor tests to measure reasoning, vocabulary, and general information, as well as crossword puzzle experience and knowledge of common crossword puzzle words such as *aril* (a needle case) and *Nene* (Hawaiian goose). Across four studies, we had over 800 participants complete the tests of these factors, along with crossword puzzles of varying levels of difficulty (a task factor). We then used structural equation modeling to estimate direct and indirect effects of the various factors on crossword puzzle proficiency (i.e., number of clues solved in the puzzles).

We expected that both knowledge and reasoning factors would directly predict crossword proficiency. However, this was not the case. Reasoning ability had a positive effect on general knowledge, which in turn had a positive effect on crossword proficiency. However, the direct effect of reasoning ability on crossword proficiency was near zero, even on difficult puzzles. Moreover, for the difficult puzzles, knowledge of crossword puzzle terms accounted for nearly all the variance in crossword proficiency. According to these results, success in solving crosswords is almost entirely dependent on crystallized abilities, even if when solving a crossword it "feels" like fluid abilities are also involved. For the present discussion, the important point is that had we taken an acontextual approach and only administered tests of reasoning ability and crossword proficiency, we would have erroneously concluded that the former directly influences the latter.

Recent work by Brooke Macnamara and David Frank provides another illustration of how contextual research on intelligence might be pursued. They have developed a video game visually similar to the commercial videogame Plants vs. Zombies in which they can manipulate several of the task factors listed in Table 11.1 (Frank & Macnamara, 2020; Macnamara & Frank, 2018). The approach is to conduct a series of experiments, and in each to manipulate a different factor, comparing a baseline version of the task to one in which one of the task factors is manipulated. In the game, a zombie apocalypse has occurred, and it is now up to the participant's avatar to collect energy for the town and fight off the zombies. The game includes two types of "missions," each with a score. In *energy collection missions*, participants plant sunflowers to collect energy from suns moving across the screen. And in the *zombie fighting missions*, the participant plants pea plants to shoot and kill zombies moving across the screen. Frank and Macnamara documented effects of various factors, listed in Table 11.1, on learning and performance in the game. For example, in a variable version of the task, the mapping of sun size to energy level (among other factors) changed across an experimental session, whereas in a consistent version the mappings are constant. As expected, average score was lower in the variable version of the game than in the consistent version. The next step in this research program is to have the participants complete the tests of cognitive ability, and to test for Task Factor × Ability interactions to see how the task manipulations moderate effects of the ability variables on performance.

From a contextual perspective, this approach is especially promising because it allows the researcher to independently vary task factors to determine which of the factors drive involvement of ability factors in performance. The knowledge gained from this type of research can move the field of intelligence from simply establishing bivariate correlations between measures of intelligence and complex task performance to understanding how exactly intelligence influences performance.

Conclusions

Measures of intelligence predict complex task performance relatively well. At the same time, intelligence research has typically focused on intelligence as the sole predictor performance in such tasks. Here, I have argued that a more profitable approach is to think about intelligence from a contextual perspective. Context includes other individual-difference variables, as well as task and environmental variables. As work discussed in this chapter highlights, one specific way that context affects complex task performance is by affording use of various types of domain knowledge. The skilled performer's ability to use domain knowledge is inextricably tied to the environment. To put it another way, the artifacts that performers interact with in performing complex tasks are *inherent* in using domain knowledge. The skilled performer may be little different from a novice when removed from the context in which they have developed their skill.

The bottom-line is that the role of intelligence in complex task performance can only be understood in the context of interactions between performers and environments in which tasks are performed. One might even argue, as Preiss and Sternberg (2005) did, that the definition of intelligence itself should move beyond the level of the individual to explicitly include such interactions:

> Most *g*-theories are static theories of intelligence: They conceive of intelligence as a genetically endowed property of the mind that saturates all cognitive tasks a person performs, as demonstrated by factor analysis of cognitive tasks….When cognitive tools are taken into consideration, the image of intelligence that arises is quite distinct from g-theory. Indeed, a consideration of technology drives us to see intelligence as shaped by the external resources an individual has on hand: a script, a numerical system, a map, or a computer, just to mention a few. (p. 199)

From a theoretical perspective, considering the role of context on the relationship between scores on intelligence tests and complex task performance will shed much-needed light on sources of individual differences in intelligence. Despite more than a century of research, the question of what psychological mechanisms underlie variation in scores on intelligence tests has never been satisfactorily answered. Examining interactions of task/situational factors with measures of *g* and more specific cognitive factors can help answer the question of what, exactly, a high level of intelligence affords a person. It could be that *g* interacts with any other factor that makes a task more or less difficult—variable versus consistent, simultaneous versus sequential, discrete versus dynamic, and so on. On the other hand, it is just as possible that some of these factors will interact with *g* whereas others will not. This knowledge could, in turn, help applied psychologists make better use of intelligence tests for practical applications. For example, in employment settings, it may be useful to know when intelligence should be expected to predict individual differences in job performance and when not, so that the right person can be placed in the right job and at the right time.

At a more general level, a contextual approach will facilitate the integration of knowledge concerning complex task performance across multiple domains of psychological inquiry (cognitive psychology, personality psychology, social psychology, etc.), and inform practices in applied settings such as the workplace and classroom.

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Part V

Social Issues and the Science of Human Intelligence

12

Mindsets of Intelligence: Their Development, Consequences, and Relation to Group-Based Inequality

Lin Bian

Humans are extremely intelligent compared with other animals, and yet what means to be intelligent remains an unsolved puzzle in the academic world. Among others, one subject of the considerable debate is whether intelligence is a naturally endowed trait of which each person has a fixed amount. On the one hand, individual performance on IQ tests tends to remain stable over time and across tasks, leading many researchers to claim that intelligence is relatively unchangeable and independent of environmental factors (Bartels et al., 2002; Canivez & Watkins, 1998; Gow et al., 2011; Herrnstein & Murray, 1994; Hertzog & Schaie, 1986; for reviews, see Deary, 2012). On the other hand, a wealth of research provides evidence for the malleability of intelligence (for reviews, see Neisser et al., 1996; Nisbett et al., 2012). For example, people's performance on IQ tests across 30 nations show sizeable and steady gains from generation to generation (Flynn, 2007); scores on intellectual assessments are influenced by differences in schooling experiences (Ceci, 1991);

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family contexts also have significant impact on children's intelligence such that children adopted by upper-middle-class parents achieve higher points on IQ tests than children adopted by socioeconomically disadvantaged families (Duyme et al., 1999; van IJzendoorn et al., 2005).

This controversy regarding the nature of intelligence resonates within the minds of the general public. Lay people hold distinct beliefs about whether intelligence is a fixed entity or a malleable attribute. These basic beliefs are often referred to as one's implicit theories of intelligence, or intelligence mindsets (Dweck, 1999, 2006). More recently, a growing body of literature shows that these mindsets are also entrenched in organizations, characterizing the culture of a company, a team, or an academic field. In this chapter, I provide a selective overview of implicit theories of intelligence at both the individual level and the organizational level, revealing their power in shaping people's motivation, achievement, and performance. Next, I turn toward another class of lay beliefs about intelligence, that is, people's stereotypes about the possession of intelligence based on one's group membership (e.g., the stereotype associating high intelligence more with men than with women). Finally, the chapter summarizes evidence demonstrating how a fixed organizational mindset is particularly detrimental to members of stigmatized groups (e.g., women), leading to a range of societal problems. Throughout the chapter, I take a developmental perspective depicting how these lay beliefs are transmitted to the next generation and influence children's behaviors. By illustrating the acquisition and consequences of lay beliefs about intelligence, this chapter provides insights into the root causes underlying group-based inequality.

Implicit Theories of Intelligence at the Individual Level

Since the groundbreaking work by Dweck and colleagues, numerous studies have revealed that people's lay theories of intelligence fall on a spectrum with fixed and growth mindsets at the far ends (Dweck, 1999, 2006). Some people hold more of a fixed mindset (also known as holding an entity theory) and view intelligence as a naturally endowed entity that is impervious to effort or learning; other people hold more of a growth mindset (also known as holding an incremental theory) and believe intelligence can be improved via hard work, versatile strategies, and effective mentoring from others. These folk theories about intelligence exert profound effects on people's behaviors in various ways (e.g., Blackwell et al., 2007; Dweck & Leggett, 1988; Haimovitz et al., 2011; Hong et al., 1999). Specifically, the fixed mindset orients people toward "performance goals," such that their priority is to obtain excellent scores in order to maintain a positive reputation with regard to their intellectual ability. In a fixed mindset, people believe that things should come naturally if they are intelligent enough, and thus expending effort is a sign of low intelligence. This philosophy leads them to be less motivated and more likely to give up in the face of setbacks. In contrast, the growth mindset orients people toward "learning goals" to prioritize expanding skills over proving intelligence. In a growth mindset, people interpret challenging situations as valuable learning opportunities and thus they are willing to persist longer on difficult tasks and achieve more successful academic outcomes.

The consequences of these different mindsets on performance and achievements have been documented in correlational studies (e.g., Gunderson et al., 2013; Smiley & Dweck, 1994) and in studies altering people's lay theories about intelligence (e.g., Cimpian et al., 2007; Heyman et al., 2003). For example, interventions to instill growth mindsets in middle school and colleges have been shown to effectively improve students' academic achievements (e.g., Aronson et al., 2002; Yeager et al., 2016a, 2016b). In a national experiment (Yeager et al., 2019), high schoolers, especially low-achieving students, who learned that "the brain is like a muscle that grows stronger and smarter when it undergoes rigorous learning experiences," achieved higher grades than students who read a similar passage without hearing about the malleability of intellectual abilities (Yeager et al., 2019). In addition to leading to personal consequences, these folk theories guide people's navigation in interpersonal contexts as well. People with a fixed mindset are ready to use limited information to attribute stable traits to other individuals or entire social groups, whereas people with a growth mindset are relatively reluctant to form or endorse stereotypes (Levy et al., 1998; Plaks et al., 2001).

How do children come to embrace a fixed or a malleable view of intelligence? Past research has highlighted the role of feedback in shaping children's beliefs about the nature of intellectual ability (e.g., Brummelman et al., 2014; Gunderson et al., 2013; Haimovitz & Dweck, 2016; Pomerantz et al., 2007). To illustrate, praising children's effort as opposed to their innate abilities nurtures a growth mindset (Kamins & Dweck, 1999; Mueller & Dweck, 1998). For example, after completing a set of easy drawings, four- to five-year-old children received either person-focused (e.g., "You are a really good drawer!") or process-focused praise (e.g., "You did a really good job drawing!"; Cimpian et al., 2007). Then they proceeded to more challenging drawing tasks in which they made some mistakes. Relative to children who had been praised for trying, children who had received person-focused praise tended to give up earlier and switch to easier tasks when they encountered setbacks. Thus, person-focused praise may encourage children to adopt a fixed mindset, leading them to perceive their abilities to be immutable and to shy away from challenges.

Follow-up studies extend these findings from laboratories to naturalist settings (Gunderson et al., 2013; Pomerantz & Kempner, 2013). In one study, parents of eight- to ten-year-old children completed daily phone interviews to record their use of person-focused and process-focused praise; six months later, their children filled out measures assessing their mindsets (Pomerantz & Kempner, 2013). In line with the lab experiments, mothers' tendency to link their children's success to their traits predicted their children's endorsement of a fixed mindset. In another longitudinal study, Gunderson et al. (2013) recorded parental praise offered to toddlers. Five years later, these children were invited back to complete measures of mindsets. Compared with children whose parents offered more person-focused praise when they were toddlers, children whose parents offered more process-focused praise were more likely to believe that intelligence is malleable and showed preferences for challenging tasks—hallmarks of endorsing a growth mindset.

Just as how we respond to children's success cultivates distinct mindsets of intelligence, so do our responses to children's failures. In a study by Kamins and Dweck (1999), five- and six-year-old children were asked to pretend to be a student doll who made a mistake. Next, a teacher doll delivered either person-focused (e.g., being disappointed at the child) or process-focused responses (e.g., drawing attention to the strategy) to the student doll. Relative to those who heard process-focused feedback, children who received person-focused feedback were more likely to develop a fixed mindset and produced more helpless behaviors when encountering subsequent setbacks. Moreover, not only negative person-focused feedback to failures promotes a fixed mindset; sometimes, well-intentioned, positive person-focused responses result in similar outcomes. In scenarios in which a student received poor grades in math tests, instructors who were taught to adopt a fixed mindset were more likely to offer comfort for the student's presumed lack of ability (e.g., "It's okay—not everyone can be good at math") rather than helpful strategies to improve, resulting in decrements in students' motivation about math and expectations for future improvements (Rattan et al., 2012).

Haimovitz and Dweck (2016) further extended these findings to parent-child interactions and found that the way parents choose to react to their children's failures is anchored in their interpretations of failures. Some parents view failures as learning opportunities for one to take lessons and to enrich themselves, while other parents view failures as obstacles hindering these processes. The more parents believe that failure is debilitating, the more likely they perceive failures as signals of low ability. As a result, they are less likely to encourage children to persist in difficult tasks and more likely to take over for them. Because children are highly sensitive to subtle environmental cues such as parental practices (e.g., Butler & Markman, 2014; Cimpian et al., 2012; Rhodes et al., 2012), they are able to accurately identify their parents' beliefs about failure and develop mindsets of intelligence accordingly. Indeed, children who perceived their parents as believing that failures are debilitating and should be avoided tended to endorse a fixed mindset of intelligence (Haimovitz & Dweck, 2016).

Implicit Theories of Intelligence at the Organizational Level

As outlined above, much research on folk theories about intelligence in the past few decades has focused on individual differences in subscribing to a fixed or growth mindset. More recent research breaks the ground by showing that these mindsets are also entrenched in organizations, such as a school, a company, or an academic field (Emerson & Murphy, 2015; Leslie et al., 2015; Murphy & Dweck, 2010). Some environments more than others emphasize to their participants that high-level success is a matter of sheer brilliance, despite that natural intelligence itself is a mere sociocultural construct that largely depends on contexts. Take the academic world as an example. Leslie, Cimpian et al. (2015) asked researchers across 30 disciplines to report to what extent they believe possessing a great deal of innate intellectual talents is a crucial factor to achieve success in their own discipline (e.g., "Being a top scholar of [discipline] requires a special aptitude that just can't be taught"). The results revealed striking variation across the academic spectrum. Specifically, researchers in some disciplines, such as mathematics, physics, and philosophy, perceived success in their fields as relying on a possession of presumed raw intelligence than researchers from other disciplines, such as molecular biology, chemistry, and psychology. This pattern resonates with the general public (Meyer et al., 2015) and was replicated with a more naturalist measure tallying students' anonymous evaluations of college instructors (Storage et al., 2016). Storage et al. (2016) found that students' descriptors expressing intellectual talents were used more often for instructors in mathematics and physics than health science or education.

Do children develop different theories of intelligence about specific academic domains? Stipek and Gralinski (1996) began to explore this question by examining third and sixth graders' beliefs about mathematics and social studies, two subjects highly familiar to children in elementary school. Children who believed that "one has to be smart to do well in math" also held the same beliefs for social studies, suggesting that they develop similar mindsets about the two subjects. More recently, Gunderson et al. (2017) recruited participants from first grade to college to track developmental changes in children's folk theories of intelligence about two domains, math versus reading and writing. Participants were asked to rate their agreement to items such as "Only the smartest kids can do well in math/reading and writing in my grade" and "Some kids in my grade can never do well in math/reading and writing even if they try hard." Contradictory to past findings, the results revealed that children from a young age begin to develop distinct theories of intelligence about the two specific academic subjects. Even first and second graders were more likely to agree that math requires postulated sheer brilliance than writing and reading, and this tendency projected into adulthood. Future studies should include a wide range of academic domains or professional jobs to paint a complete picture of the development of the organizational mindsets about intelligence.

As noted earlier, mindsets at the individual level structure adults' and children's behaviors in various contexts. Do mindsets at the organizational level bring forth similar effects? Murphy and Dweck (2010) examined this question by testing if an organization's mindsets impact people's self-concept and their hiring decisions. College students were asked to imagine that they were interested in joining a tutoring club that espouses either a fixed or a growth mindset. Students then filled out a membership application. Although students in general judged the club endorsing a fixed mindset to be less appealing than the one endorsing a growth mindset, they displayed qualifications in line with the club's theories of intelligence. Specifically, students exposed to fixed-mindset messages tended to present characteristics that presumably reflect their natural smarts such as their grade point average and IQ scores, whereas students exposed to an incremental environment tended to engage in more self-improvement practices. The club's mindset further shapes students' hiring decisions. After getting into the club embracing a fixed mindset, students tended to hire future candidates who displayed attributes signaling their raw intellectual abilities, perpetrating the organization's mindsets of intelligence (Murphy & Dweck, 2010).

An environment's fixed mindset also brings consequences to people's psychological experiences and academic performance (Canning et al., 2020; Muenks et al., 2020; for reviews, see Murphy & Reeves, 2019). In one study, Canning et al. (2020) found that institutions with a more fixed mindset discourage employees' trust. In particular, hundreds of employees from seven Fortune 1000 companies were recruited to estimate their own company's mindsets as well as their trust in the company. Employees who perceived their organization to embrace a fixed mindset also reported low trust and commitment to the organization. Extending to the educational contexts, when students believe that their professors hold more of a fixed mindset, they feel a lower sense of belonging and a stronger sense of anxiety, which in turn undermines their academic motivation and performance (Muenks et al., 2020). In contrast, when students believe that their professors hold more of a growth mindset, they experience a greater sense of belonging to the class and achieve higher school grades (Muenks et al., 2020). Similarly, Rheinberg et al. (2000) found that low achievers improved their performance significantly when their teachers held a growth mindset, but this improvement was undermined when their teachers held a fixed mindset.

Importantly, the theories of intelligence in organizational contexts are critical in determining the effectiveness of interventions on individuals' mindsets (Walton & Yeager, 2020). Many findings converge on the idea that teaching students that intelligence is malleable could be beneficial to their academic achievements (e.g., Blackwell et al., 2007; Yeager et al., 2013), but this intervention can be most effective when it is implemented in settings valuing learning and mastery (Yeager et al., 2019, 2021). For example, there was a lack of improvement in students' math grades if their teachers possessed more of a fixed mindset, even though these students themselves endorsed a growth mindset (Yeager et al., 2021). Peers' subscription to a growth mindset also matters. In schools in which peers were unwilling to seek out challenging academic tasks, students made lower academic improvements after a growth-mindset intervention than students embedded in a peer culture supporting each other to overcome hardships to improve skills (Yeager et al., 2019).

Overall, fixed organizational mindsets give rise to myriad maladaptive outcomes to people in general. Furthermore, these organizational beliefs are particularly detrimental to groups of individuals who are not culturally associated with high levels of postulated smarts (e.g., women, Black people; Aronson et al., 2002; Storage et al., 2020; Upson & Friedman, 2012). Members of groups stigmatized for their intelligence may feel a low sense of belonging in places portrayed as valuing raw intellectual capacity, and in the meantime, suffer from a strong bias against their competence in these environments. These processes may ultimately give rise to differential representation of groups. In what follows, I describe cultural stereotypes about intelligence, and illustrate how these intelligence stereotypes may interact with an organization's fixed mindset to bring in cascades of consequences to groups disadvantaged by these stereotypes.

Stereotypes About Intelligence

As humans, we automatically divide individuals into social categories and use limited evidence to construct broader knowledge about members of these categories. A subset of stereotypes pertains to people's judgments of intellectual ability solely based on one's group membership. Take the gender stereotype about intelligence as an example. Although past work has shown that men and women are comparable in terms of intelligence levels (Aluja-Fabregat et al., 2000; Colom & Garcia-Lopez, 2002; Saggino et al., 2014), a great deal of research suggests that people in general hold a negative stereotype against women's intellectual abilities (e.g., Beloff, 1992; Bennett, 1996, 1997; Kirkcaldy et al., 2007; Storage et al., 2020; Tiedemann, 2000; Upson & Friedman, 2012). For instance, studies conducted in multiple nations provide converging evidence suggesting that people tend to overestimate men's scores on IQ tests and underestimate women's (e.g., Beloff, 1992; Furnham et al., 2002; Rammstedt & Rammsayer, 2000).

These biases against women's intelligence have been found in parents and teachers, the two major human influencers in children's everyday life. For example, parents were two and a half times more likely to look up "Is my son gifted?" than "Is my daughter gifted?" in Google search, and more generally, parents tended to make more intelligence-related searches about their boys than about their girls (Stephens-Davidowitz, 2014). Interestingly, this imbalance was reversed with respect to physical appearance: parents were one and a half times more likely to search "Is my daughter overweight" than "Is my son overweight?" Lab studies provide converging evidence showing that parents favor males in their IQ estimates (e.g., Furnham et al., 2002; Furnham & Gasson, 1998; Kirkcaldy et al., 2007). For example, in samples of English and Icelandic parents, fathers provided higher estimates of their overall intelligence than mothers, and parents of sons estimated their children as possessing higher intelligence than parents of daughters (Furnham & Valgeirsson, 2007). Parents' gendered beliefs about brilliance are manifested in their conversations with their sons and daughters. In particular, parents believe that science is more intellectually challenging for their daughters than sons

(Tenenbaum & Leaper, 2003), and they offer more explanations and lead more cognitively demanding speech with sons than daughters in museum visits (Crowley et al., 2001a, 2001b). Teachers hold distinct beliefs of their male and female students' intellectual abilities as well (e.g., Bianco et al., 2011). After reading one of two student profiles (a male student or a female student), teachers were relatively less likely to refer the female than the male student to talented programs, despite that the two students shared identical qualifications (Bianco et al., 2011).

Since two of the most influential sources in children's everyday life carry the "brilliance = men" stereotype, it is not surprising to find that this stereotype takes root in early childhood. Bian et al. (2017) investigated five- to seven-year-old children's gendered notions about which gender is "really, really smart"—a way of talking about intellectual talents with young children. Before receiving the stereotype tasks, children were first introduced to six screener questions assessing their lay beliefs about the meaning of being smart. For each question, the experimenter placed a picture of an unfamiliar child behind a cardboard tent and described a behavior of the child in the picture (e.g., "*This child can always answer even the hardest questions from the teacher*"). Four of the six questions referred to behaviors typically associated with being smart (e.g., solve really hard puzzles, figure out solutions quickly) and two referred to irrelative behaviors (e.g., play on swings). Participants were asked to answer whether the child in the picture was smart (e.g., "*Is this child smart, not smart, or are you not sure?*"). Eighty percent of the sample passed the screener questions, suggesting that children as young as age five have developed conceptions of intelligence similar to adults.

Next, children received a series of stereotype tasks assessing their tendency to associate brilliance with their own gender. In one task, children heard a short story about a "really, really smart" person, without receiving any clues to the person's gender, accompanied by four pictures (two White men and two White women). They had to guess which one of them was the person featured in the story. In another task, children were shown several pictures featuring a White man and a White woman. Upon viewing each picture, children made a choice between the two individuals as the protagonist in the story.

At age five, boys and girls tended to pick people of their own gender as being “really, really smart,” showing strong favoritism toward their own gender (Shutts et al., 2013; Yee & Brown, 1994). Soon after, children begin to internalize the gender stereotype associating brilliance with men. Specifically, girls around the age of six picked females as “really, really smart” less often than boys picked males (Fig. 12.1; Bian et al., 2017). However, when children were asked to choose which gender achieves better grades in school, six- and seven-year-old children favored girls. These findings suggest that children begin to assimilate the gender stereotype about brilliance in early elementary school years. Follow-up studies found that these developmental patterns are present in both White and non-White children (Jaxon et al., 2019), do not seem to vary as a function of socioeconomic status (Bian et al., 2017), and are replicated in non-Western cultures such as China (Shu et al., 2022) and Japan (Okanda et al., 2021).

Recently, developmental psychologists set out to explore whether children’s gender stereotypes about brilliance vary according to the race of the targets. In other words, do children attribute intelligence to men in general, or do they in fact attribute intelligence to White men in particular?

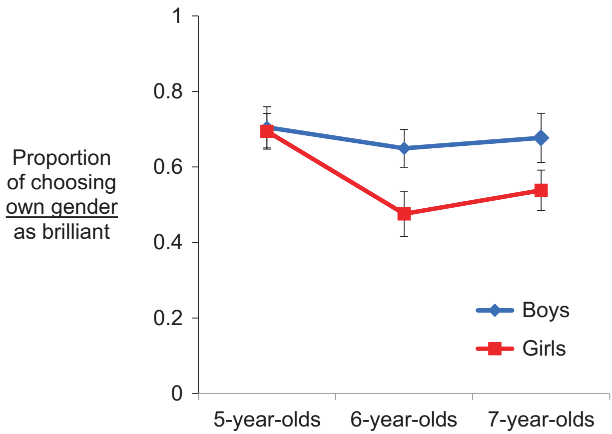

Fig. 12.1 The stereotype associating brilliance with men emerges early. Boys and girls at age five are equally likely to choose their own gender as being “really, really smart,” but with age, girls become less likely to do so than boys. The error bars represent ± 1 *SE*. Data from Bian et al. (2017)

Consistent with the latter possibility, Jaxon et al. (2019) found that, although six-year-old American children associated brilliance with White men more than White women, they were more likely to attribute brilliance to Black women than to Black men. Similarly, when shown pictures depicting Asians and asked to choose someone who is really smart, both Chinese and American children between the ages of five and seven preferred Asian women to Asian men, demonstrating a reversed gender stereotype associating brilliance with Asian women (Shu et al., 2022). These patterns suggest that children do not simply attribute brilliance to men in general. In fact, White men are perceived as being the representatives of brilliant people. These findings speak to children's capacity of considering multiple social identities to construct intelligence stereotypes, and therefore prompt researchers to adopt an intersectional framework to study children's endorsement of stereotypes.

Next, I turn to the acquisition of *racial* stereotypes about intelligence. Do children attribute intellectual talents to certain racial groups, but not others? One common cultural stereotype that permeates the adult world is that Black Americans are perceived as less likely to possess postulated raw intelligence than White Americans (Aronson et al., 2002; Devine, 1989; Smith, 1990; Steele & Aronson, 1995). For example, more than 50% of White Americans endorse the notion that Black Americans are less intellectually gifted than White Americans (Smith, 1990). Because of this negative stereotype, Black students suffer from a greater sense of anxiety and more cognitive burden in situations where their intellectual ability is being evaluated (e.g., Steele & Aronson, 1995). More recently, Baharloo et al. (2021) provided evidence showing that this racial stereotype about intelligence is acquired from early on.

Experiment 1 tested the developmental trajectory of associating White people with high intelligence relative to Black people. Five- to seven-year-old children received stereotype tasks adapted from Bian et al. (2017). For example, children were told stories about a "really smart" person. After the story, children saw pictures of White people and Black people, all matched to the child's gender, and were asked to guess which of them was the person in the story. Across all ages, children tended to select White people, as opposed to Black people, as being "really smart," suggesting that children attribute lower intellectual competence to Black than White people. However, these results are open to an alternative interpretation, that is, children may simply link brilliance to people who belong to the racial majority group rather than to the racial minority groups. To test this possibility, Baharloo et al. (2021) conducted a second experiment focusing on the comparison of White people and Asian people on the dimension of intellectual competence. In the U.S. culture, Asians are a racial minority group that is typically assumed to excel in intellectual tasks (e.g., Ambady et al., 2001; Eagly & Kite, 1987; Ghavami & Peplau, 2013; Shih et al., 1999). The procedure was identical to that of Experiment 1, except that children were presented with pictures of White and Asian faces. With age, children became increasingly more likely to choose Asian people as being "really smart" than White people. Taken together, these findings suggest that children have acquired common racial stereotypes about intelligence in early childhood.

One interesting aspect of the intelligence stereotype investigated here concerns how intellectual abilities are conceptualized. In the studies summarized above, the researchers adopted a definition of intelligence (e.g., being smart means that someone can solve difficult puzzles very quickly) that is commonly accepted by Western cultures. However, since cultural values play an important role in how human intelligence is recognized and defined (e.g., Clegg et al., 2017; Sternberg, 1985; Wen et al., 2019; Yang & Sternberg, 1997), concepts of intelligence that stem from Western cultures may not be transferrable to non-Western cultures. One prominent cross-cultural variation exists in people's ideas about the relation between intelligence and conformity. Western cultures placing a great value on independence believe that being creative and able to think outside of the box is an important aspect of being intelligent (Clegg et al., 2017; Lawton et al., 1984), whereas non-Western cultures prizing interdependence believe that one aspect of being intelligent is to comply with group norms (Booth, 2002) and to fulfill social responsibility (Sternberg & Grigorenko, 2004; Tobin et al., 2009). As shown in Clegg et al. (2017), U.S. adults were more likely than Ni-Vanuatu adults to agree that children who violate norms and act differently than others are intelligent.

In addition, different cultures take different stances about whether intelligence is fixed or malleable. Although people in general attribute behaviors to traits, members of interdependent cultures generally assume more flexibility and malleability to one's characteristics than independent cultures (Lockhart et al., 2008; Norenzayan et al., 2002). For example, Japanese children and adults hold more of a growth mindset about qualities because they believe that characteristics are largely shaped by situational factors (Dweck & Leggett, 1988; Lockhart et al., 2008). These cultural values about the malleability of traits are exemplified in their people's conceptions of intelligence. Compared with Westerners, people from East Asia, such as China, tend to perceive intelligence as depending on contextual factors as opposed to inherent traits (e.g., Heine, 2001; Markus & Kitayama, 1991; Yang & Sternberg, 1997). How cultural ideologies modify people's definitions of intelligence and how these conceptions moderate the manifestation of the intelligence stereotypes warrants future exploration.

The Consequences of Organizational Mindsets on Stigmatized Groups

Since members of certain social group face stigmas regarding their intelligence, they may encounter additional obstacles in organizations embracing a fixed mindset. In fact, women and racial minority groups disadvantaged by the intelligence stereotype are often severely underrepresented in fields and professions valuing what are perceived to be raw intellectual talents (Leslie et al., 2015; Meyer et al., 2015). How do organizations embracing a fixed mindset deter participation of members who belong to negatively stereotyped groups?

One important mechanism is people's self-efficacy—their evaluations of their ability to succeed in certain areas. According to the expectancy-value theory (Bandura, 1997; Eccles & Wigfield, 2002), one's confidence in their abilities to achieve success (or their expectancies for success) is one of the key influences on their activity choices. In contexts emphasizing the importance of postulated raw intelligence to obtain successful outcomes, people from stigmatized groups may doubt whether they possess the required capacity to succeed. These doubtful ideas then have a downstream negative effect on their sense of belonging and motivation.

In a series of experiments, college students and Mechanical Turk workers were introduced to a range of hypothetical educational and professional opportunities such as choosing a major, applying for an internship, etc. (Bian et al., 2018b). These opportunities were described as valuing either "a spark of genius" (a fixed mindset) or "excellent work ethics" (a growth mindset). Next, participants indicated to what extent they felt they would be able to perform the job and their motivation to pursue these opportunities. Although women and men were similarly interested in the opportunities requiring dedication, women were less confident in their intellectual abilities and consequently reported lower motivation toward the activities prizing superior intelligence than their male counterparts. Therefore, an environment's fixed mindsets may increase women's doubts about their ability to succeed in the environment and take a toll on their career choices.

Moreover, even after women have achieved objective proof of their intellectual competency, they still feel like they do not deserve their success (Clance & Imes, 1978). This phenomenon, also known as the imposter syndrome, has been found to be more prevalent in contexts valuing attributes believed to indicate one's raw intelligence (Muradoglu et al., 2021). In this nationwide study involving thousands of academics across 80 fields, Muradoglu et al. (2021) found that a fields' emphasis on what is perceived to be raw intellectual talents predicts women's tendency to suffer from imposter syndrome.

More strikingly, children are susceptible to these detrimental effects as well. Bian et al. (2017) showed five-, six-, and seven-year-olds two unfamiliar games and told them that one game was for children who are "really, really smart" and another game was for children who "try really, really hard." Children then answered a number of questions indicating their interest to play each game. Five-year-old boys and girls were equally interested in the game for "really smart children," but girls became less interested in it (relative to boys) at the age of six (Fig. 12.2), right around the time they begin to associate brilliance with men (Fig. 12.1, Bian et al., 2017). Moreover, girls who were less likely to associate brilliance with their own gender expressed lower interest in the brilliance-focused game than girls who were confident about their own gender's intellectual capacity. In contrast, six-year-old boys and girls expressed similar interest

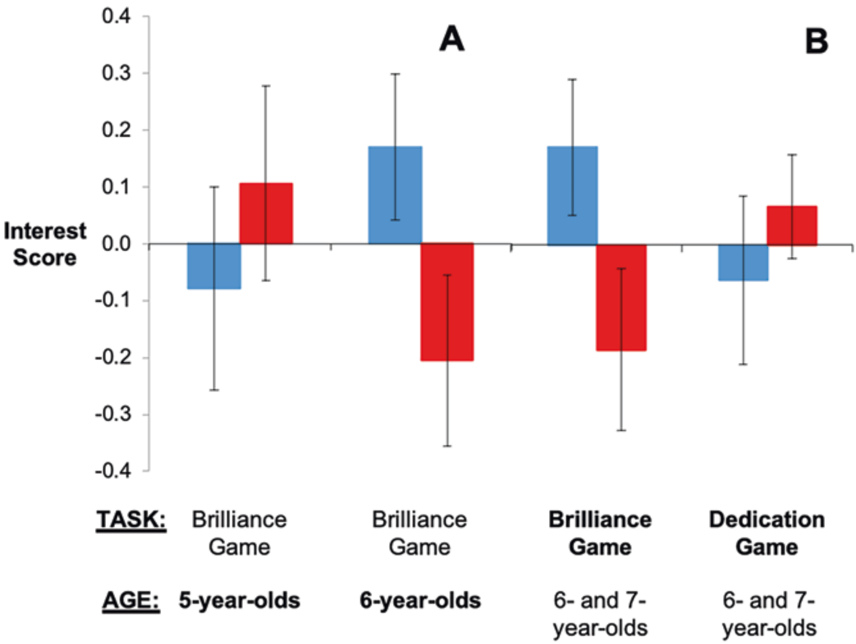

Fig. 12.2 Children's interest in novel games portrayed as requiring brilliance or dedication. Six- and seven-year-old, but not five-year-old, girls are less interested in "brilliance-required" games than boys. The error bars represent ± 1 *SE*. Data from Bian et al. (2017)

toward the game portrayed as requiring dedication. Tying back to the findings showing that children from a young age begin to view certain subjects as prizing brilliance (e.g., Mathematics; Gunderson et al., 2017), this may explain why girls veer away from these domains from early on.

Another mechanism relates to stereotype threat (Steele & Aronson, 1995). Specifically, fixed organizational mindsets can cause people from stigmatized groups to wonder whether they will be valued as much as people from the advantaged groups, resulting in psychological withdrawals and finally poor performance that seemingly confirms the stereotypes (e.g., Canning et al., 2020; Emerson & Murphy, 2015; Good et al., 2012; LaCosse et al., 2020; Smith et al., 2013). In a set of studies, people were introduced to a consulting firm that held either a fixed or a growth mindset (Emerson & Murphy, 2015). Women tended to mistrust the firm with a fixed mindset and felt less comfortable in the setting. Specifically, after receiving negative feedback, women were found to disengage more often from a company valuing innate intelligence than from a company valuing effort and persistence.

These effects have been demonstrated in educational settings as well. Good et al. (2012) found that women's sense of belonging in a calculus course was reduced when they perceived others in their calculus class to both hold stereotypes against women's mathematical abilities and believe that mathematical ability is a fixed trait (see also Smith et al., 2013). A similar stereotype threat effect was found in groups negatively stereotyped because of their race (e.g., Canning et al., 2020). Professors' mindsets of intelligence exhibit a downstream effect on underrepresented racial minority students' performance. In particular, the racial achievement gaps were reliably wider in courses taught by professors holding more of a fixed mindset than in those holding more of a growth mindset. Taken together, group members seen as not intelligent face extra pressure in organizations valuing presumed natural brilliance and may tend to avoid these contexts.

Another mechanism pertains to institutional bias. Fixed organizational mindsets can lead practitioners of these settings to serve as gatekeepers, providing unequal opportunities to the groups perceived as less intellectually capable than their counterparts. As reviewed above, Murphy and Dweck (2010) found that an organization's mindset influences its members' recruitment decisions. After getting into a club embracing a fixed mindset, students tended to hire future candidates demonstrating attributes that presumably speak to a possession of raw intellectual abilities. This hiring practice may limit the opportunities provided to people stereotyped as not intellectually gifted. Indeed, in disciplines valuing intellectual abilities, female students were less likely to get responses than their male counterparts, regardless of the gender of the faculty member (Milkman et al., 2012, 2015). When faculty members in biological and physical sciences were asked to evaluate the suitability of a male or a female applicant for a lab manager position, both male and female faculty rated the male applicant as more suited for the position, were more likely to mentor him, and provided him a higher starting salary (Moss-Racusin et al., 2012). Another study focused on people's referrals for job positions

(Bian et al., 2018a). One group of participants was told that the ideal candidates should "have a high IQ, superior reasoning skills, and a knack for big, bold ideas," whereas another group of participants was told that the ideal candidates should "be highly motivated, have an outstanding work ethic and a superior commitment to doing their work as well as possible." People who were asked to refer brilliant candidates were much less likely to recommend a woman than were people who had been asked to refer someone who is diligent (40.5% and 52.5% female referrals, respectively).

More strikingly, this bias has developmental roots in early childhood (Bian et al., 2018a). Five- to seven-year-olds were presented with unfamiliar team games. Half of the children were told the games were for "really, really smart" children, while the other half of the sample were not provided this information about the games. Next, children were asked to select three teammates among six unfamiliar children (three boy and three girls). In the initial selection rounds, they tended to choose teammates who were their own gender, which was consistent with the favoritism for in-group members that children typically display when they choose friends (e.g., Shutts et al., 2013). In the third selection round, however, children were less likely to choose girls for the brilliance-focused game: girls were chosen as teammates for the brilliance-focused game 37.6% of the time, versus 53.4% for the game not portrayed as for "really, really smart" children. These findings suggest that children demonstrate bias against girls' intellectual competence for activities said as requiring sheer brilliance.

Conclusion

The findings reviewed in this chapter suggest that implicit theories about intelligence operate at both individual and organizational levels. Many questions remain to be answered with respect to the interplay of personal and organizational mindsets. So far, Walton and Yeager (2020) have shown that teaching people to hold an incremental theory of intelligence is analogous to "planting a seed in soil." An organization's mindset has to provide a necessary affordance for people's personal mindsets to take root, grow, and bloom. In an environment upholding a fixed mindset, people are unlikely to achieve the optimal benefits that their personal growth mindsets could offer. Future research could continue exploring this interaction. For example, would people's personal mindsets become synchronized with the mindsets held by an environment they are embedded in? In what contexts might people's personal mindsets have an influence on the broader mindsets at the organizational level? Such research would help us better understand the nature of the relation between personal and organizational mindsets.

From a developmental perspective, we know little about how these organizational mindsets are passed onto the next generation. American children in the first grade have developed differential ideas about what is required to succeed in math versus writing and reading (Gunderson et al., 2017). What are the informational sources that children harness to make sense of an organization's mindset? Do they make use of parental feedback to infer not only their own abilities, but also the ingredients required to gain success in certain subjects? It would be interesting to examine the various factors that contribute to individual differences in children's perceptions of organizational mindsets and to document potential variations across cultures.

Importantly, organizational mindsets bring in a host of consequences influencing people's psychological and behavioral outcomes. Furthermore, because of the widespread stereotypes against certain social groups' intellectual capacity, institutions attributing success to what is perceived to be innate talents rather than to effort and learning are particularly unwelcoming to members of these stigmatized groups. For example, the pervasive gender imbalance in academia and industry is in part due to the unified force of an organization's fixed mindset and the general stereotype against women's intellects. To promote girls' aspirations in pursuing all kinds of careers, strategies and interventions should focus on undermining the two clusters of beliefs to alleviate their consequences. For example, to inoculate stigmatized groups against the stereotypes about intelligence, one could imagine introducing girls to female role models who have achieved success in traditionally male-dominant fields (Dasgupta, 2011; Else-Quest et al., 2010; Shachnai et al., in press). In addition, fostering a growth mindset about an activity can counteract these consequences, as when the same activities were described as requiring dedication instead of sheer brilliance, girls' interest no longer lagged behind boys' (Bian et al., 2017). This leaves us hopeful that instilling a growth mindset at the organizational level by explicitly linking success to dedication, strategies, and mentoring could be effective in rectifying group-based inequality.

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13

Re-envisioning Intelligence in Cultural Context

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The search to understand the construct of "intelligence" has been a long journey as evidenced by the immense literature base that has been generated over decades. Numerous forms of intelligence have evolved over the years including cognitive, academic, successful, spiritual, interpersonal, intrapersonal, social, cultural, artificial, emotional, adaptive, practical, etc. Spearman's (1927) statement that, "In truth, 'intelligence' has become a mere vocal sound, a word with so many meanings that finally it has none" (p. 14) may be gaining even more traction today. In our discussions of culture and intelligence our discourse is often tied intimately to issues of race and ethnicity while acknowledging that culture impacts the

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measurement of intelligence, the operationalization of intelligence has been based upon what is valued and reinforced in mainstream American culture. Indeed, all psychological measures reflect what is valued within the cultural contexts in which they were developed. Our chapter will introduce major theoretical frameworks that have shaped how we understand intelligence globally, as well as present an argument that intelligence is a cultural creation that has disadvantaged Black indigenous people of color (BIPOC) communities.

The advent of intelligence tests served to anchor the construct of intelligence, as these tests were used to operationalize the definition of intelligence in the format of items with one correct answer (Jaarsveld & Lachmann, 2017). Traditional theories of intelligence, such as the General Intelligence Theory (Spearman, 1904), conceptualized the construct as a fixed and hereditary trait that is closely related to how well one performs on various cognitive tasks. Similarly, the standardized intelligence (IQ) tests developed around the same period (Binet & Simon, 1916) aimed to assess particular cognitive and intellectual abilities to determine how smart a person is. These standardized IQ tests were widely used and promoted as one of the significant inventions of American psychology (Benson, 2003). However, the traditional definition of intelligence and its measurement has also been one of the most controversial topics in the social sciences as they raised questions regarding bias and unfair usage regarding race, socioeconomic status, gender, and culture.

In addition to the well-established historical context of the field of intelligence testing, there has been research and scholarship that offered reductive perspectives of specific groups of people. One of these examples dates back to 1969 and includes the use of intelligence tests in the classification of students of color:

> We now have what may be called a 6-hour retarded child -- retarded from 9 to 3, five days a week, solely on the basis of an IQ score, without regard to [their] adaptive behavior, which may be exceptionally adaptive to their situation and community in which [they] live (President's Committee on Mental Retardation, 1969, n.p.)

The search to address racial group differences on intelligence tests led to the attempts to adapt and modify measures including the System of Multicultural Pluralistic Assessment (SOMPA; Mercer & Lewis, 1978); the biocultural model of intelligence (Armour-Thomas & GoPaul-McNicol, 1998), the Revised SAT (Freedle, 2003) and the Cross-Battery Assessment Model's (XBA; Flanagan et al., 2007) Culture-Language Test Classifications (C-LTC) and the Culture-Language Interpretive Matrix (C-LIM). Each of these assessment models promoted the adjustment of scores on intelligence measures taking into consideration factors such as degree of cultural loading, linguistic demand, and other contextual background factors. Unfortunately, these efforts were challenged and findings regarding their application did not appear to support the hypothesized goals and ultimately did not lead to change in the current use of intelligence measures.

Scholars critiquing the use of intelligence tests have noted that they are culturally loaded based upon dominant Western ideals (Croizet, 2011; Gould, 2014). Consistent findings support the racial-ethnic group hierarchy of Full Scale IQ (FSIQ) scores (i.e., Whites scoring at the mean of 100, Blacks one standard deviation below; Latinxs, Native Americans somewhere in between, and Asians scoring relatively higher on performance abilities than verbal) have been found consistently throughout studies of intelligence. Needless to say, this research has supported the perception that particular racial and ethnic groups are less "smart" than others based upon measures of full-scale IQ. Further challenges regarding flaws in sampling methodology and research design (Eberhardt, 2020; Gillborn, 2016; Gould, 2014) have been noted but the heated politicized debates between those with an environmental/cultural perspective versus those emphasizing hereditarianism continue:

> The repeated assertions that the negative reception of research asserting average Black inferiority is due to total ideological control over the academy by 'environmentalists,' leftists, Marxists, or 'thugs' are unwarranted character assassinations on those engaged in legitimate and valuable scholarly criticism. (Jackson & Winston, 2020, p. 3)

Opposing scholars (Crenshaw, 1990; Croizet, 2011; Eberhardt, 2020) representing a racial justice perspective note that misuse of intelligence tests have resulted in direct forms of oppression impacting communities of color.

Aptitude tests like the GRE and SAT have played a major role in the admissions process for educational institutions, specifically, determining which candidates are more likely to be successful in their academic trajectory. As funding resources in academia have become more limited over time, standardized testing has served as means of gatekeeping admissions and consequently limiting opportunities for Black, Indigenous People of Color (BIPOC). Usage of these aptitude tests led to controversies over the years due to their contributions to the inequities in admissions processes, concerns regarding access to test preparation programs promising increases in test scores to the members of more affluent communities, cheating scandals, etc.

In the face of the pandemic, a number of schools moved to being test-optional, spurring a number of publications indicating the impact of these measures on members of BIPOC communities. In addition to the work of racial justice movements and critical discourse underscoring the disparities in testing outcomes and role in admissions processes, the COVID-19 pandemic has also shed light on systemic disparities in admissions procedures, including usage of aptitude tests. Many standardized measures like the GRE have been challenged as giving greater advantage to students from White, neurotypical, higher socioeconomic groups, and online administrations are noted to disadvantage applicants from rural and low-income backgrounds (De Los Reyes & Udder, 2021). Low GRE-Q scores have disproportionately served as a barrier for admissions into psychology graduate programs for underrepresented minorities leading to a call for more equitable admission procedures (Gómez et al., 2021).

The societal and political landscapes have changed in dramatic ways during the pandemic and acts of domestic terrorism have increased, as well as racist attacks against people of color. The Senior Editor, *Special Collectors Edition*, perhaps best summed it up in the introduction to the *Scientific American* entitled "The Science of Overcoming Racism: What Research Shows and Experts Say About Creating a More Just and Equitable World."

> institutional racism, not race, has made people of color more than twice as likely to die from COVID-19…Black children and other minorities are disproportionately born into poverty and thus incur more health risks throughout their lives…Black people are about three times more likely than white people to be killed by law enforcement…People of color are more likely to suffer the consequences of a degraded and plundered environment…Those with power benefit from exploiting the natural world, but it's the poorest among us who bear the impacts. (Gawrylewski, 2021, p.1)

In 2020, Academics for Black Survival (A4BL) launched by founders Bellamy and Mosley brought together over 10,000 participants from around the world to address anti-Black racism in their personal lives and the academy. There is a clarion call for change, and it is against this contextual backdrop that we write this chapter.

The goals of this chapter are not to reiterate past arguments but rather to focus on thinking about how culture (broadly defined) has led to our understanding the ways in which intelligence is defined and measured. More importantly, given the current sociopolitical context and demand for critical pedagogy, we aim to examine how identity-based inequities are inextricably intertwined with our understanding of intelligence and intelligence testing.

Culture and Intelligence Testing

Numerous studies have attested to the impact of culture on measures of intelligence, answering affirmatively the question that cultures reinforce particular forms of ability. Therefore, cultural values, beliefs, attitudes, rituals, customs, communication styles, norms, as well as social and environmental conditions, impact the understanding of intelligence in diverse communities. Some cultures reinforce and value social aspects of intelligence—social responsibility, social constructive dispositions, wisdom, trustworthiness while others focus on aptitude, educational qualifications, and abilities to problem-solve that are more commensurate with traditional mainstream definitions (Dixon et al., 2016). While we speak in this chapter to differences between cultural groups, we recognize that there are variations within cultural communities that must also be recognized in our understanding of intelligence.

Theoretical Definitions of Intelligence

After the controversial publication of *The Bell Curve: Intelligence and Class Structure in American Life* (Herrnstein & Murray, 1994), 52 scholars and researchers with expertise on intelligence and in other allied fields endorsed the following definition in an editorial in *The Wall Street Journal*:

> Intelligence is a very general mental capability that, among other things, involves the ability to reason, plan, solve problems, think abstractly, comprehend complex ideas, learn quickly and learn from experience. (Gottfredson, 1997, n.p.)

While acknowledging that people of all racial-ethnic groups can be found at every IQ "level," the article notes that the bell curve for whites centers around 100, bell curve for Blacks at 85 and those of Hispanics somewhere in between.

Given the preceding discussion of how culture reinforces particular forms of ability, aspects of this definition reflect what is valued in mainstream U.S. culture—for example, speed and advanced planning and reasoning to arrive at the correct answer. However, the *Merriam-Webster* Dictionary (https://www.merriam-webster.com/dictionary/intelligence) adds to this definition aspects of survival and adaptability to deal with new and challenging situations; to apply knowledge and manipulate the environment; to perform computer functions; and to ascertain information regarding a possible threat from an enemy. Broadening our understanding of intelligence is clearly reflected in the literature highlighting various forms of intelligence beyond what has been measured by traditional tests. We provide brief descriptions of these forms highlighting cultural linkages.

Multiple Intelligences

The Multiple Intelligence Theory (MI) of Dr. Howard Gardner (1983) was one of the earliest theories that challenged the cognitive-based view of intelligence that emphasized the hereditary and fixed nature of the concept. Gardner defined intelligence as the "biopsychological potential to process information that can be activated in a cultural setting to solve problems or create products that are of value in a culture" (Gardner & Moran, 2006). The MI theory proposed eight types of intelligences, including logical-mathematical, musical, interpersonal, intrapersonal, and naturalistic intelligence, and posited that a person who is high on one intelligence could be low on another. Interpersonal intelligence has similarities with social intelligence, a concept introduced in 1920 by Edward Thorndike and that has been defined as the ability to understand other people and "act wisely in human relations" (Thorndike, 1920). On the other hand, intrapersonal intelligence resembles emotional intelligence, which focuses on the importance of understanding and regulating one's emotions and using them as guidance for actions (Salovey & Mayer, 1990).

By moving away from defining intelligence as a merely cognitive and intellectual trait, MI theory acknowledged, at least to an extent, the absurdity of labeling someone as "unintelligent" by looking merely at their standardized IQ scores. As previously mentioned, intellectual skills such as performing rapidly on cognitively demanding tasks, grasping novel and complex concepts, or working with abstract ideas may not be socially meaningful in all cultural contexts. Thus, recognizing types of intelligences, such as interpersonal, and/or bodily kinesthetic intelligence, can be considered as a step toward evaluating people in the context of their own environment and culture, yet it is far from perfect.

The MI theory has been criticized for defining intelligence in a way that ignores the types of intelligent behaviors valued and reinforced outside of the Western educational settings and, by doing so, upholds existing societal, economic, and educational structures that discriminate toward marginalized communities (Berry, 2004). Berry suggested that the MI model also maintains the status quo and perpetuates social injustices by leading the students with more intelligence types toward leadership roles by allowing them to have access to more resources and eventually enabling them to hold more power and influence over those with fewer types of intelligence. Despite its popularity, MI theory has been criticized for lack of empirical support in part due to measurement difficulties (Waterhouse, 2006).

Successful Intelligence

Sternberg (1997) defined successful intelligence as one's ability to identify meaningful goals given their disposition, skills, and sociocultural context and move toward those goals by amplifying their strengths while compensating for their weaknesses (Sternberg, 2011). Sternberg posits that successful intelligent people use a combination of analytical, creative, and practical abilities to move toward their goals. According to his theory, successful intelligent individuals are good at adapting to their environment, taking effective steps to shape their environment according to their needs, and moving on to other environments when the current one is not aligned with their goals. Successful intelligence theory rejects the notion that intelligence is an innate and fixed cognitive trait that can be fully captured with a standardized IQ test. Instead, the theory emphasizes that what intelligence means can change significantly depending on sociocultural context.

Emphasizing the impact of culture and recognizing the uniqueness of individuals is a step toward the right direction for formulating a culturally competent definition of intelligence. However, framing individual goal setting as the ultimate indication of intelligence can be interpreted as a Western-centered perspective. Setting personal goals and moving toward them "without letting anyone or anything get in the way" might not be applicable in more collectivistic societies (e.g., Latinx or Asian communities) in which upholding the community's goals over pursuing personal desires is cherished. Moreover, maintaining momentum to achieve one's personal goals requires a certain degree of privilege. Individuals with multiple intersecting marginalized identities might need to constantly alter, suspend, or even permanently put aside their personal goals as they often have limited resources to cope with unexpected life changes such as losing a job, having a sick family member, or experiencing a global pandemic.

Cultural Intelligence

Cultural intelligence refers to one's ability to adapt effectively to new cultural contexts (Earley & Ang, 2003). This form of intelligence requires an individual to go beyond what would constitute their "normal" cultural cues as what they know about social interactions (norms and practices) are no longer clear or known. Cultural intelligence requires motivation, capability, intention, and action. Earley and Ang (2003) note that culturally intelligent behavior results from the interaction between cognitive (direction), motivational (adaptation), and behavioral (criticism). All of these are required to be viewed as culturally intelligent.

Thomas (2017) emphasizes the importance of being knowledgeable, skilled, and flexible. Culturally intelligent people are those that have knowledge about what a culture is, how they can potentially vary, and how culture can impact behavior. This is a complex process given that the ways in which a culture operates are often invisible. Being mindful of one's own knowledge and feelings is key as the individual must be attentive and sensitive to cues embedded in encountered situations. Based upon knowledge and mindfulness, cross-cultural skills and understandings can be achieved and a repertoire of potentially appropriate behaviors can be developed to address the needs and demands of varying intercultural interactions.

Cultural intelligence broadens the range of our understanding of intelligence to a global perspective. Being able to interact in a global society is a fundamental requirement (Thomas, 2017). This is reflected in the development of international competencies in psychology, emphasizing the critical importance of "cultural intelligence, language proficiency, cognitive complexity and flexibility, and highly developed interpersonal communication skills" in providing globally linked services both in person and through social media and other online resources (Inman et al., 2019, p. 630).

Emotional Intelligence

This form of intelligence has been defined as "the ability to accurately identify and express emotions, the ability to generate emotions and use them to help you think, the ability to understand emotions and their causes, and the ability to manage emotions so that they inform your decision making" (Caruso, 2008, p. 7). Emotional intelligence has gained international popularity over the years and measures of this construct have been translated into new languages, renormed, and revalidated in different countries. Understanding this concept has implications for ones' personality, quality of life, leadership skills, employment, and social relationships in similar ways as it has been associated with cultural intelligence.

In a review by Ekermans (2009) examining research on emotional intelligence in different cultural contexts, the author provides insight into how cultures may differ, on average, in emotional regulation, emotional expression, and emotional regulation. The author concludes these differences may be the result of varying cultural value dimensions that define appropriate adaptive emotionally intelligent behaviors. For example, Ekermans (2009) notes differences between individualistic and collectivistic cultures in terms of emotional expression and display rules. Collectivistic cultures emphasize maintaining harmony and promotion of overall group welfare over individual gain. Therefore, conflict-inducing behaviors are reduced. In comparison, individualistic cultures pose fewer constraints regarding emotional expression as the focus is on self-gain for the individual. Emotional display rules impact emotional regulation and are learned through reinforcement of social and cultural norms.

Spiritual Intelligence

Though there is debate as to whether spiritual intelligence is a unique form of intelligence, we include mention of work in this area given the importance that spirituality has played in indigenous cultures and the critical role it can play in understanding intersectionality. Like other forms of intelligence examined above, spiritual intelligence has been shaped by several factors, including colonialism and secularism, as well as religious ideology. Certain forms of spirituality (i.e., indigenous, African, etc.) remain marginalized and in some cases erroneously perceived as unevolved—that is, ancestor worship, religious offerings, sacrifices, etc. Given that these dynamics and social hierarchies remain ever-present in society and within the scientific community, the field of psychology has not endorsed spiritual intelligence as a unique type of intelligence (Skrzypińska, 2020). While debates continue regarding whether spiritual intelligence meets the criteria of a unique form of intelligence, we include a brief description here as it serves to inform our understanding of the range of intelligences with potential ties to our discussion of culture. Emmons (2000) highlighted characteristics of spiritual intelligence in terms of five components (p. 3):

- the capacity for transcendence (going beyond our ordinary limitations; beyond the physical);
- the ability to enter into heightened spiritual states of consciousness;
- the ability to invest everyday activities, events, and relationships with a sense of the sacredness;
- the ability to utilize spiritual resources to solve problems in living; and
- the capacity to engage in virtuous behavior (to show forgiveness, to express gratitude, to be humble, to display compassion).

Only the first four of the above components were eventually retained, given the hypothesized overlap for the last component with ethics and personality.

According to Emmons (2000), spiritual intelligence is tied to goal setting and attainment and is tied to the adaptive use of spiritual information to problem-solve and discover the meaning of life. Similarly, adaptiveness in combination with other attributes involves the coordination of multiple goals to reach higher order principles. Spiritual formation involves obtaining a knowledge base regarding that which is considered sacred. In some cultures, the study of sacred texts and commitment to the practice of spiritual exercise leads to an increase and refinement in spiritual knowledge. Religion often focuses on specific beliefs and organizational structures and practices making it distinct from our discussion of spirituality. Emmons (2000) further indicates that abilities and competencies related to spiritual intelligence are valued differently, depending on culture. For example, he cites the work of Yang and Sternberg (1997), who found that Taoist and Confucianist Chinese cultures value character virtues to definitions of intelligence in Western societies. "Tethering spirituality and intelligence enables an acknowledgement of and deeper appreciation for spiritual and religious ways of knowing that might be highly prized in certain cultures" (Emmons, 2000, p.21).

Skrzypińska (2020) notes that the historical backgrounds and traditions of societies provide examples of the creation of spiritual languages of believers, numerology, spiritual graphics, and special music representing expressions of spirituality. Spiritual intelligence in combination with emotional intelligence is hypothesized to create a sense of well-being and satisfaction, humility, benevolence, wisdom, and morality.

Artificial Intelligence

Technological advancements have changed the cultural landscape on a global scale. This is clearly evident in the face of the worldwide pandemic with unprecedented impact on all areas of society, increasing our reliance on technology to maintain educational, medical, social, religious, and other systems moving as we hunkered down, unable to continue to work in-person. To do our work remotely, this involved providing hardware and software to all students and frontline workers. Automatization of food delivery, remote classrooms, online medical appointments are but a few examples of how our world has changed. We cannot deny the disparities in access to resources provided to marginalized and oppressed groups around the world (https://ourworldindata.org/global-economic-inequality). Hence, we include attention to artificial intelligence as these modalities and strategies have changed our culture and indeed our sense of what intelligence is and could be.

> The aim of artificial intelligence is to simulate the intelligence of a human being through a computer and to make a decision that is similar to learning to a certain extent, to create a strategy of choice. Artificial intelligence generally consists of methods that aim to model the thinking systems of humans, the model/mode of work of the brain or the biological evolution of nature. (Uğur & Kurubacak, 2019, p. 2)

This definition is limited given that AI optimization models have moved beyond what can be accomplished by expert systems thereby no longer modeling human thinking but going far beyond (Teich, 2018). Techniques associated with artificial intelligence include: knowledge-based expert system approach, artificial neural networks approach, a fuzzy-logic approach, non-traditional optimization techniques, hybrid algorithms, geographic information systems, and improvement of decision support systems. Because of these advances, "cultural transformation has been initiated with the shaping power of advances in technology, media and communication" (Uğur & Kurubacak, 2019, p. 4). A cyber culture has emerged worldwide, providing computer networks for communication, entertainment, and business. The authors note that transhumanist culture is based upon technologies that have developed based upon personkind's "desire to dominate nature" (p. 6). These include developments as simple as reading glasses, robot hands, prosthetic legs, eye-tracking devices. Transhuman technologies will become integrated into everyday life and like the cultural linkage to intelligence will surround us but be unobservable. "Transhumanism, which plays a critical role in the development of the personal self, will have a critical importance in changing the social identity and cultural structure of the societies of individuals" (p. 6).

Artificial intelligence enables us to accumulate massive amounts of data to discover underlying patterns leading to predictions of future events and behaviors (Caramiaux, 2020).

> In this context, AI is often erroneously considered neutral as it appears to be no more than a set of sophisticated optimization mechanisms used to achieve a task, e.g. classifying images, generating sounds or texts, with the best performance. However, AI builds on data that capture socio-cultural expressions represented by music, videos, images, text, and social interactions, and then makes predictions based on these profoundly non-neutral and context-specific data…A human-centric perspective on AI should embrace cultural diversity and should support human creativity, critical discourses, and artistic idiosyncrasies. (https://research4committees.blog/2020/09/07/the-use-of-artificial-intelligence-in-the-cultural-and-creative-sectors/)

Caramiaux expresses caution that the cultural implications of artificial intelligence must be addressed in the development of public discourse and policies.

Adaptive Intelligence

Given that adaptive intelligence is highlighted in other sections of this text, we provide only a brief description of adaptive intelligence as it relates to culture. Sternberg (Sternberg, 2021a, 2021b) provides a critique of current intelligence measures and theories in his innovative transition to adaptive intelligence. Acknowledging the cultural imperialism embedded in the intelligence testing movement, Sternberg identifies race as the "red herring" in intelligence research and that tests represented Western cultural values.

As humankind faces global crises what is needed is an intelligence that supports adaptation to a rapidly changing environment. This requires abilities not represented in traditional intelligence measures. As noted earlier in this chapter, IQ tests, and other standardized achievement tests like the SATs and GREs are viewed by the public as measuring something that is highly meaningful and has a great deal to do with opportunities that will be available in the future. Adaptively intelligent people are able to see the implications of their behavior in the long term and take action for the good of the group rather than individual gain.

The assumptions underlying adaptive intelligence resonate with a cultural re-envisioning of intelligence.

Future Directions: Moving Toward the Next Definition

As we discussed the various ways intelligence has been conceptualized and measured since the early twentieth century, we pointed out that many theories and definitions of intelligence failed to pay close attention to the experiences, cultures, and values of BIPOC communities. Instead, most approaches are primarily aligned with the values and worldviews of predominantly white, Western, middle-class, Christian individuals. This section will focus on the aspects of intelligences held by marginalized and oppressed individuals. These are not often well-examined and nor measured in the intelligence literature.

Racial socialization relates to intelligence as evidenced by parents or other caretakers teaching BIPOC children about their race and ethnicity with the hope of preparing them to recognize, navigate, and survive microaggressions and discriminations (Neblett et al., 2010). In essence, to adapt and survive in a racist society, BIPOC communities are directly impacted by microaggressions, discriminatory actions, over-policing, and biased perceptions about their behavior as aggressive or inherently hostile (Denworth, 2021; Oreskes, 2021; Sue, 2021). Thus, being aware of potential threats at all times, avoiding certain situations, and code-switching across social settings (i.e., changing voice tone, vocabulary, and body language) play a critical role in BIPOC individuals' survival. They can also be an indication of their social astuteness and an in-depth understanding of how to navigate social hierarchies.

In a study, Carrillo (2013) interviewed three Latinx men who have graduate degrees about their experiences, as working-class Latinx men are historically not regarded as intelligent and not expected to succeed in Western educational settings. By doing so, Carillo aimed to identify the type of intelligence these men had to develop to survive in White-dominated academic environments. He concluded that the kind of intelligence these men held was reflected in their struggles of constantly navigating and adapting to the power dynamics within academia to keep doing meaningful work and getting their message across while maintaining their sense of identity and not feeling like a "sell-out." This was a type of intelligence that their White classmates did not need to survive in academia. While these examples focus on the academic context, there are other examples of survival behaviors engaged in by BIPOC communities presented by Carillo. He mentions immigrant Latinx children acting as "cultural brokers" to help their parents navigate their interactions in U.S. society and Latinx students from low-SES families constantly maintaining an additional level of consciousness to make sense and work through the contradictions and ambivalences they experience in their everyday lives.

We can also talk about intelligence related to BIPOC communities by examining how their historically marginalized, oppressed, and ridiculed aspects of cultures have become a valued part of mainstream society. The aspects of BIPOC communities' cultures, including but not limited to their values, clothes, hairstyles, foods, music, and rituals, have been labeled as "primitive" and regarded as proof of their "intellectual inferiority." However, today, many aspects of people of color's culture are being integrated and promoted for money-making and entertainment purposes. For instance, many Western clothing companies profit from using patterns, shapes, and colors on their products belonging to Native-American culture. Other examples may be seen in terms of the growing popularity of Yoga, Hip Hop, and meditation. Credit to the originators of these particular indigenous practices is often not acknowledged and no attention is given to their cultural significance.

Numerous authors have called for the recognition and integration of the "voices" of members of diverse cultural communities in understanding intelligence as a holistic construct. In the past this has meant administering intelligence tests in diverse communities. Here we are speaking about gaining an understanding of what is important and reinforced within a cultural community. Therefore, the format and content of an intelligence measure must be organically derived based upon this understanding. Further, awareness and knowledge of intersectional identities increases the complexity of our work as culture is not just related to race, ethnicity, and country of origin but also identities of social class, disability status, gender identity, etc.

Given our understanding of the various forms of intelligence and their linkage to cultural adaptability and survival, we equate intelligence to one's ability to live a life where they move toward goals that are meaningful for them (i.e., successful intelligence, adaptive intelligence). With the world changing rapidly, the same set of skills, habits, attitudes, and behavior that enabled people to move toward their goals two years ago would probably require at least some degree of modification to keep working today. The question then becomes: *What are the characteristics of people who manage to adapt to the ever-changing "next normal" and keep moving forward in the midst of this chaos?* We must also acknowledge the role of environmental factors, birth, and just pure luck as these play a role in survival and in creating the conditions under which an individual and/or community must adapt (Sternberg, 2021a, 2021b). More importantly, we must recognize that the same methods that led the field of psychology to promote biased and racist ideologies will likely continue to do so unless significant change takes place (Winston, 2020).

The Next Normal on Intelligence

The formulation of theories of intelligence, creation of intelligence tests, and allowance of these tests to create a reality of disparities between different cultural communities can be viewed through the lens of the Anthropocene epoch—that is, an example of humankind's attempt to define and control that which occurs in nature. While we want to recognize the contributions of scholars who developed a research agenda addressing what it means to be "smart" in our society we also must ask: *How can a construct so laden with controversies and challenges in BIPOC communities become viewed as the major contribution of a profession (i.e., psychology)? How can we mitigate further harm to BIPOC communities and reduce disparities?* These are questions being asked in mainstream communities and the lay public as noted in the 2021 Special Edition of the *Scientific American* entitled: "The Science of Overcoming Racism: What Research Shows and Experts Say About Creating a More Just and Equitable World."

Intelligence tests have been a major export for testing companies as they are translated, renormed, and restandardized in many countries and considered the gold standard of the psychometric movement. These measures have reified the construct of intelligence that has led to worldwide application, despite concerns regarding their usage in BIPOC communities (e.g., Suzuki et al., 2011).

The Anthropocene epoch challenges us to think about how our culturally biased view of the world and attempts to survive and adapt to the environment have led to changes in nature that we find ourselves now unable to control (Sternberg, 2021a, 2021b). Global climate change, immigration, xenophobia, civil and ethnic conflict, pollution, policing, and the COVID pandemic have disproportionately impacted BIPOC communities (Boyce, 2021). That ultimately, our efforts are futile given the forces of nature Gaea once supported the development of humanity but is now demonstrating her ultimate control as she protects the earth. Members of indigenous cultures (e.g., Native Americans and Hawaiians) recognized their role in the world as being the caretakers of the Earth rather than adopting the goal of gaining mastery over nature. The challenges facing our society are great and will require intelligent people broadly defined and groups to alleviate problems for all communities.

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14

Challenges for Intelligence Today: Combatting Misinformation and Fake News

Stephen J. Ceci and Wendy M. Williams

Ubiquity of Fake News Today

Fake news abounds today on social media. Ideologues and conspiracy theorists, as well as the merely misinformed, regularly post claims that are misleading at best and outright lies at worst. But how can people tell whether an online claim is valid? Does cognitive ability play a role in this ability, possibly immunizing the *so-called* cognitive elite—highly educated, high IQ people—from believing and sharing false claims?

The short answer is that one cannot discern the truth value of an online statement from the information and details contained within the post itself, if the post is deliberately intended to mislead readers. This is because humans are notoriously poor at lie detection, which is demonstrated every time people believe a dubious online claim. Consider a recent claim that the Saudi Arabian women's judo champion, Tahani Al-Qahtani, died

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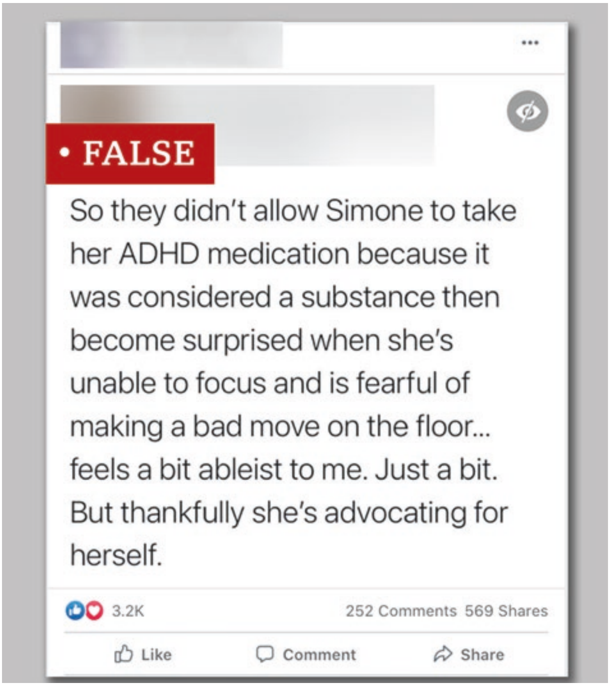
of a heart attack after losing her Olympics match to her Israeli opponent, which led to bullying that resulted in her fatal heart attack. It is true that Al-Qahtani did lose the match to her Israeli opponent in the 2020 Olympics (held in July 2021). But she never had a heart attack and she is still very much alive, leading Twitter to label the claim of her death as false. But this is not something that even a highly intelligent or well-educated person could discern from the tweet itself. To recognize the falsity of it, readers had to be privy to information that went beyond the tweet itself. That is, there is nothing in the tweet itself that would allow a smart, educated person to perform superiorly to someone with less cognitive ability in detecting its falsity.

An internet search of other 2020 Olympic athletes reveals similarly false assertions, including the claim that the renowned gymnast, Simone Biles, lost her concentration because she was forbidden by the Olympic Committee's governing board to take her medication for attention-deficit disorder with hyperactivity (ADDH). This claim was later shown to be false. (She had not taken the ADDH medication for five years, and it had no bearing on her performance.) There is no validated textual analysis that would reveal the falsity of this claim.



This phenomenon extends into virtually every domain. A search for terms such as *vaccine risk, Sandy Hook, election fraud,* and *climate change* will yield thousands of similar claims that not only lack scientific support, but that often contradict all available scientific evidence: See, for example, Alex Jones' notorious claim that the massacre of 26 children and their teachers at Sandy Hook Elementary School in Newtown, CT, was a "giant hoax," staged by actors; or the claim that during the 2020 presidential election the Dominion voting system was rigged in favor of President Biden; or the claim that stem-cell therapy cured famed ice hockey star Gordie Howe. For this last example of the reliance on unproven medical therapies, only 3 out of 2783 tweets following Howe's treatment with stem cells after his stroke acknowledged the absence of scientific support for direct-to-consumer stem-cell treatments. Such false claims are no easier to detect than are other types of falsehoods and, as already noted, humans are very poor lie detectors. Psychometric intelligence does not appear to afford an advantage in lie detection regardless of whether lies are encountered offline or online. This is consistent with views that distinguish the cognitive ability required to perform well on intelligence tests with the skills required to excel at rational reasoning—they are quite different (see Stanovich & Stanovich, 2010).

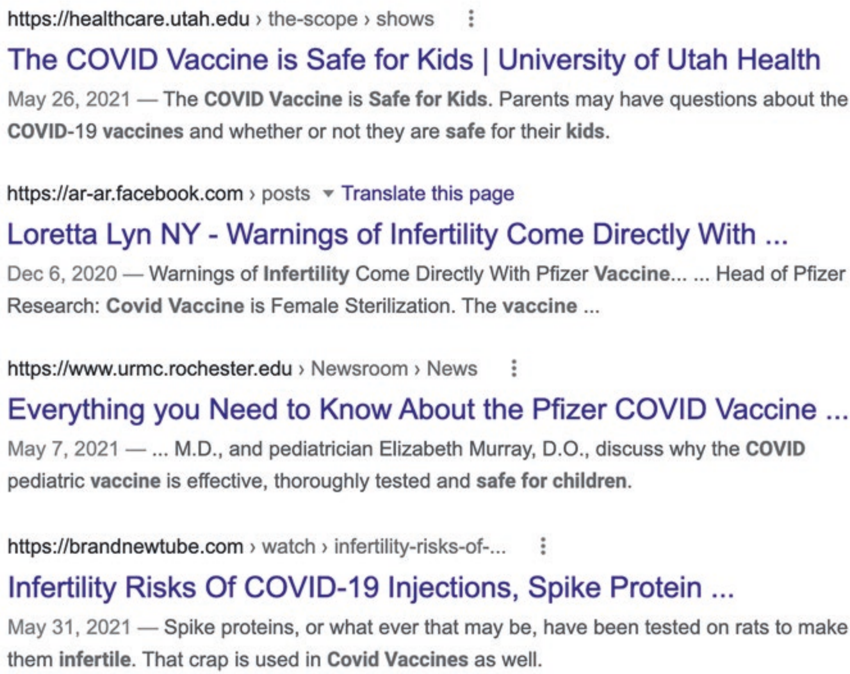
Detecting Fake News

The problem of detecting fake claims is rooted in our ancestrally essential, recurrent need to identify honest agents and reciprocators. It therefore is quite limited and domain-specific, because it searches for signs of dishonesty that might benefit one side in a social exchange. Even if there is an advantage to this ability, it has no value in detecting falsity in situations in which incorrect information has no obvious motivational value for its purveyor (Cosmides et al., 2010). Of course, there may be less-obvious advantages associated with crafting and disseminating inaccurate information, such as indirect benefits for the authors of deliberately false claims.

So, for instance, fake news that has no obvious value for its perpetrator is difficult to recognize (e.g., only 40% of respondents were able to correctly detect the falsity of the claim that "chemosynthesis is the name of the process by which plants make their food"). In contrast, consider the ability to detect fake news in which the readers' real-world knowledge can help them to decide the truth value and motivational component via a battery of inferential tools that include inferences about the motives of the purveyor. For example, detecting the false claim "Trump to Ban All TV Shows that Promote Gay Activity Starting with *Empire* as President" was correctly recognized as fake news by 82.2% of respondents (Pennycook et al., 2018).

Fake claims on social media are not limited to sporting news or trivia, of course. The majority of Americans now rely on social media for all of their science news, as we show below. This represents an enormous shift away from traditional sources of news that are filtered and curated by the mainstream media. And it presents a formidable challenge when trying to sort the wheat from the chaff, lest scientific findings get misconstrued. For instance, several of the claims below assert that the Pfizer mRNA vaccine leads to female infertility, and several make the opposite claim. The same is true of claims and counterclaims about vaccine safety for children. Deciding which claims are supported by scientific or medical evidence is not as easy as one might hope. Once again, there is little in the tweets themselves that can help with this task.

It is tempting to conclude that those who uncritically accept misinformation are lower on measures of general intelligence, but the evidence for such an aspersion is weak at best, and examples abound of highly educated readers falling prey to online financial and medical scams. Consider the following posts that were generated by recent searches for COVID safety and multiply this number by several orders of magnitude to get a sense of how widespread are the posts containing misinformation.



Cognitive and Non-Cognitive Factors Influencing Detection of Fake News

How do readers decide which claims are based on solid evidence and which are demonstrably false? And what role, if any, do cognitive and non-cognitive factors play in their decision process? Do readers downrate sources that do not sound reputable (e.g., by preferencing scientific or medical sources)? Or are they skeptical about sources that contain extremist-sounding language, and/or sources that fail to conform to their prior beliefs and ideology, or that evoke doubts about the ulterior motives of the source? How do cognitive and non-cognitive factors influence their decisions?

Before delving into these questions, we note that there are many studies showing that the challenges of recognizing fake news are not limited to those who are poorly educated. Even members of the professoriate are not immune to making these errors, including social scientists, who have been shown to be prone to committing ideologically motivated reasoning errors when they are asked to judge the accuracy of claims (Ceci et al., 2021). For example, social scientists downrate the validity of research proposals or scientific articles when they are led to believe that the authors of the proposals and articles hold ideological beliefs contrary to their own, even when the actual content is identical except for the authors' alleged political alignment. Relatedly, scientists downrate the quality of findings that are methodologically identical, except that one purports to find in favor of a liberal aim, and the other purports to find in favor of a conservative aim (Clark & Winegard, 2020; Ceci et al., 2021). This finding is noted in recent reviews based on decision-making about scientific findings from hypothetical experiments that are identical except for their ideological tilt: "people are more critical of scientific evidence (e.g., Campbell & Kay, 2014; Munro & Munro, 2014), and, at a computational level, make more mistakes with numeric (Kahan et al., 2017) and logical reasoning (Gampa et al., 2019) when the conclusions, outcomes, or consequences are politically inconvenient than when they are ideologically desirable" (Clark & Winegard, 2020).

Thus, even highly educated individuals are not immune to the lure of false postings on social media. Social scientists are often members of homogenous social networks and they exchange information primarily with those who share their sociopolitical orientation; they are also motivated to be particularly skeptical of comments that run counter to their ideology. Sternberg (2005) has argued that smart people are in fact more susceptible to being foolish, because they do not believe that they can be. More about this below.

Misinformation, Disinformation, Gullibility, and Suggestibility

To address the issue of vulnerability to fake news, there are four constructs that need to be distinguished: *misinformation*, *disinformation*, *gullibility*, and *suggestibility*. Cognitive scientists have studied these constructs for many decades, including in our lab at Cornell University. The first two refer to the nature of information that is presented, whereas the third and fourth constructs describe a listener's or reader's proneness to incorporate information into their reports and possibly into their belief systems.

Misinformation is the presentation of invalid information. This presentation may or may not be intentional on the part of the speaker or writer. For example, a speaker may unwittingly convey misinformation to a listener, without realizing that it was misinformation, or repeat invalid information that is honestly believed to be valid. Misinformation exists independently of the proneness of the listener to believe it. On the other hand, a speaker may knowingly present invalid information in an attempt to influence a listener, and this is referred to as disinformation. *Disinformation* refers to the wanton provision of false information in an attempt to mislead others, and it also exists independently of a listener's gullibility. Thus, misinformation encompasses all forms of inaccurate information, regardless of the beliefs of the writer or speaker, whereas disinformation is restricted to the subtype of misinformation that is deliberately and knowingly false.

In contrast to distinctions based on the nature of information (valid vs. invalid claims) and motives (claims that are deliberately inaccurate or not), the construct of *suggestibility* has to do with the listener's or reader's likelihood of adopting claims made by others, regardless of their validity or the motives of their source. Some individuals are more suggestible than others when they are confronted with claims, regardless of whether the claim is accurate, unknowingly invalid, or deliberately invalid. This can be seen in numerous experiments that show individual differences in incorporating information in response to a wide range of sources, from subtle suggestions and leading questions to blatantly false claims. But IQ and education are not the drivers of this vulnerability, because it is largely an automatic, non-cognitive process, what Kahneman (2011) refers to as System 1 processing that does not benefit from the conscious attention or limited capacity resources that the cognitive elite might possess in abundance. Even if the initial exposure to a false claim raises some suspicion, once it has been encountered it can take root in our belief system (Corneille et al., 2020; Pennycook et al., 2020).

An example of suggestibility is Loftus and Palmer's (1974) classic experiment showing witnesses who watched a video of an auto accident and were asked to recollect the vehicles' speed prior to impact using various suggestive verbs, such as "About how fast were the cars going when they (smashed /collided/bumped/hit/contacted) each other?" Those who were asked how fast the cars were traveling when they smashed into each other estimated that they were going significantly faster than witnesses who were questioned about how fast they were traveling prior to contacting or hitting each other. Suggestible individuals were more likely to rate the cars' speed higher when a verb like smashed was used. This was an automatic response that was influenced by the semantics of the verb used. Not all individuals are equally suggestible, but measures of cognitive aptitude are not good predictors and in many studies there is no correlation at all once the lowest-functioning individuals are excluded.

Gullibility is a related construct with an important difference. It is a failure of social intelligence in which a person is easily manipulated into an ill-advised act. It is closely related to credulity, which is the tendency to believe unlikely propositions that are unsupported by evidence.

The willingness to believe in fake news may in some cases be the result of non-cognitive factors like credulity. Pennycook et al. (2015) showed that the endorsement of fake news headlines that appeared on Facebook was affected by individuals' credulity. For example, when presented with meaningless statements, some believe they reflect deep insights. (Anyone familiar with Deepak Chopra's writings—see examples below—may have wondered if they somehow missed the deeper meaning to what appear to be nonsensical statements that others seem to appreciate.) Consider the following statements taken from Pennycook et al.'s (2015) Bullshit Receptivity Index.

> **Hidden meaning transforms unparalleled abstract beauty.** [a]
> **Good health imparts reality to subtle creativity.** [a]
> **Wholeness quiets infinite phenomena. a**
> **The future explains irrational facts.** [a]
> **Imagination is inside exponential space time events.** [a]
> **Your consciousness gives rise to a jumble of neural networks.** [a]
> **Your movement transforms universal observations.** [a]
> **Perceptual reality transcends subtle truth.** [a]
> **The invisible is beyond new timelessness.** [a]
> **The unexplainable undertakes intrinsic experiences.** [a]

Source: wisdomofchopra.com

Attention and intention are the mechanics of manifestation. [c]
Our minds extend across space and time as waves in the ocean of the one mind. [c]
Nature is a self-regulating ecosystem of awareness. [c]
We are non-local beings that localize as a dot then inflate to become non-local again. The universe is mirrored in us. [c]
Mechanics of Manifestation: Intention, detachment, centered in being allowing juxtaposition of possibilities to unfold. [c]
Mind and matter are subtle and dense vibrations of consciousness (spirit). [c]
We are not an emergent property of a mechanical universe but the seasonal activity of a living cosmos. [c]
Every material particle is a relationship of probability waves in a field of infinite possibilities. You are that. [c]
As beings of light we are local and non-local, time bound and timeless actuality and possibility. [c]
Matter is the experience in consciousness of a deeper non-material reality. [c]

Source: twitter.com/deepakchopra

The type of credulity that accepts the cogency of vapid statements is a component of Pennycook et al.'s Bullshit Receptivity Index. This type of credulity might also be instrumental in persuading some people to accept unwarranted medical and scientific assertions that ignore base rates, lack appropriate control groups, and fail to consider contrary evidence. Such flawed reasoning has been omnipresent during the Coronavirus pandemic, with tragic consequences.

Intelligence, Cognitive Biases, and Online Fake News

A great deal of research on cognitive biases reveals that individuals who are members of the *so-called* cognitive elite (i.e., those who are highly educated or have high IQs; we note that some people find this term elitist in itself) are spared from the worst cognitive ravages caused by many forms of bias. These forms of bias include hindsight bias, confirmation bias, anchoring, framing, conjunction, overconfidence, and gambler's fallacy (see Kahneman, 2011 for descriptions of these biases): "We have repeatedly observed this tendency in our lab for over two decades now (see Stanovich, West, and Toplak 2016 for a review of the evidence), and our finding has been replicated in numerous experiments conducted by other researchers" (Stanovich, 2021; see also Ceci, 1996). In short, resistance to most types of bias is correlated with individual differences in cognitive ability (Aczel et al., 2015; Bruine de Bruin et al., 2007; Finucane & Gullion, 2010; Klaczynski 2014; Parker & Fischhoff, 2005; Parker et al., 2018; Stanovich, 2021; Weaver & Stewart, 2012; Weller et al., 2018).

However, there is an interesting and important disjunction in this work. Notwithstanding the role that intelligence plays in resisting the above forms of cognitive bias, there is one type of cognitive bias for which intelligence seems to play a very limited role: The cognitive elite are *not* spared when it comes to what is known as "myside bias." This is an important type of bias for recognizing fake news and resisting misinformation. Myside bias is related to confirmation bias but goes beyond it. It reflects a biased tendency when (a) searching, (b) assimilating, and (c) evaluating evidence, as well as (d) biased reconstruction of these undertakings (e.g., Clark et al., 2019; Ditto et al., 2019; Epley & Gilovich, 2016; Taber & Lodge, 2016). Thus, myside bias relates to the biased search and idea-generation process, which is not central to confirmatory bias, while also addressing factors such as biased evaluation that is central to confirmation bias. Unlike other forms of cognitive bias that largely spare the cognitive elite, myside bias affects the cognitive elite just as much, including social scientists: "(myside bias) *is the bias where the cognitive elites most often think they are unbiased when in fact they are just as biased as everyone else*" (Stanovich, 2021, p. xi).

On its face, myside bias would seem to be involved in succumbing to invalid claims. As noted, Stanovich et al. (2013) report that myside bias, in which people evaluate evidence, generate evidence, and test hypotheses in a manner that favors their own opinions and attitudes, is unrelated to intelligence—approaching zero correlations across the wide ability range that is found on a public college campus (see also Klaczynski, 1997; Klaczynski & Lavallee, 2005). Even eminent scientists can fall prey to ideologically driven myside bias, as we show below. Myside bias operates in an insidious manner. It influences reasoners' "intuitive likelihood" estimation, which in turn influences their decision to accept or reject fake news. For example, those who believe that promoting the use of condoms is immoral are less likely to believe that condoms are effective at preventing pregnancy and sexually transmitted diseases. Similarly, the more strongly one believes that coercive interrogation of terrorists is immoral, the less likely they are to believe that it leads to accurate disclosures by those being brutally interrogated.

In other words, there is a human tendency to lower the costs of moral commitments we endorse, which in turn leads to acceptance of false claims/fake news that is consistent with our beliefs. This explains why when Stanovich and Toplak (2019) asked participants in their study to generate arguments in favor of their stance on controversial issues such as selling their organs. They gave many more reasons that aligned with their position than reasons that ran counter to it; this form of myside bias was uncorrelated with cognitive aptitude. Perkins et al. (1991) had originally published a related finding showing that although subjects with higher intelligence generated more arguments overall during an argument-generation task, they did not generate more arguments against their personal position, an early demonstration of myside bias being uncorrelated with intelligence. This is one of myriad studies using an argument-generation paradigm to reveal a myside bias in which participants rated arguments aligned with their personal views as superior to those that were misaligned. As Stanovich (2021) points out in his review, in all of these studies, myside bias was just as evident in participants possessing high intellectual ability as in less-intelligent people.

Readers may be surprised to read that myside bias is uncorrelated with cognitive ability, given that the latter is a strong predictor of a wide range of cognitive outcomes. The key to understanding why this is so can be seen in Klaczynski and colleagues' experiments (Klaczynski, 1997; Klaczynski & Lavallee, 2005; Klaczynski & Robinson, 2000). Their subjects were given hypothetical experiments that contained reasoning flaws (e.g., base-rate neglect, sample limitations) and conclusions that were either opinion-consistent or opinion-inconsistent. Klaczynski and his colleagues examined the quality of reasoning when subjects critiqued the flaws in these hypothetical experiments, and showed—as might be expected based on the larger literature—that cognitive ability was a significant predictor of subjects' overall quality of reasoning in both the opinion-consistent and opinion-inconsistent conditions. However, the critique of opinion-inconsistent results was far greater than the critique of opinion-consistent results, that is, the myside bias. So, it is not that cognitive ability plays no role in reasoning tasks; rather, it is that myside bias can be found across the cognitive spectrum of participants in typical psychology experiments on state college campuses. It is highly domain-specific, surfacing in some domains but not in others. Thus, myside bias in one situation is not a reliable predictor of myside bias in another.

Suggestibility Versus Gullibility

When it comes to suggestibility, researchers have not consistently found significant correlations between cognitive measures (IQ, Cognitive Failures Questionnaire) and suggestibility. The most suggestible individuals tend to perform as well as the least suggestible ones on intelligence measures, at least if we exclude very low-IQ individuals (Merckelbach et al., 1998). The late intelligence researcher, James Flynn, described a legal case he consulted on in which a low-functioning young man was extremely gullible (Flynn, informal talk at Cornell University, 2008). Other men showed him how to hot-wire a car and asked him to bring a neighbor's car to them so they could test it, which they told him was a request. In their seminal work, Gudjonsson and Clark (1986) found that intelligence does not affect suggestibility when the participant's IQ scores are within the low-average to above-average range, a finding that has been found by others. For example, Richardson and Kelly (1994) found that among average and above-average adolescent offenders, there was no correlation between suggestibility and IQ scores; the only group showing a significant correlation were those who scored below average. Sondenaa et al. (2010) did report significant correlations between the various Wechsler scales and total suggestibility. As seen in Table 14.1, the lowest IQ individuals tend to possess the highest suggestibility scores, hence the negative sign referring to the relationship between intelligence and suggestibility. But the magnitude of the effect was small and driven by the lowest IQ individuals.

Table 14.1 Data from Sondenaa et al. (2010). All correlations are significant at $p < 0.05$

Correlation of WASI IQ with GSS and GCS			
	WASI Full Scale IQ	WASI Verbal IQ	WASI Performance IQ
GSS ($n = 113$)			
Immediate recall	0.544	0.540	0.411
Yield 1	–0.263	–0.229	–0.223
Yield 2	–0.259	–0.237	–0.216
Shift	–0.257	–0.237	–0.233
Total suggestibility	–0.321	–0.281	–0.281

Is Actively Open-Minded Thinking (AOT) Protective?

Stanovich and Toplak (2019) reviewed the evidence supporting the value of what they term Actively Open-Minded Thinking (AOT) in resisting biased claims. AOT refers to the tendency of subjects to consider evidence that goes against their beliefs, to delay closure during problem-solving, and to engage in reflective thought: "Actively open-minded thinking (AOT) is … the willingness to consider alternative opinions, the sensitivity to evidence contradictory to current beliefs, the willingness to postpone closure, and reflective thought." They reported that AOT is a strong predictor of performance on various reasoning and biases tasks, including rejection of superstitious thinking and avoidance of conspiracy theories, both of which characterize much of fake news.

The absence of AOT is correlated with various types of reasoning fallacies, the most relevant of which is the acceptance of fake news. Pennycook et al. (2018) demonstrated a fascinating but troubling phenomenon: Participants in their large-scale experiments were willing to believe fake news headlines taken from actual Facebook posts as long as they were not outrageously false (e.g., claims that the earth was a perfect square). A single presentation of fake news increased its perceived plausibility a week later. Notifying participants of its falsity was not sufficient to dissuade them. These were well-educated and otherwise smart individuals, yet they readily succumbed to false information.

Concluding Thoughts

The situation facing users of social media is that online posts often contain misinformation that is not readily detected, even by highly educated, cognitively sophisticated users. And this problem is not confined to news about athletics and entertainment but includes medical and scientific news as well. In a 2015 Pew survey of 2000 Twitter and Facebook users, Barthel et al. (2015) found that 63% of Americans obtained scientific news through online social media, with many reporting that they get their news exclusively from social media rather than through the more-responsibly curated news coverage in traditional mainstream media: "The rise in the share of social media users getting news on Facebook or Twitter cuts across nearly every demographic group" (Barthel et al., 2015, p. 2). Reddit's *Ask Me Anything*, which has over 11 million readers, is now the single most likely place for non-scientists to learn about breaking medical and scientific news.

Thus, the search for interventions to resist fake news has high stakes and significant implications for society. It would seem that interventions that teach readers how to avoid early closure and consider alternative views are a promising place to start, given the Actively Open-Minded Thinking (AOT) findings. A key aspect of dodging reasoning traps must be to encourage readers to challenge their own views and consider alternative views from their own, especially ideologically divergent views. There is no demonstrated way to do this at present, because such views emerge from long periods of reflection. However, one place to start is with the awareness that liberals and conservatives have been shown to rely on different moral foundations while reasoning (Graham et al., 2009); there may even be a biological component to reliance on specific moral foundations (Haidt, 2012). Research demonstrates the value of including opponents' moral foundations while attempting to persuade them (Haidt, 2012).

What does this discussion imply for our conceptions of intelligence today, and for how these ideas should be evolving to encompass the novel demands of life in our rapidly changing era? Few would argue with the statement that succumbing to fake news and then sharing and acting upon it is a widespread and substantial threat to democracy and well-being. Stanovich has argued for AOT as a way to address myside bias, which afflicts the cognitively able (and others) and reduces the quality of their reasoning. (The degree to which myside bias affects the highly educated versus people with high practical intelligence who are less educated, for example, is an open and interesting question. But intelligence can and should be distinguished from rational thinking (see Stanovich & Stanovich, 2010, for a conceptual analysis of the difference between psychometric intelligence and rational thinking). The key is that myside bias affects everyone.)

Acting with intelligence requires that we modify our beliefs in the face of credible data, and thus it falls upon us all to engage in Actively Open-Minded Thinking or other related techniques to combat our own biases and develop our ability to see both sides and even-handedly assess the content of potential fake news. In addition, it behooves us to reconsider our definitions of intelligence to include the ability to avoid myside bias and to fully appreciate all sides of an argument or position—even a politically charged one for which the "correct" side seems obvious. One unfortunate aspect of life within the modern university is that its faculty often reflexively believe that because they have high levels of intelligence, they are unqualifiedly excellent at detecting fake news. However, as we have shown, the research does not support this belief, and consequently, we find ourself with centers of learning led by individuals who may unwittingly be a key part of the problem itself.

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Part VI

The Future of the Science of Human Intelligence and Its Implications for Society

15

Human Intelligence in the Time of the Anthropocene

David D. Preiss

If I have seen further, it is by standing on the shoulders of giants.
Isaac Newton

IQ gains over time signal the evolution of minds that can be better educated. They provide no guarantee that the educating will be done.
James Flynn

We are living in an era of great transformation. This transformation involves a deep and unprecedented change in our ecological niche. The roots of the current transformation are in the social upheaval associated with the Industrial Revolution, and the invention of the market society that was so well described by political economist Karl Polanyi (1944) in

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a book aptly entitled *The Great Transformation*. Today, this transformation has taken on its own dynamism. After the realization that we are living in a new geological era, its consequences have been discussed in ecological terms, not only sociological or economic ones.

The general features of this transformation should be familiar to anyone who has been following the warnings that climate and atmospheric scientists have made during the last three decades. They were also widely publicized by Al Gore's famous 2006 documentary *An Inconvenient Truth*. Yet, evidence of the changes we have experienced are not new. Indeed, one of the first warnings about the risks we have been facing was a paper by Charles Keeling and collaborators reporting the growing concentration of atmospheric carbon dioxide at Mauna Loa Observatory (Keeling et al., 1976). Continuing Keeling's work, the Scripps Institution of Oceanography at the University of California, San Diego, reports a daily record of global atmospheric dioxide concentration at Mauna Loa. These reports are now known as the Keeling Curve. This curve is the most eloquent graphic summary of our species' carbon footprint. Today it can be followed online (https://keelingcurve.ucsd.edu/.)

Not only university scientists have been aware of these changes. The atmospheric impact triggered by the production and consumption of fossil fuels was also anticipated by experts working at the companies involved in their exploitation during the now-distant 1970s (Hall, 2015). These companies didn't warn the public, although that didn't prevent international institutions from realizing the dangers ahead. In 1990, the Intergovernmental Panel on Climate Change (IPCC) produced its first report on climate change. Since then, this United Nations body for assessing the science related to climate change has published five reports cautioning countries of the impact of the growing atmospheric concentrations of greenhouse gases in climate.

As we enter the third decade of the twenty-first century, awareness of the magnitude of the ecological disruptions caused by the climate crisis has increased. As mentioned, the roots of that crisis are in the Industrial Revolution. We are literally resting on the dirty shoulders of previous generations. As illustrated in Fig. 15.1, taking as a reference the year 1750, CO_2 emissions in the world have increased more than 350,000%, with most of that growth happening after 1950 (Ritchie & Roser, 2020).

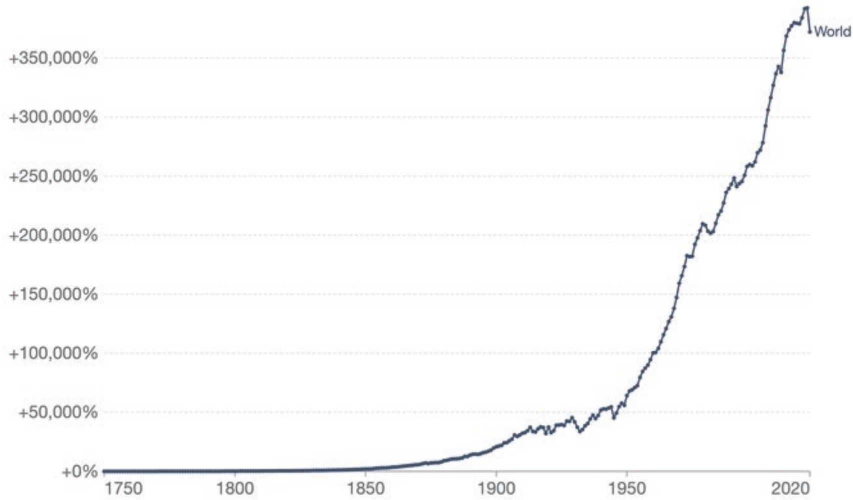

Fig. 15.1 Change in annual CO_2 emissions. Source: Ritchie & Roser (2020). This is a visualization from OurWorldinData.Org

Recently, on May 12, 2019, the twitter account of the Keeling curve reported CO_2 levels not recorded in the entire history of the human species. That day, news outlets reported that CO_2 levels were similar to those estimated for the Pliocene Epoch, three million years ago (Griffiths, 2019). These changes in our atmosphere have caused a systematic rise in world temperatures that is creating havoc in different ecosystems, including unprecedented floods, storms, droughts, and increasing sea levels to a point that is putting in danger many coastal communities and the nation islands of the South Pacific. Today, reducing our greenhouse gases emissions is essential if we want to keep global climate in a range that does not trigger a societal collapse. Unfortunately, denial of the climate crisis is challenging our ability to act with the urgency that is needed.

On top of the climate crisis, we face two additional challenges: environmental pollution (including air, water, and soil pollution) and what scientists have called the sixth mass extinction, which involves the continuous decimation of a large number of species across the world. To illustrate the magnitude of our impact on other species, I will just mention the case of one of our close relatives: more than 100,000 orangutans were lost between 1999 and 2015 in Borneo because of hunting in forests and land clearance for industrial plantations. That meant that half of the orangutan population there was affected by human activity (Voigt et al., 2018). Not only human activity and pollution per se are contributing to the demise of many animal species. Homo sapiens seems to be an anomaly, a metaphorical rare bird amongst predators, and its ecological impact substantially higher than the one of any other predators (Darimont et al., 2009, 2015).

At the beginning of this century, scientists suggested that we are living in a new geological epoch, which is distinct from the Holocene. This new epoch is called the Anthropocene because human activity has altered our planet in such a way that these ecological effects will become permanent, or at least will last for millennia (Crutzen & Stoermer, 2000). Although the amount of carbon and methane in our planet's atmosphere has been increasing substantially since the Industrial Revolution, the Anthropocene Working Group signaled that this new geological epoch began in the mid-twentieth century, when demographic growth accelerated agricultural and industrial production and the first nuclear blasts produced radioactive debris that became part of the geological record (Subramanian, 2019). The natural impact of human activity is gigantic and cannot be summarized in a few sentences. The Anthropocene working group noted that:

> Phenomena associated with the Anthropocene include: an order-of-magnitude increase in erosion and sediment transport associated with urbanization and agriculture; marked and abrupt anthropogenic perturbations of the cycles of elements such as carbon, nitrogen, phosphorus and various metals together with new chemical compounds; environmental changes generated by these perturbations, including global warming, sea-level rise, ocean acidification and spreading oceanic 'dead zones'; rapid changes in the biosphere both on land and in the sea, as a result of habitat loss, predation, explosion of domestic animal populations and species invasions; and the proliferation and global dispersion of many new 'minerals' and 'rocks' including concrete, fly ash and plastics, and the myriad 'technofossils' produced from these and other materials. (Anthropocene Working Group, 2019)

Sternberg (2019, 2021, this volume) has noted that Homo sapiens is on a species-suicidal course, which is in part related to the type of abilities we hold dear at the expense of others that may have a higher adaptive value. Therefore, he calls for a new conception of intelligence addressing the challenges to our survival. Complementing Sternberg's call, the purpose of this chapter is to discuss the status of intelligence research in the Anthropocene. In order to do so, the plan of the chapter is as follows. First, I discuss how the transformations we have experienced signal the need to more deeply consider the role of context in our thinking of intelligence. Next, I discuss the demographic and cultural changes that transformed the niche of human intelligence after the Industrial Revolution. Then, I comment on how, in the origin of intelligence research, the invention of the theory of general intelligence was marked by a lack of consideration of the role of context, notwithstanding that the British founders of the field were working in the midst of the great transformation provoked by the Industrial Revolution. Finally, I conclude discussing how intelligence research should be conducted to address the demands of the Anthropocene.

The Evolving Niche of Human Intelligence

Although the heritability approach has demonstrated that both nature and nurture play a role in the variation in individual differences in intelligence (Sternberg et al., 2005), some committed hereditarians have disseminated among the public the notion that innate determinants are the most significant ones (Gottfredson, 2016, 2018; Herrnstein & Murray, 1994; Jensen, 1969). Additionally, a significant part of research on general intelligence has not put enough attention to its contextual or ecological determinants (Ceci, 1996; Sternberg et al., 2000). Against the prevailing a-contextual and static conception of human cognitive ability, here I argue that the psychological and demographic changes that our species experienced during the last century make evident that a context-dependent and dynamic view of human cognitive ability provides a better framework to understand human intelligence.

We are living now through one of the most radical experiences of niche construction ever experienced by any natural species on earth. As the Anthropocene shows, the Industrial Revolution and the invention of a market society have triggered a number of ecological changes that have modified Homo sapiens' ecological niche. Today, it is more true than ever that "hominin evolution is hominin response to selective environments that earlier hominins have made" (Sterelny, 2007, p. 719). These changes confirm that Homo sapiens is the one and only species with the ability to shape its environment by means of cultural evolution. Although modern theories of intelligence are inspired by the theory of natural evolution, they have not taken into consideration the role that niche construction plays in the abilities that are commonly measured by psychometric tests. In so doing, they not only make a very selective appropriation of evolutionary metaphors but risk becoming irrelevant.

The changes we have experienced as a species during the Anthropocene make evident that a unitary (or one-factor) theory of human ability will not be enough to explain how intelligence is shaped by the changes in our biological niche resulting from our own activity. As Flynn (2012) has shown, many of the changes identified in the rise of IQ scores during the twentieth century are not dependent on only one specific environmental variable. Some changes, as I will note below, capitalize on others. Additionally, those increases are not factor-invariant. As Flynn illustrated, the increases in different verbal scales of the WISC such as Similarities and Vocabulary, which load on a shared verbal factor, are not equivalent:

> Factor analysis does not capture the dynamic scenario of social priorities altering over time. Thus, g-loadings turn out to be bad guides as to which real-world cognitive skills are merely correlated and which are functionally related. To anticipate, a social change over time such as people putting on scientific spectacles might greatly enhance the ability to classify (similarities) without much affecting everyday vocabulary or fund of general information. Nonetheless all these trends would be of great significance, and to dismiss them as "hollow" would be a barrier to understanding the cognitive history of our time. (Flynn, 2012, p. 12)

On the other hand, as technologies change, some abilities become relevant whereas others become obsolete (Preiss & Sternberg, 2005). To illustrate, tests of arithmetic computation such as those considered in measurement of the number factor in Thurstone's tests are just an anachronism today. Probably, these abilities not only become obsolete because a computer can replace them but also because this replacement makes their practice at school less frequent. Another case at point is that of memorization. Remembering phone numbers was very important during the last half of the twentieth century. However, smart phones have made that ability almost useless today. Probably, many persons don't even know any of the numbers that they are calling to, since the users save these numbers directly in their devices bypassing their own brains.

The theory of general intelligence grew in influence during the twentieth century, notwithstanding that the evidence of its limitations became more evident as mass intelligence testing developed. Thus, the same industrialized nations that saw the flourishing of the testing industry and the dissemination of the intelligence quotient (IQ) as a high-stakes criterion in educational and work settings experienced a continuous rise in IQ scores across generations. The phenomenon was identified by James Flynn and named after him (Flynn, 1984; Kanaya et al., 2003). The Flynn effect challenged the predictions of impending doom made by eugenicists, such as Francis Galton, or more recent neo-Social-Darwinists, such as Herrnstein and Murray (1994), who were very alarmed by what they expected to be an unavoidable decrease of the intelligence of the nations, if forceful measures were not taken to prevent it, with many of the proposed policies being, as we see clear today, racist, anti-immigration, or violating human rights (Rutherford, 2021).

The Flynn effect not only revealed that those prophecies were unfounded but that the opposite trend happened (Flynn, 1987). IQ scores increased and they did so in so-called culture fair tests such as the Raven's Progressive Matrices Test (Raven, 1956; Raven et al., 1992). The reasons for these increases have been debated (Neisser, 1998). Among the drivers of the increase, some authors have suggested some environmental ones: specifically, schooling (Baker et al., 2015; Blair et al., 2005) and the dissemination of visual-spatial technologies (Maynard et al., 2005). That said, the rise of IQ scores has limits and might be reversed, as seems to be happening in Norway (Bratsberg & Rogeberg, 2018). Nonetheless, the Flynn effect (or its reversion) shows that IQ scores are highly susceptible to environmental changes and to historical and cultural influences. It is an interesting coincidence that James Flynn dates in a similar moment to the origin of the Anthropocene a further acceleration of these effects:

> post- 1950 IQ cognitive gains have been significant. More and more people continued to put on scientific spectacles. As use of logic and the hypothetical moved beyond the concrete, people developed new habits of mind. The scientific ethos provided the prerequisites for this advance. However, once minds were prepared to attack these new problems, certain social triggers enhanced performance greatly (Flynn, 2011, p. 662).

The Flynn effect should be understood as one of the many global changes happening since the Industrial Revolution and the invention of the market society, changes that produced what we today experience as a globalized society. Flynn also acknowledged that the final cause of IQ increases is the Industrial Revolution, which is followed by intermediate causes, such as schooling, and then proximate ones, such as the new habits of mind people develop in industrialized societies (Flynn, 2020). It has been noted that improvements in nutrition have improved IQ scores and therefore might be related to the Flynn effect (Martorell, 1998). Yet, Flynn (2011, 2020) suggested that, in the developed world, better nutrition was probably a factor in this process before 1950, but not since the mid-century when cultural influences were more important, particularly those related to developing a scientific understanding of the world and developing new habits of mind.

The changes associated with the Flynn effect cannot be properly understood if their demographic context is not taken into consideration. As shown in Fig. 15.2, between 1700 and 1900, the human population on the Planet Earth increased from roughly 600 million to roughly 1.65 billion, and to roughly 6 billion in 1999. One billion was added just in the next decade (Roser, Ritchie et al., 2013). Many other processes, including urbanization, the industrialization of agriculture, and the expansion of schooling, accompanied that transition, of course. On the other hand, not long ago, during most of the nineteenth century, estimates of life

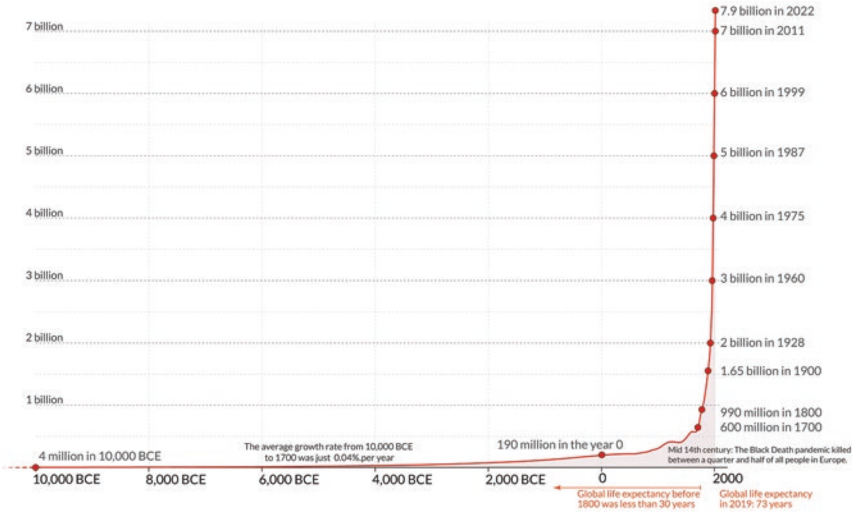

Fig. 15.2 The size of the world population over the last 12,000 years. Source: Roser, Ritchie, & Ortiz-Ospina (2013). This is a visualization from OurWorldinData.org

expectancy worldwide were well below 40 years, with some variation between world regions. More important, life expectancy was quite constant for most of human history until societies started to experience a "health transition," which has improved life expectancy worldwide. Although the starting date of this health transition varies across the world, the trend is the same everywhere. Globally, life expectancy increased from an average of 28.5 in 1800 to 72.6 years in 2019 (Roser, Ortiz-Ospina et al., 2013).

Here, I want to point out two aspects that are not commonly taken into consideration when addressing cognitive change across time. In about two centuries, demographic growth meant that the number of individuals available to participate in networks of distributed cognition has grown significantly. Not only the sheer number of individuals that can participate in these networks of collaboration has increased but also these individuals are, on average, significantly more educated than the individuals that inhabited our planet one century ago.

Additionally, as shown in Fig. 15.3, a large number of these individuals have, on average, a higher life expectancy than their forebears (Roser,

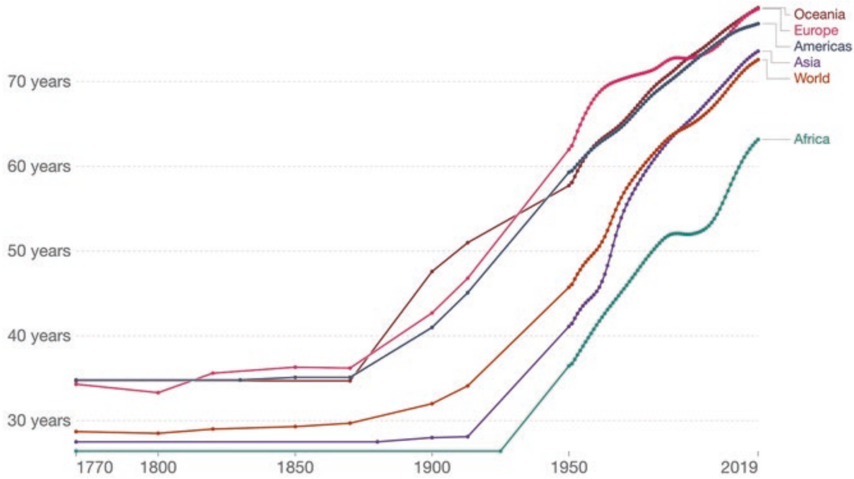

Fig. 15.3 Life expectancy, 1770 to 2019. Source: Roser, Ortiz-Ospina, & Ritchie (2013). This is a visualization from: OurWorldinData.org

Ritchie et al., 2013), which means that they have not only an extended amount of time to get more life experience, but also more time, if they have access to the appropriate educational opportunities, to develop specific expertise in a particular area of knowledge. As the rates of schooling have increased worldwide, for some people, most of these gained years are now employed not in foraging but in fostering our species' cognitive capital. Additionally, with the dissemination of modern schooling and the modern bureaucratic professions, symbolic and not manual interactions use most of our time. Also, the case can be made that this process has been accelerated even more with the computerization of everyday life and a wide range of new visual-spatial technologies (Greenfield, 2020; Maynard et al., 2005).

Thus, not only we have more time to invest in symbolic training, but also we use those acquired symbolic capabilities more every day. Obviously, a higher life expectancy has the limitations associated with cognitive decline, which is becoming a growing issue in aging populations. However, that decline does not prevent these individuals from contributing to humankind's cognitive capital much more time than previous generations.

At present, the cognitive benefits from this "extra time" are concentrated in an elite that has access to advanced formal education and, eventually, to participation in globalized science. As James Flynn noticed, individuals that graduated from universities integrate this elite: "The expanded population of secondary school graduates was a prerequisite for the educational advance of the post-1950 era, that is, the huge increase in the number of university graduates. These graduates have gone the farthest toward viewing the world through scientific spectacles. They are more likely to be innovative and independent and therefore, can meet professional and managerial demands" (Flynn, 2011, p. 662). Indeed, the continuous growth of science and technology cannot be explained without taking into consideration these demographic forces, making that growth possible. Every year, the amount of international collaboration in advanced academic institutions not only grows but also amplifies our capability to, literally, crack the code of many scientific phenomena. To illustrate, the human genome project took only 13 years to complete, and involved 2800 researchers worldwide, from 20 institutions in 6 countries. It is worth noting that this achievement was reached roughly 140 years after Gregor Mendel single-handedly defined the basic laws of genetics. Today, thanks to the new technologies of collaboration and communication, collaborative work in science is habitually an international endeavor. According to an analysis published in the journal Nature, made in the context of the COVID-19 pandemic, during the current century, the proportion of papers involving international collaborations has increased steadily as well as collaborations with three or more countries. Moreover, as the number of countries in the author affiliation of a paper increases, also its citation impact increases. Only scientific nationalism can stop this trend. The tension between international collaboration and scientific nationalism has been evident during the pandemic (Maher & Van Noorden, 2021).

What is astonishing is that this increase in cognitive capital is happening while, at the same time, the massive dissemination of fake news and anti-scientific discourse is becoming one of the most critical social issues of the present (Ceci & Williams, this volume). Therefore, just numbers in themselves are not enough to explain the situation of human intelligence today, although they help us to picture the cognitive potential afforded by demographic growth. So far, only a limited portion of the human population has been able to develop the intellectual potential offered by a quality tertiary education, but that number is still high enough to sustain the continuous and explosive progress characterizing science in the post-1950 era. However, as social networking has made possible unfiltered massive instant communication, many persons without access to a quality education are susceptible to information manipulation by interested parties. Not before the twenty-first century so many people had had access to so much information without having the adequate training to distinguish truth from falsity.

The current situation of the COVID-19 pandemic is an exemplary illustration. At the time that scientists produced a Covid-19 vaccine in record time using state-of-the-art mRNA technology, the social and health impact of the vaccine was eroded by the anti-scientific discourse plaguing social networks. As a result, in those countries where mRNA vaccines had been massively available early, such as the United States and Israel, a significant part of the population *decided* not to get vaccinated, largely because of misinformation. Many of these unvaccinated individuals got infected by a more contagious variant of the virus and transmitted the virus among their close contacts. Many of them have died, in a moment of the pandemic when dying from COVID-19 was highly preventable. It is worth noting that vaccine hesitancy has not been restricted to mRNA vaccines. It has also impacted vaccination programs in other countries, such as the United Kingdom and Russia, which use their own viral vector vaccines that were also created in record time. Unfortunately, vaccine nationalism, and competition between vaccine providers, has also been instrumental to the dissemination of fake news regarding the purposes of the vaccination programs and their safety and efficacy.

The Ratchet Effect and the Development of Human Intelligence

The process of acceleration that we have experienced since the Industrial Revolution and specially in the post-1950 era was not inexorable. An inspection of the Smithsonian Natural Museum of Natural History's human evolution interactive timeline (at https://humanorigins.si.edu/evidence/human-evolution-interactive-timeline) shows that Homo sapiens were not in a hurry during most of cultural evolution. Capital inventions took thousands of years before showing up in our pre-historical record. According to current estimations, our species evolved approximately 300,000 thousand years ago. Evidence that is indicative of early forms of symbolic communication, such as pigmenting objects and probably our skin, dates to 250,000 years ago. Then, the timeline shows that the oldest evidence of drawings dates to between 60,000–40,000 thousand years ago, sculpture of figurines to 40,000 years ago, early musical instruments to 35,000 years ago, and use of symbols to represent words and concepts, that is writing, to 8000 years ago.

Nickerson (2005) noticed that the invention of symbol systems is one of the most relevant achievements of prehistory. The invention of writing is arguably the most relevant achievement humanity has ever made since it is the principal vehicle of cultural evolution. Although it took us most of our time on Earth to reach the point where we invented writing, today we expect children to acquire the basic mechanisms needed for decoding symbol systems when they are six or seven years old. In so doing, we compact thousands of years of cultural evolution into a few years of deliberate instruction at school. Moreover, at this stage of our cultural evolution, learning how to read and write is only the beginning of an educative process that, in the end, equips modern adults not only with those abilities, but also with a number of cognitive tools that, for instance, will enable a select few to eventually crack the human genome.

After the invention of writing, cultural evolution started to move with a different pace. To picture this change of pace, let me note the milestones of our impact on the natural world as marked in the same timeline of the Smithsonian Museum. About 10,500 years ago, Homo sapiens developed technologies, which made plant and animal domestication possible. The change of pace with pre-historical evolution is quite noteworthy. By 1995, 83% of the land surface had been affected by human action. And by 2007, for first time in history, more humans lived in cities than in rural areas. Human population, as we saw above, increased substantially after the Industrial Revolution. Only 2000 years ago, the human population was estimated to be 200 million (roughly, the population of Brazil today). In 2012, we reached seven billion. It only took four decades for the population to double from three to six billion, between 1959 and 1999, in what we understand today was the beginning of the Anthropocene.

The main mechanism that makes possible the process of cultural evolution is the ratchet effect. Tennie et al. (2009) define the ratchet effect as follows:

> One generation does things in a certain way, and the next generation then does them in that same way - except that perhaps they add some modification or improvement. The generation after that then learns the modified or improved version, which then persists across generations until further changes are made. Human cultural transmission is thus characterized by the so-called 'ratchet effect', in which modifications and improvements stay in the population fairly readily (with relatively little loss or backward slippage) until further changes ratchet things up again. (Tennie et al., 2009, p. 2405)

The ratchet effect operates in all areas of human endeavor. It evidently is essential for the processes of niche construction. Here, I am interested in the relation between the ratchet effect and the construction of our cognitive niche. There are two milestones that define our cognitive niche: one is the invention of writing; the other is schooling. Beyond plant and animal domestication, writing and schooling make modern humans a very singular species: no other animal species has been seen representing sounds in symbols and sending its offspring to an organized setting of learning.

By writing, I understand all the activities allowing Homo sapiens to represent words and concepts in symbols. For the sake of the argument made here, I am using a very expansive definition of writing. What is relevant is that these activities enabled human groups to store knowledge and to create a cultural memory that can be transmitted from one generation to the next. As commonly noted, whereas human language is universal, not all human groups have invented or adopted a writing system across history. Therefore, writing is not an inexorable consequence of our evolved dispositions. Writing is a historical achievement and therefore its fate is contingent on historical events, as shown by the fate of the Inca khipus, a very original system for recording information based on knots whose decoding was lost after the Spanish conquest and that is seen today as a three-dimensional writing system (Hyland, 2017). Because of its relevance in social life, writing in an official language is one of the basic skills universally promoted in modern states.

By schooling, I understand, the institutionalization of the process of cultural learning in organizations dedicated to the goal of compacting and transmitting knowledge to the new generations and where the teaching of writing is a key developmental activity. Like writing, schooling is also a historical invention. As noted by Cole (2005), schooling appeared in complex societies with a division of labor. Sumerian schools have social arrangements that look very much as the schools of today, he notices. These canonical arrangements favor a type of instruction where an adult transmits knowledge to a set of students. This basic arrangement has evolved across time, of course. In modern times, "the school has been internally organized to include age grading, sequentially organized curricula based on level of difficulty and permanent buildings designed for the purpose of teaching" (Cole, 2005, p. 202). As I noted elsewhere, "once modern schooling is established, a curriculum is set. Once a curriculum is set, there are age-fixed expectations for learning, although many of these curricular contents are based on the previous work of many generations of adults" (Preiss, 2020, p. 169).

Tomasello (1999) has proposed that systems of representation, such as mathematics and writing, were created in a process of cultural accumulation and cultural transmission. As regards writing, Olson (1996, 2005) has suggested that one of the main cognitive consequences of writing was the development of metalinguistic awareness. He noted: "a script provides the model, a set of distinctive but related concepts and categories however distorted and fragmentary, in terms of which one can analyze and so become aware of certain basic properties of one's speech" (Olson, 1996, p. 86). In so doing, literacy makes language an object of thought and reflection. For Olson (2005), this metacognitive and metalinguistic awareness, that is proper of literacy, is the distinctive mark of human intelligence. According to him, intelligence tests are, in the end, tests of our literate competence. These tests not only measure verbal intelligence but they also measure the cognitive consequences of literacy, that is, the metacognitive and metalinguistic habits of mind that are promoted at school and that Flynn considered the proximal cause of intellectual growth during the Anthropocene.

What schooling does is to make the cognitive affordances of literacy massively available for each new generation. Thus, schooling sets the conditions for the development of intelligence, as measured by tests of academic intelligence. Schooling is a subsequent amplifier of the cognitive impact of literacy and of the ways of thinking and dealing with texts that are taught at school. As Cole (2005) summarized: "Cognitive changes associated with formal schooling appear to be content and context specific for those directly involved. However, they may become general to the extent that many practices within that society demand skill in that content and to the extent to which participation in schooling changes participants' orientation to modern bureaucratic structures and to the raising of their own children" (p. 213). It should not be a surprise then that the impact of schooling on psychometric intelligence is one of the most established facts of research on the environmental influences of intelligence (Ceci, 1991, 1996).

Intelligence Research Meets the Anthropocene

Research on intelligence was established in the context of the Industrial Revolution. The social upheaval caused for this revolution intrigued scholars who started to ask what were the determinants of success in the midst of a society that was freeing itself of many traditional conventions and that was producing wealth in an unprecedented manner. One of those scholars was Francis Galton. Galton—an eclectic and polymath scholar but also a fervid advocate of social Darwinism and eugenics—took a particular interest in the study of genius. Noting that genius runs in families, and inspired by the work of his cousin Charles Darwin, he proposed that there must exist an innate capability explaining individual differences in intellect.

Galton summarized his ideas in a book entitled *Hereditary Genius* (Galton, 1869), which Darwin had the opportunity to read. After perusing the book, the famous naturalist sent his cousin the following comment in a personal letter: "You have made a convert of an opponent in one sense, for I have always maintained that, excepting fools, men did not differ much in intellect, only in zeal and hard work; and I still think this is an eminently important difference" (Darwin, 1869). Although Darwin reminded his cousin of the role of "zeal and hard work" in intelligence, Galton was not interested in them. Quite the opposite, he claimed that differences in genius were consequence of an attribute that was not only heritable but also barely responsive to environmental influence. His deep belief was consistent with the cultural ethos of his time, marked by the publication of Charles Darwin theory of natural evolution and the re-discovery of Mendelian genetics. As commonly noted in the portraits of the field of intelligence (Mackintosh, 2011), Galton set up an Anthropometric Laboratory in the South Kensington Museum in London in order to measure intelligence. He used sensory and motor tests as his basis for research. To study effects of heredity, he also invented the coefficient of correlation, which was later further developed by Pearson (Stanton, 2001) and Spearman (1904a).

Not all the academic circles were eager to accept Galton's view on intelligence. In the United States, there was some skepticism with regard to Galton's innatism. Observing the differences in scientific achievement across the United States, James Cattell wrote in *Science*:

> The inequality in the production of scientific men in different parts of the country seems to be a forcible argument against the view of Dr. Galton and Professor Pearson that scientific performance is almost exclusively due to heredity. It is unlikely that there are such differences in family stocks as would lead one part of the country to produce a hundred times as many scientific men as other parts. (Cattell, 1906, p. 734)

One of the theories most influenced by Galton's beliefs on the nature of genius was Spearman's theory of general intelligence (Spearman, 1904b, 1927). This theory has been one of the most debated in the history of the field, with scholars disagreeing not only in the number of factors explaining performance in intelligence tests but also on its determinants (for a comparison of perspectives on general intelligence, see essays in Sternberg & Grigorenko, 2002). For some, the theory of general intelligence provided a convenient if flawed explanation of the origin of the social differences triggered by the Industrial Revolution and the market society. In modern parlance, this theory sets the basis of the genetic meritocracy argument that informed IQ research across the twentieth century and that resurfaced openly during the 1990s (Ceci, 1996). In short, the theory of general intelligence helped to give scientific credibility to the idea that social inequalities have a genetic origin, thereby obscuring their social determinants. It is a paradox that, in the midst of one of the biggest social and technological upheavals of human history, the great transformation that Polanyi described so well, many scholars in the field of individual differences adopted a static notion of human intelligence. The contrast between such a restricted view of intelligence and the context in which that view was advanced will become more evident in the decades to come. The same century that would see the rise of the theory of general intelligence would also provide dramatic real-world illustrations of its theoretical and ethical limitations. Indeed, although IQ scores rose substantially, the abilities measured by IQ tests didn't prevent humanity to engage in self-destructive behavior (Sternberg, 2019, 2021).

Since the work of Galton and Spearman, the notion that intelligence represents an inborn fixed general ability trait, which is instrumental for adaptation, permeated much of the research on human intelligence. Thus, many of the scientists working on general intelligence paid insufficient attention to what Darwin called zeal and hard work. Additionally, the scientific study of environmental influences on general intelligence almost came to a halt. Yet, it didn't have to be this way (Gould, 1981). At the same time that Spearman was proposing the theory of general intelligence (Spearman, 1904b, 1927), Alfred Binet (Binet & Simon, 1911) was advancing a different way to understand intelligence. Binet was not interested in intelligence as a general factor but rather in inventing a test that could be used to identify children with learning disabilities, so they could get access to special education. His test was not a test based on psychophysics or sensorimotor measures but rather was inspired by complex school tasks. However, during its adaptation in the United States, Binet's test was matched with Galton's view of intelligence (Kaufman et al., in press).

It is worth noting here that one of the psychologists influenced by Binet's work was Jean Piaget. After finishing his PhD, Piaget went to work in Paris in a laboratory created by Binet (at the Ecole de la rue de la Grange-aux-Belles), which was after his death under the direction of his collaborator Théodore Simon. There, Simon asked Piaget to standardize Burt's test of intelligence. This gave Piaget the first opportunity to test children on topics such as classes and relations, causality, and number (Harris, 1997). His whole experience in Paris seems to have been academically formative, since some of the tasks invented by Binet would influence Piaget's own work (Wesley, 1989). Piaget would also go to develop his own theory of intelligence (Piaget, 1960), but he was most interested in understanding the universal stages of cognitive development rather than the nature of individual differences in cognition. In particular, he was not interested in the rightness or wrongness of an answer but rather in the *how* and *why* it was right or wrong (Wesley, 1989). Therefore, he had a limited influence in mainstream intelligence research. Psychometric research on intelligence would become involved with the *how* and *why* only decades later, with the development of componential models of intelligence (Sternberg, 1980). Thus, it was not Piaget's but rather Spearman's theory, and the psychometric tradition established by his theory, that became the one most used to understand differences in performance in the very same test that Binet created and subsequent psychometric tests of intelligence.

Some psychometricians, such as Thurstone (Thurstone & Thurstone, 1941) and Guilford (1967), contested the idea that intelligence could be reduced to just one factor. Thus, scholars on intelligence disputed during a large part of the last century how many factors (and, after the cognitive revolution, information-processing components) were explaining differences in performance in intelligence tests and how much of these differences could be attributed to heredity or environment. Questions about the real-world relevance of these measures were not properly raised until the last quarter of the century when researchers started to note that academic intelligence was distinct from real world intelligence (see essays in Sternberg & Wagner, 1994). Distinguishing general and academic intelligence from a prototype standpoint, Neisser (1979) wrote: "all of us can think of highly 'intelligent' acquaintances who are nevertheless 'stupid' about a lot of things, or vice versa. Such judgments do not involve any real contradiction. One characterization is being made with respect to an academic prototype, the other with respect to a more mundane one" (p. 225).

The twentieth century closed with a renewed bet on the g-factor in the form of a book entitled *The Bell Curve* (Herrnstein & Murray, 1994). The book revisited the argument that ethnic differences in intelligence were one of the main causes of socio-economic differences in the United States. Stephen Ceci (1996) denounced the argument for a genetically based meritocracy espoused in Herrnstein and Murray's book. He proposed that argument could be summarized as follows: first, individual differences in intelligence exist; second, they are appropriately measured by IQ tests; third, they are in part genetic in origin; fourth, these differences are related to differences in real world achievement, specifically in schooling and earnings; therefore, according to that argument, life success depends on genetic differences among individuals. Ceci (1996) wrote a full epilogue in his *bioecological treatise on intellectual development* to denounce this argument as being scientifically flawed.

Galton published the first edition of his *Hereditary Genius* in 1869. After more than one century—including two world wars, the Holocaust, the Cold War, the rise and fall of the USSR—the need to dispute the notion that environmental influences in intelligence matter was still necessary. That we were living in what was a new geological epoch as a result of human activity didn't prevent some of insisting on a very restricted view of the origins of intelligence, making a case for its social consequences and even proposing recommendations for education and public policy (Gottfredson, 2018; Herrnstein & Murray, 1994; Jensen, 2002).

Conclusion

As Sternberg recently indicated: "people's increasing so-called 'general intelligence' seems to have been useless in leading them to guard adequately against the long-term destructive consequences of their behavior aimed at maximizing their short-term gains. They have compromised not only their own lives, but those of their children and grandchildren" (Sternberg, 2021, p. 74). Thus, although the g-factor theory optimistically predicted that intelligence is associated with social progress, today we are challenged by a global environmental and societal crisis. Before the current ecological emergency, schooling did not prevent our species of making wrong ethical choices. In the past century, one of the most educated nations on Earth perpetrated the Holocaust and another one, which was fighting totalitarianism in the name of democracy, dropped two atomic bombs on two large, inhabited cities. Partly as a result of these events, we are aware today that, in the same way that instrumental rationality does not guarantee moral progress, analytical intelligence, as measured by IQ tests, does not guarantee wisdom (Sternberg, 2021). What was striking of the second half of the twentieth century is that the process of progressive increase of our intelligence, as measured by IQ tests, was happening at the same time of the process of ecological destruction. Our new acquired abilities helped us to understand scientifically the impact of our instrumental activity in the world but not to prevent its self-destructive consequences.

Although the theory of general intelligence has been severely disputed, it remains influential, given that static intelligence measures are still gatekeepers for many social opportunities turning democratic societies into what some scholars consider as meritocracies that are, at least in part, dependent on our genetic dispositions (Herrnstein & Murray, 1994). The notion of a genetic meritocracy is in my view an oxymoron. Additionally, the group and socio-economic differences plaguing intelligence testing since its origins have limited the opportunities of many individuals from disadvantaged backgrounds that, possessing other practical abilities that are relevant in real life, don't always perform well on IQ tests or on tests of scholastic aptitude, which are also intelligence tests

(Sternberg, 2010). Notwithstanding the limitations that this situation produces to create a fair playing field, some scholars avidly defended this scientific status quo. In 2002, Jensen still insisted that:

> "The construct known as psychometric g is arguably the most important construct in all psychology largely because of its ubiquitous presence in all tests of mental ability and its wide-ranging predictive validity for a great many socially significant variables, including scholastic performance and intellectual attainments, occupational status, job performance, income, law abidingness, and welfare dependency. (Jensen, 2002, p. 39)

Among the many changes experienced by Homo sapiens since the industrial revolution, there are three that I believe have significantly shaped our environmental niche. We are more people, we live longer, and an ever-growing part of our youth receives cognitive training in institutions presumably devoted to improving our literacy and our intelligence. As noted above, schooling is one of the main drivers of the process of cognitive acceleration that we have experienced during the last century. Schools permit Homo sapiens to accelerate the acquisition and use of knowledge that took their ancestors many generations to produce (Preiss, 2020). As we have more time to live, we not only have more time to learn but also to contribute to the cognitive ratchet effect. That said, not everyone benefits from this growth and a substantial part of the global population receives an education that does not really deliver the promised gains in cognitive function. On the other hand, even in those cases where IQ gains are delivered, they are not enough to prepare the future generations to deal with the challenges of the present, particularly those that involve dealing with problems that require a more collectivist approach such as climate change or the ongoing COVID-19 pandemic. To illustrate, our analytical abilities have allowed us to produce effective vaccines to prevent hospitalization and death from COVID-19, yet they don't seem enough to guide us to take decisions based on the common good. Thus, at the time of writing this paper, disparities in vaccine distribution mean that, while most of the industrialized countries in the northern hemisphere are in advanced stages of the vaccination process, most of the countries in Africa and other poor nations of the global south have almost not received vaccines leaving their populations exposed to the pandemic. What makes this situation even more absurd is that these social disparities make more probable the appearance of virus variants among the unvaccinated, which may substantially reduce the efficacy of the same vaccines hoarded and used by the developed nations. This is one of the few cases where self-interest should prevent selfishness, and yet the latter has prevailed over the former. Although rich nations need to share more vaccines because they will be highly exposed to variants if they don't, vaccine sharing has been slower than is needed to overturn the global pandemic. How smart is that?

One of the consequences of the early emphasis on the hereditary nature of intelligence is that it established a field that was severely dissociated from other areas of the social sciences. Certainly, this was not exclusive to intelligence research. As it is commonly taught in history of psychology courses, psychology has aspired to become, since its first laboratories in Europe were created, one more of the prestigious natural sciences (Leahey, 2018). In its aspiration to find universal laws governing the functioning of the human mind, an important part of psychologists have been reluctant to consider the concept of culture as a proper scientific concept. Although psychology has become much more sensitive to societal and cultural influences in cognitive development (Bronfenbrenner, 1979, 1986; Bruner, 1990; Cole, 1996; Kessen, 1979), that reluctance exists until this day. Nowadays, evolutionary psychologists argue that what they call, in a derogatory way, the social-sciences standard model, is a mistaken representation of the human mind (Barkow et al., 1995). According to their scientific view, modern cognitive capabilities are mostly defined by natural evolution in the Pleistocene and not by cultural influence in the Anthropocene.

In the field of intelligence, the reluctance to address cultural influences in cognition has probably limited the scope and slowed theoretical advances in our understanding of what human abilities are, even from an evolutionary perspective. These limitations are illustrated by Boring's famous dictum stating that intelligence is what intelligence tests test, probably one of the most tautological (and boring) definitions in the history of our discipline (Boring, 1923) and by the above-discussed claim that psychometric intelligence is mostly measuring academic intelligence.

It is not really surprising that tests validated, one after another, against a test that was invented to measure academic achievement, the Binet test, are specially well able to predict academic achievement (Mackintosh, 2011). How could they not? That should not drive us to disregard other abilities that are consequential in real life, as research on practical intelligence has shown (Ceci, 1996; Nunes, 1999; Nunes et al., 1993; Sternberg, 2021; Sternberg et al., 2000; Sternberg & Wagner, 1994).

Although much of the field of intelligence still adheres to the theory of the general factor of intelligence, some researchers have insisted that this view of intelligence is insufficient to understand human abilities and how they interact with the social context and the cultural domains (Ceci, 1996; Gardner, 1985; Sternberg, 2021). If we are to fully understand what intelligence is, I believe we have to take an alternative view of intelligence as a dynamic, culturally shaped, multiple and distributed construct (Preiss & Sternberg, 2005). Intelligence is dynamic because its nature is contingent with the process of niche construction that is defining of our species. Intelligence is shaped by culture because the ratchet effect allows for the accumulation of symbolic systems that help us to increase our ability to transform the environment. Intelligence is multiple because technologies change what particular abilities are important in a specific context. Intelligence is distributed because collaboration between people and use of cultural tools is instrumental to tackle complex problems. However, there is a fifth attribute. Intelligence is not sufficient for our species adaptation. Although our cognitive capabilities have been able to produce the conditions for a geological transformation, they might not be enough to save us from their consequences. These same capabilities have put our survival at risk. If we are to survive the Anthropocene, we need to recruit a set of other abilities not only to adjust but also to reverse the accumulated damage we have done to our environment. What is the nature of these abilities? This is probably one of the defining questions for the psychology of the twentieth first century. Whereas the inventors of the field of intelligence, and some of their followers, were concerned by the attributes that helped people to be successful in the market society, today's scholars need to re-define that question. The re-defined question is what the abilities are that will help us to survive as a species in the Anthropocene and how are we going to promote them in our schools (see also Sternberg, 2021). The frame of this question is almost the opposite of the kind of questions mobilized by the infamous eugenics movement, and that still pervade the current agenda of some political movements (Turiel, 2020; Wintroub, 2020). In summary, if we are to identify the abilities that we need to overcome the climate and pollution crises, we better start thinking in this century in terms of a psychology of intelligence that is substantially different than the one that we tried, unsuccessfully, in the past one.

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16

Time Bomb: How the Western Conception of Intelligence Is Taking Down Humanity

Robert J. Sternberg

The Western conception of intelligence is a time bomb. It is taking down humanity. In this chapter, I will present evidence for why I believe this is the case, why we ended up with such a destructive conception, and what we can do about it. Let's start with a scene from a movie from the 1950s.

White Wilderness, an otherwise forgettable 1958 Walt Disney movie, appears to be truly famous for one and only one scene—a scene in which lemmings commit mass suicide by jumping off a cliff into the ocean. The whole scene was faked, from top to bottom (Woodford, 2003). The lemmings supposedly committing mass suicide did not jump. They were thrown off the cliff by Walt Disney filmmakers. Oddly, a movie famous

Note: This chapter is based upon a talk, "Time Bomb: How the Western Conception of Intelligence Is Taking Down Humanity," first previously presented to the Western Psychological Association, October 28, 2020. Example problems are actual items from Sternberg Lab research projects.

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for propagating a myth won an Academy Award for Best Documentary Feature (https://disney.fandom.com/wiki/White_Wilderness). The truth is that lemmings do not commit mass suicide and never have, to anyone's knowledge.

What's Wrong?

There is only one species in the history of the Earth for which a case could be made that it has committed mass suicide, and that species is not the lemming. Rather, that species is humans, of the genus/species Homo sapiens. They are engaged in mass-suicidal behavior now and in the past, recent and not so recent.

Antonio Guterres, Secretary-General of the United Nations, has stated: "To put it simply, the state of the planet is broken. Dear friends, humanity is waging war on nature. This is suicidal. Nature always strikes back—and it is already doing so with growing force and fury. Biodiversity is collapsing. One million species are at risk of extinction."

—United Nations Secretary-General, 2020, December 2.

Thus, not only is humanity killing off itself. It is taking a million other species with it. That is, well, insane!

How is humanity killing itself off? It has found innumerable ways (Sternberg, 2021).

- **Weapons of mass destruction.** A conservative estimate of casualties from Hiroshima and Nagasaki is 200,000, with 105,000 dead (Atomicarchive.com, n.d.). As I write (May 19, 2021), there are mass casualties in wars around the world. Myanmar is enduring brutal repression, as are the Uighurs in China. In countries around the world, especially in Syria but also in Iraq and elsewhere, there also have been casualties of poison-gas attacks (Sly et al., 2018). Agent Orange is estimated to have caused almost five million deaths during the Vietnam War, according to the Vietnamese Red Cross (Baldino, 2013).
- **Air pollution.** According to the World Health Organization (WHO), nine out of ten people breathe polluted air (World Health Organization, n.d.). WHO estimates that around seven million people die annually

from the effects of air pollution. That is more than the population of all U.S. cities except for New York City, and it closes in even on that.

- **Water pollution.** At least eight million metric tons of plastics are released into the oceans of the world every year, with the total currently at more than 150 million metric tons. Various forms of plastic have been discovered in more than 60% of seabirds that have been examined and in 100% of all sea turtles (Ocean Conservancy, n.d.). Some fish, some such as shark, tilefish, swordfish, and even much tuna, is only dubiously safe to eat because of mercury contamination (WebMD, n.d.).
- **Human-induced climate change.** Probably most catastrophic of all these human-created messes is global climate change. More than 95% of scientists studying climate believe that humans are causing worsening of global climate ("The 97% consensus on global warming," n.d.). Carbon dioxide levels keep reaching record highs. The changes are resulting in massive extinctions, with one million species either going or gone (Fears, 2019; Rettner, 2019). In the not-too-distant future, in excess of a quarter-million people may die each year as a result of global climate change. But already, there are massive changes in weather, such as warming of temperatures and increased hurricane and other storm activities.
- **Disease.** As I write, a pandemic has been sweeping the globe, COVID-19. As of May 19, 2021, it has killed roughly 3½ million people. The true figures are undoubtedly much higher, and almost certainly have exceeded the population of Los Angeles, CA, which is about four million. The estimated number of cases is 164 million. This is probably a gross underestimate. Many of these people will end up with long-COVID, resulting in months and possibly years of serious illness (https://www.google.com/search?client=firefox-b-1-d& q=how+many+people+in+the+world+of+died+of+covid-19). No one knows the origin of COVID-19, but whether it originated in a laboratory or because of too close contact between wild animals and humans, humans end up carrying much of the blame. In addition, many people are dying of bacteria that have become antibiotic-resistant. Almost three million antibiotic-resistant infections occur in the United States each year, with an estimated 35,000 U.S. deaths per year (CDC, n.d.).

- **Decreased sperm counts.** Over the past four decades, men's sperm levels, at least in Western nations, have decreased by more than 50% (Swan, 2021). The decrease appears to be due to industrial chemicals in the environment or toxins in foods. This is about as close as one can get to mass suicide.

Obviously, the world faces far more challenges than those listed above. But what do these challenges have to do with the Western conception of intelligence, anyway? All of them are a result, directly or indirectly, of "intelligence" in the Western sense of the word. Of course, intelligence is not solely responsible for any of them. But, I would argue, it is responsible in part for all of them.

Weapons of mass destruction can be designed only by people who have the high level of intelligence in the Western sense—I will call it "IQ" for short—needed to design such technologically complex weapons. Pollution, whether of air or water, results from industrial products (e.g., plastics) and wastes (e.g., sulfur dioxide) that represent the byproducts of IQ applied in industrial uses. Human-induced climate change results in large part from the emission of gasses, such as carbon dioxide and methane, that result from human industrialization. The COVID-19 pandemic was probably caused by human carelessness and the catastrophic response to it, resulting in millions of deaths; it was also a result of human stupidity, as is the overuse of antibiotics, allowing bacteria to gain resistance to them. And the slow extinction of the species by decreased sperm counts also is due to human negligence with chemicals allowed to enter into the environment and, eventually, into human bodies.

High IQ has its obvious advantages. It enables some people to create complex cell phones and many more people to benefit from them. It enables some people to create complex computers and others to operate them, as I am operating the computer on which I am writing this chapter. It enables some people to design cars, others to build them, and still others to drive them so that they do not have frequent crashes.

All of these advantages notwithstanding, high IQ also has brought humanity a lot of grief. Perhaps not only humanity. One hypothesis for why the Earth has not had extraterrestrial visitors is that any civilization advanced enough to create interstellar space travel would have destroyed itself before it even got to doing the travel (Hart, 1975; Howell, 2018; Spektor, 2018). Moreover, IQ predicts many different kinds of long-term individual successes (Deary et al., 2009).

The founders of the IQ- and, more generally, the ability-testing movement had positive intentions. Binet and Simon (1916) wanted to ensure that students who had intellectual challenges were properly educated, and moreover, that those who had behavioral issues, but not mental challenges, were kept out of special-education classes, which would provide them with insufficient challenge and publicly mark them as intellectually subpar.

How Environmental Context Can Make Us Smarter or Stupider

There are many factors in the environmental context that make us smarter. For example, information is far easier to acquire today than it was in the past. A few pushes of buttons on a computer or cell phone can yield information that used to be difficult or even impossible to obtain. Is it any wonder that crystallized intelligence has risen so greatly since the beginning of the twentieth century (Flynn, 1987, 2012, 2016)? No more visits to obscure stacks in the library or to specialized libraries that exist only in a few places in the world. Moreover, education is much more widely available than it once was, and resources are available today to disseminate knowledge that once could hardly be dreamed of.

Yet, the same environment that generates so much information comes at a price with regard to the effective deployment of that information. The price is that, in the desire to pursue profits above all else, social-media companies as well as other companies have employed artificial-intelligence techniques to tailor messages to deceive users of the Internet. Their goal is to shape the way people think without the people knowing they are being persuaded, much in the manner that Packard warned about many years ago in his book, *The Hidden Persuaders* (Packard, 1957, 2007). For whatever power the techniques of 1957 may have had, they were child's play compared with the subtle manipulations that are employed today through the Internet. What one sees on the Internet, how it is presented, and specifically how it is tailored to one's demographic and known background and preferences are probably unique in history. People are manipulated without knowing it. Moreover, given the chance to rise up against the manipulation, they generally have failed to do so. They would rather have the tailored messages, even at the expense of losing privacy and being propagandized.

Worse, the relentless pursuit of clicks—of keeping users of social media and other Internet sites on the sites—drives companies to reward bad behavior. False news is spread more than real news (Dizikes, 2018; Vosoughi et al., 2018), and emotionally sensational material spreads more quickly and widely than material that is rational but emotionally cool. If clicks are designed to keep people on a site, then news that is sensationalistic, emotionally arousing, and likely false will generate more engagement to users, simply because those posts are the ones on which people spend more time and the ones people retweet or recirculate more. The reward system is devised to reward not only bad behavior, but even anti-intellectual behavior.

The situation is worsened by the reward systems promoted by schools in the United States and abroad. These reward systems favor students who do what they are told, do it well, and do it consistently. Multiple-choice and short-answer examinations, for example, do not allow a great deal of latitude to students to show creative, practical, or wisdom-based skills. What they do allow students to know is their knowledge base and analytical skills operating on that knowledge base. At best, creativity is not rewarded; at worst, it is punished.

Because societies have created systems that employ an educational funnel to determine who gets the most rewards and who gets on in the systems, those whose intellectual bent is to do whatever society rewards—such as accumulate knowledge and analyze that knowledge—reap the most rewards. As they go through the educational system, their need to think creatively, practically, and wisely is minimized, and they either never fully develop these skills or, if they have developed them, start to lose them through disuse. The result is students who excel because they are, in the words of one scholar, intellectual sheep (Deresiewicz, 2015).

If schools overemphasize the development of knowledge and analytical skills, then what they get is experts at knowledge base, or at least, retrieval of knowledge base, who can analyze it and perhaps poke holes or craters in it, but who may not be able as well to creatively go beyond that knowledge base, apply it in a practical way, or think wisely about it, seeking a common good. The result may be a generation of leaders who have degrees from prestigious colleges and universities, who are IQ-smart in that they have large knowledge bases and can analyze problems well, but who are lacking in creativity, common sense, and wisdom and thus prove to be inept leaders. Moreover, even as people become more sophisticated, the means for manipulating them become more sophisticated, and it appears that, so far, people are losing to the AI that seeks to make money for the corporations that control social media and related sites.

What people need most from schooling today is not preparation for tests that, however relevant they may have been in the early twentieth century, today are a relic and a sad commentary on the utter fecklessness of the assessment industry. We need tests, as well as education, that help students arise to today's challenges (Sternberg, 2021). And those challenges include our involving ourselves in creative, practical, and wise thinking; our not being taken in by social-media and related manipulation; and our not falling for authoritarian appeals to stop thinking and to have the authoritarians to think for us. The last is probably the greatest challenge of all, in that despite rising IQs, many people today seem more taken in by the lure of authoritarianism than at any time since World War II (Albright, 2018; Applebaum, 2020; Levitsky & Ziblatt, 2018; Mounk, 2018).

The Law of Unintended Consequences

The Law of Unintended Consequences seems to have occurred with full force in the case of intelligence tests and proxies that measure the same knowledge and skills under a different name. What were originally intended as tests to separate those with learning challenges from those with behavioral issues have become tests that are used for an astonishing array of purposes, including identification of persons with intellectual challenges, persons with intellectual gifts, admissions decisions for universities, financial-aid decisions for universities, employment decisions, profiles of intellectual strengths and weaknesses, and beyond. These broad uses would not have been a problem were the tests used as advisory among large numbers of other criteria. But decisions, such as about identification of the gifted and about university admissions, started to be made solely on the basis of test scores, and still are. Admission today can be gained or denied to many universities solely on the basis of scores on standardized tests, and such scores can lead younger students to be placed into dead-end low-achievement tracks in schools from which it will be difficult to exit, as they fall further and further behind their peers placed into higher tracks.

The early testers—Alfred Binet, inventor of the first modern intelligence test; Henry Chauncey, first president of the Educational Testing Service; James Bryant Conant, President of Harvard University; E. F. Lindquist, creator of the ACT (American College Test)—would not have realized that scores on their tests would be highly correlated with socioeconomic status (SES). If one looks at SES groups and compares average SATs (formerly known as the Scholastic Aptitude Test), for example, the correlation for SES groups with SATs (critical reading, mathematics, writing) are over 0.95 (Rampell, 2009).

It would be easy to blame the early testers for the overuse of testing today, but such blame would be misplaced. Too much time has passed, and the earlier testers had no reasonable way of foreseeing where things would go. One also could place the blame on contemporary testing companies—Educational Testing Service (ETS), the College Board, ACT, Pearson, or whichever—but that would miss the point that testing companies only provide products and services if there are purchasers. The blame belongs not just on them, but on all of us.

All kinds of groups profit from the current emphasis on narrow tests of IQ and its proxies, for example:

- College and universities get data for free that they hope will raise their prestige ratings
- Wealthy and well-connected parents can afford to buy books and courses for their children that will assist the children in test prepara-

tion; they also can afford to send their children to public or private schools that better prepare the children for the tests. In extreme cases, parents illegally have hired professional test-takers to take the tests for their children, in some cases, resulting in prison terms (Taylor, 2020).

- School administrators often like the tests because the tests provide them a way of demonstrating "accountability," although in a very narrow sense. Sometimes, the administrators purposely exclude from the testing students whose scores might bring down their averages.
- Certain magazines and websites like the tests because they use the ratings to evaluate colleges and universities, which parents then can use to help their children decide on where to apply; the websites make money through subscriptions and advertising.
- Some book publishers, websites, and course publishers make money by offering preparation for the tests.

In general, enough different powerful stakeholders stand to profit from the tests that there is not a lot of incentive to change the situation. Ironically, the strongest incentive for change was offered not by researchers questioning the validity of the tests for the purposes for which they are used, but rather, by the collateral effects of the COVID-19 pandemic. It became much harder to administer the tests and for examinees to take them, with the result that some colleges and universities made the tests optional, and others dispensed with them altogether.

How Do We Set What Is Wrong, Right?

If humanity is to avoid setting off the time bomb, we all need to conceive of intelligence in a broader, more inclusive, more contextually relevant, and more positive way in terms of setting the world on a better course.

I have proposed that we need to return to the original definition of intelligence as adaptation to the environment (Binet & Simon, 1916; "Intelligence and its Measurement," 1921; Wechsler, 1940). This means that instead of defining IQ and its proxies in terms of the knowledge and abstract-reasoning skills directly needed for academic problem solving, we look at intelligence more broadly, in terms of the adaptive skills we need as individuals and as humanity collectively, to ensure not only our own future but also that of all interacting species that share this planet (Sternberg, 2021). The path humanity is on is a destructive one. It takes only a minimal IQ to see that. Rather, humanity has allowed short-term greed and other economic interests to take priority over the long-term well-being not only of humanity and other species today, but also of humanity and other species in the long term. We are mortgaging their future interests for our own present, short-term ones. If our ancestors had done that, we might not be here, or if we were, we might be living in the severely damaged world that we are leaving for our descendants.

Elements of a Theory of Adaptive Intelligence

Adaptive intelligence serves to make the world better—it operates to make a positive, meaningful, and possibly enduring difference to the world. It does so by people finding their role in the world and then using that role to make a positive difference. They do so by creatively generating ideas that are novel, useful, and positive in the difference they make; analyzing these ideas to ensure that they are of high quality; effectively implementing and promoting the ideas in a practical way; and ensuring that the ideas wisely help to achieve a common good.

This conception of adaptive intelligence is quite distant from that of general-intelligence theorists, who view intelligence as a hierarchical set of abilities with general intelligence (*g*) at the top, and then successively more narrow levels of abilities beneath the most general one (e.g., Carroll, 1993; McGrew, 2005). Admittedly, adaptive intelligence seems broad by the standards of *g*-based theories. The adaptive-intelligence notion, however, fits quite well with indigenous conceptions of intelligence in many parts of the world. For example, in rural Kenya, we found four words that characterized intelligence: rieko, luoro, paro, and winjo (Grigorenko et al., 2001). *Rieko* involves knowledge, ability, and cognitive skills in general; it is close to *g* but also involves domain-specific skills. *Luoro* involves respect and other aspects of practical intelligence. *Paro* involves initiative and other aspects of creativity. And *winjo* involves comprehension of the complexities of a problem situation and other aspects of wisdom. Thus, the adaptive-intelligence notion has a strong precedent, just not in contemporary Western theories.

Consider now the elements of creativity, analytical thinking, practical thinking, and wisdom.

Creativity

Creativity is the production of ideas that are both novel and useful. From the standpoint of adaptive intelligence, the ideas also need to be positive—that is, they help to make the world a better place. Our work on creativity is based on a so-called *triangular theory of creativity*, according to which creativity involves defiance of three kinds: defiance of oneself, defiance of the crowd, and defiance of the Zeitgeist (Sternberg, 2018). Defiance of oneself refers to one's willingness to give up on ideas that one has accepted for some length of time. People often are uncreative because they simply cannot give up on their own ideas that they have become convinced are true or, at the very least, the best ideas. These people metaphorically are stuck in place. Defiance of the crowd refers to defiance of ideas that many other people, especially people with whom one identifies, accept. One even may know that the ideas are wrong but be afraid to go against the current groupthink of others of one's profession, religious or ideological group, or self-perceived tribe. Defiance of the Zeitgeist refers to willingness to defy entrenched beliefs within a sociocultural context, often beliefs one scarcely is aware of or may be unaware of entirely. They may be the foundations upon which one's thought and behavior are based. For example, during the times of COVID-19, many people have had trouble with masks or social distancing simply because they were unable to give up on the idea that they should be able to go around maskless and get close to whomever they wished. They reconceived the idea as one of "personal freedom" in order to avoid conceiving of the problem as one of dogmatic entrenchment: they simply were too rigid to think differently from the way they had thought before, even, in many cases, at the cost of their own and others' lives. The phenomenon was so breathtaking because it has shown how even the Darwinian impulse toward survival can be trumped by rigidity in thought and behavior.

Natural selection rewards those gene pools that have the flexibility to adapt to current circumstances, not past ones. My colleagues and I have measured creativity in a variety of ways (see, e.g., Sternberg, 2017).

Measuring creative thinking made a difference in the various projects we did. For example, in one project, the Rainbow Project, we tested high school and college students around the United States for their analytical, creative, and practical skills (Sternberg & the Rainbow Project Collaborators, 2006). We found that including a test of creative thinking in a best battery doubled prediction over the SAT alone of academic success (grade-point-average—GPA) in the first year of college. We further found that including a test of practical abilities increased prediction by about 25%.

Analytical Thinking

Analytical thinking is largely what conventional tests of intelligence and proxy tests of intelligence (SAT, ACT, GRE) measure (Sternberg, 2020). For much of my career, I believed that these tests are reasonable, if sometimes biased measures of abstract-analytical thinking. I say "sometimes biased," because what they measure will depend to some extent on examinees' background and education and life socialization up to the point of testing. However, in recent years, I have come to question just how well the conventional tests even measure analytical reasoning, at least as it generalizes to one particular kind of situation, namely, STEM (scientific/technological/engineering/mathematical) thinking.

In a series of studies (Sternberg & Sternberg, 2017; Sternberg et al., 2017, 2019, 2020), my colleagues and I investigated STEM reasoning of three kinds: Generating Alternative Hypotheses, Generating Experiments, and Drawing Conclusions. The results of the research were consistent. First, scores on these kinds of STEM reasoning tests and other related STEM reasoning tests tended to correlate significantly with, and to factor with, each other. Second, scores on tests of fluid-reasoning ability (which is almost the same as general intelligence—Kvist & Gustafsson, 2008) tended to correlate significantly with each other and also to factor with each other. But the STEM reasoning tests did not show consistently positive correlations with the tests of fluid intelligence and sometimes even showed significant negative correlations in our samples.

These results suggest that whatever it is that the intelligence-test proxies measure, it is potentially not central to STEM reasoning as it exists in scientific research and teaching (the latter of which we also studied). General intelligence may affect performance in many cognitive domains, but if one wishes to select or train scientists for research, general intelligence as measured by current tests may be a non-optimal place to start.

Practical Thinking

Practical thinking is the application of one's cognitive processing to the solution of everyday, practical problems. It is used to adapt to, shape, and select environments.

Generally, scores on tests of these kinds have shown minimal correlations with general intelligence (Sternberg & Hedlund, 2002). These tests are important because they measure real-world adaptive skills, not just academic analytical skills. We found that practical tests, like creative tests, significantly and substantially improved prediction of undergraduate college/university success.

Consider the following problem (Sternberg et al., 2001): "A small child in your family has homa. She has a sore throat, headache, and fever. She has been sick for 3 days. Which of the following five Yadh nyaluo (Luo herbal medicines) can treat homa? i. Chamama. Take the leaf and fito (sniff medicine up the nose to sneeze out illness).*ii. Kaladali. Take the leaves, drink, and fito.*iii. Obuo. Take the leaves and fito.*iv. Ogaka. Take the roots, pound, and drink.v. Ahundo. Take the leaves and fito."(Correct answers are starred.) Children in the United States and most of the world would have trouble solving this problem. Most of the children we tested were able to solve problems like this one quite well. Why? Because practical, tacit-knowledge-based skills are quite domain-specific. This problem is relevant to practical adaptation in the rural Kenyan context because the children are continually having to stave off or combat parasitic illnesses of various kinds. Children in, say, the United States and Western Europe do not have to do this. But their children should not be expected to do the practical tasks our children are expected to do.

When we first submitted this article for review, a reviewer criticized the task as too culturally specific—as one that might fit less-developed countries but that would be far away from the demands of more developed cultures. But today's cultural demands have changed. Western children and adults alike could have used these skills when it came to preparing for and handling the COVID-epidemic!

In the Kenya study, scores on the test of tacit knowledge of natural herbal medicines yielded negative correlations with traditional measures of general intelligence. The reason appears to be that, in this society, the brighter children are removed from academic schooling earlier in order to become apprentices to master craftsmen and to others; the less able are not selected and stay in school. So, the students appearing to be less competent are left to develop the kinds of academic skills measured by IQ tests, while the ones appearing to be more competent are taken out to develop practical skills that can lead to a successful career.

Wisdom

Wisdom is the use of one's abilities and knowledge to achieve a common good, by balancing intrapersonal, interpersonal, and extrapersonal interests, over the long- as well as the short-term, by infusing positive ethical values in order to adapt to, shape, and select environments. Schools need to develop in students not only knowledge and analytical skills in the evaluation of that knowledge, but skills in the deployment of knowledge toward a common good (Sternberg, 2019).

Conclusion

Standardized tests, based on modern Western notions of intelligence, are seriously limited and narrow because modern Western notions of intelligence are seriously limited and narrow. There are available at least prototypes of tests that could expand our conceptions and our measurements. Why don't we use them? There are a number of reasons, I believe:

- Entrenchment: People keep doing what they are used to doing.
- Intellectual laziness: People don't want to bother to change what they are thinking or doing.
- Short-term thinking: People think about short-term outcomes, such as academic success, rather than long-term outcomes, such as success in societal leadership positions.
- Desire to preserve the existing socioeconomic hierarchy: The tests essentially launder existing socioeconomic status and keep in power the children of those already in power.
- Quantitative precision fallacy: The numbers yielded by tests sound exact and thus meaningful.
- Similarity fallacy: People look for others like themselves to lead.
- Public relations: It helps promote the image of an educational institution if it has high test scores.
- Financial and other benefits: Schools do not pay for the students to take tests—the students pay.
- Superstition: People rarely try to disconfirm what they are already doing, and come to believe it must be the right way of doing things.

The Western conception of intelligence values people who are very good at doing what they are told to do and fitting into an existing cognitive/social/economic structure. Even creative professions often value those who are creative working within entrenched paradigms and who do not challenge the existing structure of the field. People who are highly creative or wise do not fit well into this structure and are challenged at every turn to stay in their place. So little changes because the existing power structure (which often is hidden) does not allow it to change. And that spells a dismal future.

The problems facing the world are enormous and psychologists and other behavioral scientists often have reacted as though these problems are not *their* problem. They have persisted, especially in the field of intelligence and related fields, in defining problems narrowly, failing to realize that if the world falls apart, there won't be a next generation to continue small or self-satisfied approaches to small problems, much less, small approaches to big problems.

We are worried about standardized test scores while the world has serious problems to address. Our time is running out. By the time we get around to solving some of our problems, global climate change may have rendered much of our land mass unlivable, while large parts of this land mass may be overrun by water. We need to do better. Our time is running out. Lemmings do not commit suicide, but humans do. It is not too late to reverse the trend but it is not clear how much time we have, as a species, to reverse the change. If ever there was a time, it is now. We have set a time bomb. We need to defuse it now.

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Part VII

Conclusion

17

Conclusion: Intelligence Does Not Inhere Within the Individual but Rather in Person x Task x Situation Interactions

Robert J. Sternberg and David D. Preiss

Historically, intelligence has been viewed as a trait—a characteristic of a person that is at least partially heritable and that is relatively stable, relative to other persons, throughout a lifetime. Sternberg (2021a) has questioned this view and suggested instead that intelligence is not an inherent trait but rather a person x task x situation interaction.

People who view themselves as generally intelligent flatter themselves: Many of them, placed into a different cultural or secular temporal environment, not only would not flourish, but might barely be able to hang on by

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the skin of their teeth. Similarly, many people who might not fare well in a post-industrialized knowledge-based cultural milieu might fare far better at a different time or in a different place. And, probably, many of the most successful analytically smart individuals of our contemporary corporate cities would not be able to survive even one day in the Amazon as the still un-contacted tribes do there even today. These largely unexplored areas so far they remain almost inaccessible to visitors. Some of those visitors, given the chance, would indirectly kill the inhabitants by destroying their natural ecosystem. The visitors would be—and often, in the past as well as the present, have been—more interested in the profits from logging or mining than in the lives of the indigenous inhabitants. They might also bring with them viruses to which the indigenous inhabitants have not been exposed, much as did the Spanish, Portuguese, and other explorers in times past.

Shifts in what constitutes adaptive, or intelligent behavior are happening at what seems to be lightning speed. Who would have thought, just a few years ago, that a decision as to whether to get vaccinated, or to wear a mask, or to socially distance might become a matter of adaptive intelligence, and also potentially a matter of life or death? Such decisions have become a matter of the intelligence used to adapt to the environment. Poor decision-making might be and has been a matter of life or death, not only to oneself, but also to those with whom one comes into contact.

Many scientists studying intelligence have continued to think of intelligence as the same fixed trait it always has been. They think in this entrenched and obsolete way despite the fact that some of the more traditionally "intelligent" politicians and others in the US and elsewhere have advocated for policies that likely would lead to deaths of men, women, and children alike, and in some cases, themselves (Edwards, 2021). Apparently, advanced university degrees, for whatever they may tell us about IQ, tell us little about intelligence as adaptation to the modern world, unless "adaptation" is defined in terms of cynical exploitation of followers by leaders for leaders' personal gain. People always have been attracted to toxic leaders, and still are (Lipman-Blumen 2006).

In the history of psychology, several scholars have proposed developmental and contextual models of intelligence. But these models have not impacted the mainstream of intelligence research. There has been no lack of scholars who have noted that intelligence changes with time (Greenfield,

2019) as well as place (Berry, 1974, 1984, this volume; Ceci & Bronfenbrenner, 1985; Ceci & Roazzi, 1994; Cole, 1996; Greenfield 2019; Luria, 1976; Sternberg, 1984). According to one account, the basic processes of intelligence stay the same, but how they are contextualized and thus how they are applied in life change over time and place (Sternberg, 2004). This is an argument also made in this book.

Berry (this volume) understands intelligence as the "*cognitive and social capacity to adapt successfully to life conditions*, including those that have been experienced during the course of development, and to the changing conditions that are now being experienced." Additionally, Kaufman et al. (this volume) noted that "Notions of fixed intelligence have been replaced, for most knowledgeable professionals, by awareness of the malleable nature of intelligence and the fact that IQ tests measure only a fraction of what can legitimately be thought of as intelligent behavior."

The example of supposedly intelligent people killing themselves and their beloved ones by going maskless, not vaccinating themselves, or not socially distancing is a contemporary real-life example of how behavior that was adequate in 2019 was not intelligent in 2021 during the surge of the potentially deadly delta variant of COVID-19. The transition to what once was "normal" life back from the pandemic way of life has made these decisions even more complex, because it is not entirely clear when a pandemic truly is "over." An analytically smart person should be able, in theory, to make an adaptive decision based on a number of variables that seem to be continuously evolving. But the evolution of these variables has occurred in a context of growing incertitude because of the rapid evolution of the novel coronavirus and because of the contingencies triggered by the often ill-informed and deeply inconsiderate behavior of others. Are we going to go back to business as usual or will some of the new habits remain in place? No one knows. Will we adjust our priorities and change our habits of consumption and entertainment? No one knows. It is not clear just yet what will be "smart" when the pandemic is over, if it ever is entirely over. And at that point, should it come, we will have to deal with the socioeconomic and political consequences of what our own mindlessness during the pandemic has wrought.

The necessity to rapidly adapt to a changing environment will grow more and more important as we enter the uncharted waters of the

Anthropocene. In this new epoch, contextual changes will be more frequent and we will need to re-assess what is smart and what is not in very short time frames. Meanwhile, many psychologists stuck in what for them is the endless world of the twentieth century will remain fixated on the intelligence that, more or less, got people through the twentieth century but is not getting them through the twenty-first. Entrenchment of assumptions and worldviews is very powerful in the field of intelligence, as it is in many other sciences as well.

Additionally, many activities that were "intelligent" during the twentieth century will become less adaptive as the impact of climate change in our life grows. Sea border properties, which were desirable during the past century, will become less and less attractive as sea levels rise and hurricanes and storms grow in intensity. They already have become less attractive, as flooding has wrecked some of them and rising insurance rates have affected the value of many more. More consequentially, beyond the decisions that are important individually, we will need to make decisions to face the "tragedy of the commons" across a number of environmental crises: air pollution, traffic congestion, overfishing, water scarcity, epidemics, and so forth. "Smart" people using their smarts to benefit themselves at other people's expense already is backfiring on the smart people, as the air they breathe becomes worse, as the climate worsens, and as the unfortunates become increasingly desperate and turn to populist leaders seeking to be autocrats.

In order to survive the challenges of the Anthropocene, our species will be required, among other strategies, to incentivize cooperation toward a common good and to sanction individual maximization that occurs at the expense of the common good (Chiu et al., this volume; Preiss, this volume; Sternberg, this volume). Implementation of these adaptive strategies does not naturally follow from the use of our analytical intelligence but also requires adaptive intelligence and especially wisdom (Sternberg, this volume). As noted by Chiu et al. (this volume), we need adaptive intelligence to solve the tragedy of the commons. Cultural-evolution theories explain why it is so—things are changing too quickly for static intelligence or a static notion of intelligence fitting school performance in the early twentieth century.

Notwithstanding that our life today requires adaptation to rapidly evolving environmental circumstances, some scholars prefer empirical demonstrations through scientific research in the laboratory rather than through real-world problem-solving. That is, an empirical demonstration based on some college students in a laboratory might be viewed as more valuable to some than the demonstration of millions of real-world deaths, many of them avoidable (e.g., Redlener et al., 2020). That said, evidence that context matters is not recent. Nuñes (1994) and Ceci and Roazzi (1994) showed how students could perform at one level in school mathematics and perform at an entirely different level when the mathematics was presented in a street context. Lave (1988) provided a similar demonstration for Berkeley housewives, whose performance on a numerical task differed, depending on whether the housewives were calculating in a supermarket context or a classroom context. Grigorenko et al. (2004) and Sternberg et al. (2001) showed that task performance on a test of intelligence relevant to an adaptive context was entirely different from performance on IQ test proxies.

Person x Task x Situation Interactions Across Milieus

This volume considers a variety of contexts to assess the notion of a person x task x situation in intelligence as adaptation. Berry (this volume) notes that the social and cognitive abilities that define human intelligence accomplish an adaptive function. In general, human diversity requires individual and social adaptations to the demands of environmental contexts. That view is shared by most of the authors of this volume. For example, Sternberg, Chiu and collaborators, and Preiss make very similar arguments regarding the interaction between abilities and context. Moreover, these same authors note that, as contexts change, so do the abilities required to adapt to those contexts. A view of intelligence restricted by the mere consideration of IQ scores is a limited view. That said, although IQ scores are a static measure of an individual intelligence, the Flynn effect has shown that they are not immune to environmental influence.

These contexts are as follows:

1. Cultural—External Orientation
2. Historical—External Orientation
3. Cognitive/Social Psychological—Internal Orientation

How do persons x tasks x situations interact? Here we distinguish these interactions in different time scales and situations, based on the work presented by the contributors to our book.

Long-term cultural evolution defines the overall context of what constitutes intelligence. Because of the ratchet effect, symbolic tools continuously expand and transform the nature of the cognitive abilities fulfilling an adaptive role (Preiss, this volume). Chiu et al. (this volume) place the development of intelligence within the broad and long-term context of cultural evolution. They summarize the processes that support the development of adaptive intelligence, depending on personal and contextual malleability as follows:

- migration or environment selection when personal or environmental adjustment is not possible (what Sternberg, 2021b, refers to as "selecting" an environment);
- standing variations of existing preferences when self-adjustment is permissible or preferable or when environmental change is not possible (what Sternberg, 2021b, refers to as "narrow adaptation" to the environment);
- niche construction, de novo innovation when self-adjustment is not possible and when environmental change is permissible or preferred (what Sternberg, 2021b, calls "shaping" the environment);
- person-environment co-evolution when personal and environmental adjustments are both possible.

Thus, the adaptive value of abilities depends in part on the malleability afforded to the individuals and to the environment by the present circumstances. No static measure can properly assess the dynamic nature of these changes, particularly in the time range provided by cultural evolution. IQ tests produce a score based on a set of abstract-analytical abilities that may be of lesser importance today than in other moments of our cultural evolution. That is true for other abilities as well. Creativity is especially important for niche construction, but it may be useless in situations where the only response possible for an individual is a minor variation of existing preferences—creativity is not afforded. For example, in dictatorships such as China or Russia, one can be creative in many domains, but only if the government views the creativity as nonthreatening, and what the government will view as threatening is often ill-defined. In extreme situations, such as those today experienced by the individuals belonging to the uncontacted tribes of the Amazon, whose entire survival is contingent upon the sustainability and isolation of their ecological niche, the analytical (and academic) skills measured by IQ scores are, quite probably, largely irrelevant (Sternberg 2021a, 2021b).

Flynn (2012, 2016) believed that increases in IQ could be traced to the increased demands of modern society on our intelligence. But IQ seems to have undergone—whether recently or in the more distant past—a divorce from critical and rational thinking (Stanovich, 2010, 2021; Stanovich et al., 2018). Any number of people with presumably high IQs, educated at top universities, are in leadership positions and using these leadership positions to promote a death cult that encourages people not to wear masks and not to get vaccinated. Most of them are themselves vaccinated, but if their idea of being "smart" is indirectly to promote the illness and deaths of their own followers (i.e., those who elect or otherwise choose them), something seems to be wrong with this notion of "smart": These leaders are contributing to killing off their own supporters. If IQ ever cut it—which is doubtful—it no longer does. That will not, of course, convince the high-IQ people the success of whose careers is bound up with the perpetuation of the notion that IQ is a fully valid measure of intellectual skills.

What constitutes intelligence is responsive to historical influences, particularly in highly literate cultures. Yang et al. (this volume) have shown how long-standing beliefs about the nature of intelligence, rooted in ancient Chinese philosophy, still permeate what contemporary Taiwanese understand as intelligence. This is not only true for the specific concept of intelligence but also for implicit and explicit theories of group and gender differences in intelligence, as shown by Gigerenzer (this volume). These theories were not responsive to adaptive needs but rather to historical developments in the way scholars have thought about the topic to justify discrimination against women.

Another illustration of changes in our understanding of intelligence is how scholars have considered the malleability of intelligence. Although the original definition of general intelligence by Spearman assumed a static view of intelligence, not all the scholars who supported the idea of a general intelligence and IQ testing agreed with the view that intelligence could not be modified by experience. As noted by Kaufman et al. (this volume), Wechsler and many psychologists after him didn't believe that general intelligence was necessarily static:

> Quite clearly, Terman's psychometric approach, and his personal belief systems, aligned with fixed intelligence, whereas Wechsler's clinical approach and philosophy were more in tune with the notion of malleability. Fixed intelligence and deification of global IQs clearly were the standard of the day into the 1960s, even the 1970s. But the notions of IQ being fixed and the global IQ reigning as king have become alien to a substantial proportion of psychologists, IQ test developers, and special educators during the last generation and a half (pages xx).

As Kaufman and collaborators show, adherence to the theory of general intelligence does not mean necessarily that one must endorse a static view of intelligence. Wechsler adhered to the notion of a global score to measure an individual's intelligence without necessarily following the idea that this score is immune to environmental influences. Beyond the notion of general intelligence, at the end of the last century many psychologists started to look for broader definitions of intelligence. These new models have offered scholars different avenues to develop more inclusive views of human ability. Suzuki et al. (this volume) have made the case that one way to overcome the social and racial biases of intelligence is by expanding the notion of intelligence to include broader contextualist models beyond the canonical definitions that value speed, advance planning, and abstract reasoning to arrive at the correct answer.

Beyond the global evolution of Homo sapiens as a species and the more recent historical changes in our modern understanding of intelligence, it is worth noting that the expression of these abilities changes depending upon proximal influences as well. One of the main issues of understanding intelligence across cultures is that of comparability. Fontaine and Poortinga (this volume) discuss in depth the challenges associated with the comparability between populations in measures of intelligence. They note that there have been two extreme positions in discussing the issue of comparability. On the one hand, one position adheres to the notion that it is possible to prove innate differences between populations using intelligence tests. On the other hand, the other position adheres to the claim that intelligence is so task- or situation-specific that comparisons are not feasible. The authors note that, in order to overcome these extremes, and to overcome the misuse of intelligence tests, it is not necessary to abandon the concept of intelligence entirely. Use of tests across cultures is possible if researchers take into consideration validity and other methodological issues and identify which intellectual processes can be properly measured and compared across different contexts (Fontaine & Poortinga, this volume).

In addition to cross-cultural studies on intelligence, there are two other ways of addressing the relationship between culture and intelligence. One of these is the one proposed by Ng et al. (this volume). They propose a new construct, that of cultural intelligence (CQ), which they define as "an individual's capability to function effectively in contexts characterized by cultural diversity" (p. xx). The authors indicate that CQ is a *capability* instead of an *ability*. According to the authors, whereas a capability involves proven performance, an ability reflects potential for performance. Additionally, they indicate that the abilities underlying CQ go beyond mere adaptation to also include, following Sternberg's (2021b) notion of adaptive intelligence, shaping the environment or finding new environments. CQ requires meta-intelligence, not only intelligence, to navigate the conflicting rules existing in culturally diverse environments. CQ is malleable and trainable and involves other skills beyond mere abilities: motivational, cognitive, metacognitive, and behavioral.

Another way to study the localized impact of culture on intelligence is by doing in-depth single cultural studies. That is the approach taken by

Tan and Grigorenko (this volume). These scholars show that the development of intelligence is closely related to the demands of the physical, cultural, and social environments. Tan and Grigorenko propose that people capitalize on the strengths that are fostered by their own culture and, as a case in point, show that the social competencies fostered by African kinship systems play a life-saving role in the families impacted by HIV/AIDS. Additionally, they note that culturally and socially shaped competences regarding time cognition have also been important for medication adherence in sub-Saharan Africa. As with other authors of this book, Tan and Grigorenko also adhere to the idea that although intelligence is universal, it varies depending on the specific demands and cultural resources existing in its developmental niche. As the conditions of this niche change, people extend their local competencies to cope with the new challenges that arise in their horizon.

In addition to evolutionary, cultural, historical, and cross-cultural influences, specific and immediate contexts matter. Hambrick (this volume) notes that what we understand as context has to take into consideration other individual-difference variables, in addition to task and environmental/situational ones. He notes that context impacts task performance through the artifacts individuals use, which require a specific expertise. Manipulation of these artifacts is dependent on domain knowledge, which is in turn task-relevant. Hambrick argues that this contextual approach will be informative of the interactions between tasks/situational factors with measures of general intelligence. These interactions are more informative of the real performance of an individual in a specific task/situation than a de-contextualized IQ score.

Complementing this concern for the nature of intellectual assessment, and as an illustration of the role that artifacts have on intellectual performance, Furnham (this volume) notes that, given that the changes that surround us have impacted the way we process information, we may need new ways of testing intelligence that are more compatible with this reality. He notes that computer games may have many advantages that can help to renew the field of intellectual testing. First, they measure efficiency of information processing. Second, since they are games, they are less anxiety-provoking than actual tests of intelligence. Also, they generate greater engagement and intrinsic motivation than intelligence tests to perform. The question is whether they can be made sufficiently realistic so that they measure real-world problem-solving skills.

A final way of addressing the relationship between intelligence and context is that of the way intellectual abilities and intellectual assessment relate to social issues. This is a two-way street. As Ceci and Williams (this volume) show, emerging social issues can force us to re-assess what we understand by intelligence and to be more aware of their limitations. Fake news is a working example of these limitations. The authors note that more intelligent people will not necessarily be more protected from fake news. Quite the contrary, intelligent people are prone to dangerous reasoning because they think they are not, which makes them susceptible to nefarious influences. A way to address these limitations, they claim, is to engage in actively open-minded thinking to prevent biases and to better assess the content of fake news. Such news capitalizes on "myside bias."

At the same time that social issues can force us to reconsider our notion of intelligence, our notion of intelligence is also impacting the generation of new social issues. Bian (this volume) shows how fixed mindsets of intelligence and people's stereotypes about intelligence based on gender or race can have a negative impact on stigmatized groups. Those organizations whose members adhere to the view of the importance of innate dispositions instead of effort and learning seem to be especially unwelcoming to people belonging to marginalized communities. One way to address the imbalances caused by these conceptions is to promote a growth mindset in these organizations. In a similar way, Suzuki et al. (this volume) propose that, as traditional definitions of intelligence are not inclusive of multiple identities, conventional IQ tests are not sufficient to capture the abilities displayed by different social groups and to address the demands of adaptation and survival in their lives.

Conclusion

Historically, human intelligence has changed, as it has been affected by cultural evolution (Greenfield, 2019; Preiss & Sternberg, 2005; Sternberg, 2021a, 2021b). Intelligence in action also differs widely across cultures (Berry, 1974; Laboratory of Comparative Human Cognition, 1982;

Sternberg, 2004, 2020). This change is scarcely surprising. The skills needed for adaptation are quite different over time and place. In a hunting-gathering society of the distant past (and a few of today), being unable to hunt successfully for food could result in death by starvation or by the hunter's becoming food for a wild animal. Being unable to gather could result in a diet that lacks the important nutrients one needs in order to survive. In a modern technologically oriented society, there are also threats to survival, some of which are quite different. In such a modern society, believing fake news and Internet propaganda poses a serious challenge. Many of those who have shunned vaccines against COVID-19 or masks have died because they were either gullible or ideologically rigid.

The people who are gullible or ideologically rigid in their seeking of, and evaluating of Internet information are not necessarily those who would be ineffective hunters or gatherers. We know that failures in rational thinking—as in failing adequately to seek out and evaluate Internet information—are not equivalent to merely having a low IQ (Stanovich, 2010; Stanovich et al. 2018). Moreover, those gullible individuals often show extreme myside bias—who only see things from their own point of view—and high-IQ people are susceptible to this bias, just as are other people (Stanovich, 2021).

In a similar way, the people who are good hunters can use IQ-based skills, but in the end, if they lack what Gardner (2011) has called the bodily kinesthetic intelligence to aim their arrow or their spear or whatever hunting implements they are using, their high IQs might not be worth much to them. It is pretty much the same in any physical endeavor. A basketball player may have the IQ to strategize effectively in a basketball game, but without the aim and coordination skills to shoot basketballs into baskets, or at least to pass effectively to teammates, those IQ points will not count for so much.

Task variables that can affect intelligence are whether a task is verbal or spatial, whether it requires some kind of performance or merely responses on paper, whether it is a typical-performance task or a maximum-performance task, whether it involves numbers or not, and whether it is presented with adequate directions. Situational variables that can affect intelligence are pressures caused by time limits, real-world consequences such that mistakes become extremely costly or fatal to someone, emotional involvement, ideological bias, cultural expectations, and the like (Sternberg, 2021b).

A typical argument might be that these variables merely affect the expression of intelligence, not intelligence itself. But the problem, from a measurement point of view, is that intelligence always must be measured with a given set of tasks and in a given type of situation. The tasks used will vary according to the theory. With regard to tasks, results from a full battery based upon CHC theory (McGrew, 2005) might look quite different from one based only on g-c/g-f theory (Cattell, 1971). And a battery taking into account cultural and/or temporal differences in intellectual requirements might look very different yet again (Sternberg, 2004). Similarly, results from a battery in which speed is very much emphasized might look very different from one in which accuracy is very much emphasized, and one administered for extremely high stakes might yield results different from those if the battery is administered for low stakes.

Why, if intelligence is interactional, does the view of intelligence as inhering only in the person persist? There probably are a lot of reasons.

First, it is very hard to overturn a scientific paradigm (Kuhn, 1970). Scientists often cling to their paradigms for dear life, even after evidence comes in that the paradigms fail to account for substantial information, and even after the paradigms fail. The large majority of scientific careers are built on working within established paradigms—not on overthrowing them.

Second, one can hit upon a piece of empirical evidence and be satisfied it is sufficient or even “proof-like.” Many researchers are satisfied with the IQ construct in large part because it predicts many different criteria (Sackett et al., 2020). But height also predicts basketball skill; yet it is not causal of basketball skill. Many tall people are unskilled at basketball.

Third, there are just so many individuals and types of individuals who profit or think they profit from the current system—test publishers and those who work for them; the test-preparation industry; schools that use the tests; parents who think they understand the tests and can help their children prepare for them; government officials who can claim, without much thought, that the tests somehow provide a kind of accountability;

and so on. Entrenched systems are hard to change when many people have a vested interest in them.

We believe the essays in this volume have made a strong case for understanding intelligence in context, not just as a person variable independent of that context. We hope you are persuaded!

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