THE Human Spark

The Science of Human Development

Jerome Kagan

BASIC BOOKS
A MEMBER OF THE PERSEUS BOOKS GROUP
New York

CONTENTS

PREFACE

Social scientists who were trained in American universities during the first half of the twentieth century found it hard to escape the assumptions about human nature that history had bestowed on them. As that century began, large numbers of children from impoverished, illiterate immigrant families living in densely populated neighborhoods were doing poorly in school and disrupting civic harmony. The social scientists' preferred explanation of such facts emphasized the power of experience to create these and other profiles. This unquestioned faith in the malleability of the mind, an idea not yet documented by research, sustained the hope that proper rearing within the family and proper instruction by conscientious teachers in the schools could transform all children into productive citizens.

Only a few decades earlier, many experts had assumed that the less-than-adequate adjustment of the children born to poor immigrants was attributable to inherited biological defects. This pessimistic explanation bothered liberal Americans who, believing in the power of experience to conquer all but the most serious deficiencies, hungered for scientific support of their belief. Freud and the behaviorists supplied the reassurance by announcing that variation in experience could account for most of the variation in children's competences and behaviors. By the 1950s, a large majority of developmental psychologists were certain that the events of early childhood, especially in the home, were the primary determinants of adolescent and adult profiles. Each child's biological features, which the psychologists did not deny, could essentially be ignored.

A rash of unexpected scientific discoveries after 1960 challenged this optimistic position. Stella Chess and Alexander Thomas described the contribution of infant temperaments to later personality at the same time that others were finding

evidence for genetic contributions to many talents. These discoveries—combined with the failure to provide convincing evidence that experience alone could create an extremely shy, aggressive, or intellectually impaired child—forced the next cohort of psychologists to acknowledge biology's influence.

I entered graduate school in 1950 committed to the older environmental position but sufficiently receptive to the biological perspective to take advantage of a chance event that led to a personal epiphany. This event occurred during the 1960s, when I visited Guatemala as a member of a team of American scientists charged with evaluating a research proposal on the effects of nutritional supplements on the health and cognitive talents of malnourished children living in poor, rural villages. Following our formal meeting, Robert Klein, the American psychologist who would direct the day-to-day operations of the research, took me to Lake Atitlan in the northwest part of the country. This exquisitely beautiful, cobalt-blue lake at the foot of a volcano was rimmed by a number of villages containing the descendants of Mayan Indians, some living under conditions that had not changed much over the previous two hundred years.

This scene provoked my curiosity about the development of children in this non-Western setting, and I spent my sabbatical year in 1972–1973 observing adults and children in one of the poorest, most isolated villages on the lake. It was there, after several months of study, that I was forced to acknowledge biology's substantial contribution to psychological development through its control of brain maturation—an idea supported by evidence from other laboratories as well. Upon returning to Harvard in the fall of 1973, I devoted much of the work of my own laboratory to the pursuit of this idea.

I summarized my revised views of development in 1984 in *The Nature of the Child.* This book (and its 1994 revision) contained three major themes. The first was that the major changes in behavior over the first few years of life depend on stages of brain maturation. This idea implied the second theme—namely, that the habits and emotions established during the first year might be so seriously altered as to have little influence on the psychological profiles of older adolescents. The third theme was that the human capacity to understand the distinction between right and wrong emerges during the second year. All three ideas, which were tentative twenty-eight years ago, are now firm facts thanks to the efforts of many investigators.

As I was searching for a writing project in the spring of 2011, the idea of revising *The Nature of the Child* pierced consciousness and T.J. Kelleher of Basic Books

found this proposal attractive. Upon completing the early drafts of each chapter, I was surprised by the need to recast the arguments and to elaborate three questions that had been less clearly articulated in the 1984 book: What is the expected developmental course for the cognitive talents, motor skills, emotions, beliefs, and moral values that are inherent possibilities in all children? How does variation in experience affect the rates at which these properties develop and the forms they assume? And, finally, what factors determine the variation among children and adults within every community? The present book probes the concepts of morality and emotion more deeply than the original and addresses a concern that was less salient in 1984 but is now widespread: mental illness in children and adolescents. Because this book covers a larger territory than the earlier one, it needed a new title.

Chapter 1 considers the influences of culture and history. Each person's experiences in a particular culture during a particular era select one profile from an envelope of possibilities that existed during the first hours after birth. Human behavior is controlled by features in the local setting and the person's motives and beliefs. On the one hand, children must react to events that threaten their survival or mental serenity. They must do something if attacked and maintain relationships with those supporting them. On the other hand, many actions are provoked by ideas, especially representations of the properties one ought to attain—whether good grades, friends, love, money, a higher status, or greater power.

Events during a historical era within a culture often challenge existing values to produce a generation with different ethical premises. The generation of Americans who came to maturity after 1970 were more tolerant, more skeptical of authority, and less prudish about sexuality than their grandparents.

Chapters 2 and 3 document the biologically based progression of cognitive advances during the first three years. Among the most important advances are the nature of the infant's representations of experience, the enhancement of working memory, and the emergence of the first forms of language, inference, a moral sense, and consciousness.

Developmental scientists are engaged in a lively debate over the similarity between the infant's knowledge and what seem to be similar ideas in adolescents. Some psychologists claim that the infant's understanding of the concepts of number and causality shares important features with thirteen-year-olds' understanding of the corresponding conceptions. I consider the evidence and side with the skeptics.

Chapter 4 considers the complementary influences on development of a variety of factors, including parental practices, identifications with family members and social groups, birth order, size of community, and historical era. I award considerable power to the social class of the child's family. Many psychologists regard a child's class of rearing as a nuisance variable that must be controlled statistically in order to prove the critical influence of a particular experience, whether harsh punishment, abuse, bullying, or maternal illness. Unfortunately, statistically controlling for the consequences of class eliminates an important causal condition because the influence of the unpleasant experiences listed above is diluted in children from more advantaged families. The child's social class represents a large collection of correlated experiences that cannot be removed from the total pattern without affecting the outcome.

The child's identifications with parents, family pedigree, class, and ethnicity—based on shared features and vicarious emotions—have a profound effect on moods and expectations that can last a lifetime. Unfortunately, psychologists have not invented methods that measure these identifications accurately. Hence, I was forced to rely on memoirs and autobiographies to document the emotional consequences of being, for example, the grandchild of an eminent writer or Nazi official. This chapter also considers the popular concept of attachment and concludes that John Bowlby's bold assertion that the quality of an infant's attachment to a parent is a sensitive predictor of the person's later adjustment has not been affirmed.

Chapter 5 deals with two critical puzzles: which properties of early childhood are preserved and whether the child's developmental stage affects the degree of preservation. The evidence implies that most public behaviors show minimal long-term preservation until children reach six or seven years of age. This fact motivates a discussion of the stages of psychological development that are accompanied by new cognitive talents that, in turn, have implications for the preservation of habits and moods.

Human morality has always been a source of deep curiosity. I continue to believe, as I did in 1984, that acquisition of the concepts *right, wrong, good,* and *bad* affect many aspects of the child's behavior. Chapter 6 contains an analysis of the varied meanings of morality as well as a description of the phases that precede the establishment of a more permanent moral position during adolescence. I remain skeptical of the Darwinian notion that human morality is a derivative of the sociability of monkeys and apes. Indeed, I argue that the defining feature of human altruism is a person's intention, whereas the comparable feature in animals is the consequence

of an agent's action on another animal. Humans help others because they want to regard themselves as good persons and wish to avoid the unpleasant feeling of guilt that can occur when one is indifferent to the suffering of another. Despite the use of the same word by students of animals and humans, the two meanings of *altruism* are seriously discrepant.

The puzzle surrounding the relation between bodily feelings and human emotional states continues to evade satisfying solutions. Chapter 7 begins with an analysis of the many definitions of *emotion* and claims that the popular emotional words in all languages are interpretations of bodily feelings. These words can be used in the absence of a feeling—and when a feeling is present, words often fail to specify the quality and origin of the feeling and the target of any given behavior.

The extraordinary increase in the diagnoses of mental illnesses in children and adults over the past three decades demanded a chapter on this troublesome fact. Chapter 8 questions the usefulness of contemporary illness categories because they are indifferent to the causes of the symptom; it also discusses why a belief in the effectiveness of a therapy, whether a drug or psychotherapy, is the most essential reason for remission or cure.

The final chapter describes four reasons for the slower progress of the social sciences compared with the biological sciences. One barrier is the habit of relying on single causes and single outcome measures rather than on patterns of causes and outcomes. Too many psychologists studying humans rely solely on questionnaires as evidence. This information does not capture the complexity of the feelings, intentions, and thoughts that the informant's answers purport to describe. Even when single behaviors are measured, the accompanying concepts do not have an unambiguous meaning because most behaviors are the result of more than one condition. To understand the theoretical significance or meaning of a particular behavior, we need additional information, including measurements of the brain and/or bodily activity accompanying a behavior.

Many psychologists are exploiting technical advances in brain measurement such as the electroencephalogram, the magnetic resonance scanner, and the magnetoencephalogram. The results of studies using these machines have taught us the homely truth that two sources of evidence are always better than one. When replies to questionnaires are combined with measures of the brain, investigators have a richer understanding of the meaning of both the verbal statements and the biology.

The lack of attention to processes that account for the striking psychological differences between members of divergent social classes is a second barrier to progress

in the social sciences. Many reports document disparities in academic achievement, mental illness, and criminal behavior, but few psychologists try to discover the patina of events that create the private perceptions of one's place in society.

A preference for initiating research guided by an intuitively attractive hypothesis, rather than a puzzling phenomenon, is a third obstruction to progress. Natural scientists usually try to understand the causes of a robust fact. Why do cats beget cats? Why does the moon's position in the sky change throughout each month? Why do only some people come down with a fever during an epidemic? Why does milk sour?

By contrast, social scientists more often begin with a big word, such as *regulation, anxiety,* or *stress,* that originates in an intuition and does not specify the agent, setting, or source of evidence for the concept. The temptation to fall in love with an abstract idea and search for proof of its existence in evidence produced by a single procedure administered in a single setting is a major reason for the slow progress of the social sciences. Many significant discoveries in biology were accidental observations that had not been predicted from existing theory. These include the power of experience to silence a gene, the effect of chronic stress on the integrity of the immune system, the neural bases for knowing one's location in an environment, and the role of the amygdala in states of fear.

The inability to explain how a psychological phenomenon emerges from a brain state is a fourth barrier. The reasons for this state of affairs include a reluctance to acknowledge that a brain state can be the foundation for more than one psychological outcome; the problems trailing heavy reliance on magnetic scanners, which provide too crude an index of psychological processes; and neuroscientists' failure to invent a vocabulary that describes brain profiles.

Despite these problems, there are good reasons to celebrate the substantial progress of the last thirty years. Few psychologists today argue, as many did earlier, that children learn to speak or develop a moral sense through conditioning mechanisms alone. We now recognize the contribution of temperament to personality development and the term *emotion,* which had been viewed as too fuzzy to study, now has a journal with that term as its title. The wall that existed between thought and feeling has been breached.

Most important, many members of the younger cohort are willing to learn the complex technologies needed to measure brain activity, genes, and molecular concentrations in order to evaluate the biological influences on development. The scientific study of children is less than 150 years old. Physics has a 400-year history if

we assign its birth to Galileo's discoveries in the early seventeenth century. The first cohorts of natural scientists who followed Galileo had no idea that leptons, quarks, and bosons were the foundations of matter. I hope that readers will regard my interpretation of the hard-won victories of talented investigators as reasonable, readable, and an incentive for reflection. I have tried to be honest, occasionally harshly honest, in my interpretations of the available evidence—though such evidence may be uneven, scattered, and insufficiently firm to insulate many tentative conclusions from further questioning. Every author imagines an audience sitting on a shoulder peeking at the prose being cobbled together. As I composed this manuscript, my imaginary readers were those who had not made up their minds about the defining features of human nature and the forces that transform infants into children, children into adolescents, and adolescents into adults. I hope such readers exist.

I thank Marshall Haith, David Kupfer, Jay Schulkin, and Robert Levine for their critical comments on separate chapters. I am also deeply indebted to Thomas Kelleher for his masterful editing of a draft that I thought was fine. I thank Christine Arden for her excellent copyediting and Moira Dillon for preparing figures.

CHAPTER ONE

Setting the Stage

There are two answers to the question "What does it mean to be human?" On the one hand, most members of the species *Homo sapiens* inherit a brain and body that award them the potential to acquire a set of psychological properties that distinguish them from every other animal. On the other hand, most of these properties, especially varied talents, memories, beliefs, moral standards, and emotions, began as vessels that have to be filled. The potential to learn a language is present in the newborn, but that inherent capacity can result in the acquisition of any of six thousand different languages. The child's cultural setting and historical era "fill" these vessels. The beliefs held by medieval French adults concerning family relationships, sex, and life after death were not shared by thirteenth-century Chinese adults, are not held by contemporary Parisians, and would not be present in the minds of infants from all three settings. A satisfying understanding of how children acquire the habits, skills, emotions, values, and ideas that define their culture has so far evaded us. This book weaves a developmental thread into the larger tapestry we lovingly call human nature.

The mystery of the infant's mind makes it easy to construe early behaviors as confirming whatever assumptions an observer would like to believe. Imagine three women watching a sixteen-week-old infant's facial expressions, directions of gaze, limb movements, and vocalizations. After about twenty minutes of simply watching,

one woman, standing behind the infant, moves a mobile constructed from attractively colored toys back and forth in front of the infant's face while all three observers note the vigor of the infant's arm and leg movements and any fretting or crying. When the infant has calmed down, the second woman places a drop of sugar water on the infant's tongue, waits a few minutes, and then places a drop of lemon juice on the tongue while all three observers note any change in facial expression. The third woman then looks down at the infant and—in sequence—smiles, frowns, says a few words, and finally gently caresses the infant's forehead. When the three women share what they believe the infant felt, perceived, or thought during the past forty minutes, they discover that they arrived at dissimilar impressions.

The ambiguity of infant behaviors, which we might compare to the facial expression on the Mona Lisa, frustrates those who study development. Are infants born without ideas, or do they possess certain core understandings of the world? Do they have a self? Are they biased toward selfish or caring behavior? Are they consciously aware of events around them? Although the answers to these questions are being debated, one truth seems relatively certain. All children, excluding the small number with serious compromises in brain function, have the potential to acquire a large number of talents, beliefs, habits, values, and emotions. The family and the local culture select for elaboration those properties that are likely to protect the child from harm and allow the adult to enjoy respect and acceptance from a majority in the society.

The practices of Mayan Indian mothers in small, isolated villages in northwest Guatemala provide an example of cultural selection. Mayan parents believe that infants during the first year are vulnerable to being harmed by the stares of strangers. The gaze of a man wet with perspiration from a day's work is exceptionally dangerous. Mothers protect their infants by wrapping them tightly and placing them in a hammock in a dark region at the back of the hut where, except for times when they are nursing, the infants remain for most of the first year. As a result, these one-year-olds are pale, listless, and display a motor and psychological profile that lags behind most of their counterparts elsewhere in the world. After their first birthday, however, mothers no longer consider them vulnerable and they are allowed to leave the hut to play with objects and other children. By their third birthday they have developed the basic motor skills and psychological talents that are inherent in the biology of all three-year-olds.

A tribe residing in an isolated region of New Guinea holds the rarer belief that all male infants are born sterile. Because these boys must eventually become fathers,

the society invented a ritual to guarantee their future fertility. When a group of boys is within a few years of puberty, the older men of the village take them to a secluded spot, arrange the boys in a circle, and march around them playing flutes. From that day forward until late adolescence, but before they marry, the boys perform fellatio on the unmarried older adolescent boys in order to acquire the seed they need to become fathers. Once these boys become older adolescents, the fellatio ceases; when they marry and sire children, they affirm the truth of the culture's premise.[1]

Nineteenth-century Americans were convinced that infants were born with an instinct for freedom and individualism that, acting together, facilitated their society's ascent toward a state of perfection. A faith in the inevitability of a progression from less to more mature is present in the writings of the three major Western theorists of development: Freud, Erikson, and Piaget all posited a sequence of developmental stages through which children ascended to more satisfying, creative, or rational states. Adolescents do reason and regulate emotion more effectively than infants, but they are also more often angry, suspicious, deceitful, depressed, and anxious. Psychological development should be seen as a sequence of additions, losses, and transformations in which new traits emerge, no-longer-useful ones are discarded, and some remnants of earlier phases are retained as elements in new patterns. A stairway to paradise is a poor metaphor for development.

Far Eastern cultures, by contrast, regarded nature and society as following cycles in which benevolent eras alternated with intervals of adversity. The cyclical advances and retreats of glaciers throughout Earth's long history provide an example from geology. The creative Greek and Roman societies were replaced by the Dark Ages, which, in turn, were followed by the advances of the medieval era.

Reflection on the societies that gave rise to important inventions during different historical periods supports a cyclical view. China and the Mediterranean basin fostered the most significant inventions during the 5,000 years before the modern era. Europe became dominant over the next 1,800 years, as did the United States during the past two centuries. It is obvious that the features of a cultural setting that make creative ideas and products more probable cycle over time and place. Application of a cyclical conception to human development implies that each stage is marked by specific talents, pleasures, and understandings and that no stage is inherently superior to another.

Although major transformations of beliefs and practices usually occur over long periods of time, important changes can occur in one or two generations. For example, Carl Degler notes that between 1760 and 1820 a majority of Americans

adopted three new attitudes: (1) young adults were allowed to use sexual attraction as a basis for choosing a marital partner, (2) wives possessed moral authority in the home, and (3) rearing children was the mother's major responsibility.[2]

The Mayan town of San Pedro, located on the side of a volcano bordering Lake Atitlan in northwest Guatemala, witnessed an equally rapid change in values: today, most youths complete at least twelve years of education, and men whose fathers, grandfathers, and great-grandfathers had been farmers are now plumbers, accountants, dentists, or lawyers using the Internet.[3] I studied the nearby smaller, poorer village of San Marcos in 1972, when it had no foreigners, no running water or electricity, and minimal communication with the outside world. When my wife and I returned in 2008, we were surprised to learn that the village now had a small hotel, an Internet café, a yoga center, and an agency selling tickets to tourists who wanted the delight of a moonlight cruise on the lake.

China experienced three radical transformations during the twentieth century. In 1901, as an autonomous, mainly rural society controlled by an empress, the country suffered the humiliation of defeat and subjugation by European powers who occupied many of its large cities. Fifty years later, Mao Zedong transformed what was then a hierarchical society of peasants exploited by a small group of landlords into a despotic communist state. The third change, accomplished in only forty years, introduced a capitalist economy that celebrated a combination of individualism, materialism, corruption, and cynicism that was a novelty in this ancient society. It took less than half a century to transform China from an economically impoverished society into one of the economic powerhouses of the modern world.

Similarly, Luther's sixteenth-century critique of the Church had a profound effect on the values of succeeding generations. By questioning the sacredness of God's representatives on Earth, the Protestant Reformation legitimized a skeptical posture toward all authority and affirmed the right of a single individual to question the proclamations of those in positions of power. Two centuries later, when industrialization came to England and Scotland, the writings of social philosopher Adam Smith enhanced the primacy of the individual. The declining power of the Church, the rise of the nation-state, discoveries in natural science, industrialization, and democratically elected legislatures coalesced around a question that most cultures had never considered—namely, how much personal freedom is a person entitled to?

Smith thought he saw a harmonious balance in nature and assumed that a similar balance applied to a marketplace model of the economy. This intuition persuaded

him that a society would prosper if each person placed his or her welfare and pleasures ahead of the needs of others. Emma Rothschild of Cambridge University invites us to reflect on the fact that Smith's suggestions in *The Wealth of Nations* were motivated primarily by his concern with the large number of poor English families who were superstitious victims of political and economic decisions that led to exorbitantly high food prices they could not afford.[4] Smith assumed that a laissez-faire economy would free these families from the burdens of both poverty and superstition.

The United States has the laissez-faire economy that Smith favored. Nonetheless, more than 40 million poor Americans go to bed hungry each night, an equally large number believe in astrology, and the economic disaster of 2007–2009 was brought on by the self-interest of a small number of Americans who either persuaded poor families to assume mortgage payments they could not meet or sold bundled mortgages they knew were risky investments to individuals who assumed they were safe.

The authors of the Declaration of Independence married the Enlightenment assumption that the individual ought to be the primary beneficiary of personal and governmental decisions with the premise that no person, no matter how elite his or her family, was entitled to more privilege or dignity than any other. The former assumption, which Plato and Hobbes would have rejected, has become a fundamental tenet in a large number of the world's societies.

The changing historical narrative also influences the phenomena that scholars select as important puzzles to resolve. The nature of God and an immaterial soul were the seminal mysteries that European philosophers brooded on during the medieval era. Seven hundred years later, the properties of nature began to compete with the mystery of God and, as a result, uncertainty began to replace a faith in certain truths. A century later, curiosity centered on the essential characteristics of human nature. And by the end of the nineteenth century, the enigma of human psychological development became a target of scientific curiosity for the first time.

The knowledge, talents, traits, and values that children need in order to thrive in their cultural setting require a combination of biology and experience in order to be actualized. Both processes are responsible for the obvious variation in traits and talents among children in any community. The child's biologically based temperaments make a significant contribution to some of this variation. *Temperament* is defined as a proclivity for particular actions and feelings that originate in the chemistry

and anatomy of the brain. Adults who have always wakened early and gone to sleep by 10 or 11 in the evening—known as "larks"—have a happier disposition than the "owls" who wake late and go to bed late. These two types were probably born with different temperaments.

Children born in a region of the world that has been reproductively isolated for at least ten thousand years, such as China, Japan, Scandinavia, Southern Europe, India, South America, and Africa, possess unique genomes that can be the foundation of distinctive temperaments. Any two randomly selected pair of humans differ in about 3 million of the bases that are the components of genes. (The sequences of DNA called genes are composed of four molecules called bases.) Although 3 million is a small proportion of the 6.4 billion bases (3.2 billion base pairs), it is large enough to produce a large number of temperamental biases.

The behavioral signs of a temperamental bias in the first year include ease of becoming distressed or active to hunger, cold, pain, or unexpected events; ease of being soothed; ease of alerting to varied events; duration of attention following an initial alerting; and usual mood, often revealed in babbling and smiles or crying and facial frowns. Inherited neurochemical patterns that affect brain activity are likely to be the foundations of most temperamental biases, but scientists do not yet understand the relation between the biology and the behaviors. Hence, behaviors define temperaments at present. One day, however, a child's biological properties will be added to the behaviors.

Rather than guarantee the development of a particular personality, a temperament can only nudge a child in a particular direction. Relaxed four-month-olds who smile frequently and rarely cry inherit a temperament my colleagues and I call *low-reactivity.* Though unlikely to become shy, anxious, vigilant adolescents, these infants can acquire a large number of different personalities. Nathan Fox and his colleagues at the University of Maryland are studying infants they call *exuberant* because they display vigorous motor activity, babbling, and smiling, but no crying, when they encounter unfamiliar events.[5] Infants with this temperament are likely to become sociable and willing to take risks when they are older children. By contrast, infants whose profile is characterized by crying and vigorous motor activity, but little smiling, when exposed to unfamiliar events, are likely to become shy, timid children who are susceptible to high levels of guilt following a misdemeanor. If we assume, hypothetically, that humans have the potential to acquire any of a thousand adult psychological profiles, the possession of a particular temperament lops off

a proportion of those possibilities, say two hundred, leaving the child with eight hundred potential personalities.

The child's history of experiences, initially within the family and later with peers and adults, imposes a second set of limitations on the talents, traits, and values an adolescent might possess. Consider two girls—Alice and Mary—born with the same low-reactive temperament favoring a relaxed, minimally irritable mood during the first year followed by a sociable, bold personality during the childhood years. Alice is the first-born child of educated, affectionate parents who encourage their daughter's verbal abilities and have the money to send her to a private school. Mary, born to parents who did not graduate high school, lives with two older brothers in a densely populated neighborhood of a large city with a high crime rate and poor schools. Alice is likely to attend one of America's better colleges and pursue a career in medicine, business, law, science, or politics. Mary has a moderately high probability of dropping out of high school, becoming pregnant before she is seventeen, developing an addiction to drugs or alcohol, and struggling as a single parent in a low-paying job. The two girls in this hypothetical comparison, who began life with the same temperament and behaved similarly during their first few years, grew apart during childhood and adolescence because of their different life circumstances.

This narrative has been less popular than one based on the premise that the traits that emerge during the first two years resist change. The latter view, called infant determinism, received a boost when Charles Darwin—brooding about the history of life forms in the quiet English village of Down in the middle of the nineteenth century—published his thesis on evolution and, a dozen years later, a book defending his belief that humans are only quantitatively different from apes. Darwin wanted to persuade readers that the traits we regard as uniquely human, especially language, reason, and morality, have their origin in similar processes present in higher mammals. This bold idea influenced every discipline in the life sciences but had an especially profound effect on scholars studying psychological development. If the emergence of modern humans was only one chapter in a seamless narrative that began about 3 billion years ago with the first living cell, it was reasonable to assume a comparable continuity in the development of each person's psychological traits. If this were true, then the talents and personalities of twenty-year-olds probably had a partial origin in their biology and the experiences of early childhood.

This intuition motivated scientists to look for early signs of adult traits. One nineteenth-century expert declared that the origin of adult greed could be traced

FIGURE 1.1 **Newborn protruding tongue to an adult**

to the observation that two-week-olds reflexively grasped a pencil placed in their palm. This intuition remains popular. Two contemporary American psychologists announced that two-day-old infants were capable of imitation because they protruded their tongue when an adult, standing close to them, stuck out his tongue.[6] (See Figure 1.1.) Psychologists who were skeptical of this conjecture discovered later that two-day-olds protrude their tongue in response to any small, slim object moving back and forth close to their face (a pencil, for example), because infants use their tongue to explore the environment. Hence, what seemed to be an act of willful imitation was probably a biologically prepared reflex bearing no relation to the imitations seen in ten-month-olds.

The discontinuities in human development are analogous to equally salient discontinuities in evolution. The emergence of the first animal with a backbone, about 530 million years ago, and the appearance of the first mammal, about 200 million years ago, are discontinuous with the life forms that had existed before. These evolutionary changes were due to chance mutations and alterations in the ecology. Psychological discontinuities, by contrast, are the result of maturation of the brain,

unpredictable historical events that affect an entire population, or unusual experiences that affect a particular individual.

Unfortunately, the reciprocal influences among each individual's biology, the groups in which he or she participates, and local social conditions are being ignored. The media's frequent references to the extraordinary discoveries in genetics and neuroscience have persuaded the public that biological processes have a greater influence on a child's psychological properties than family practices and local circumstances. Quite by chance, the extraordinary biological discoveries occurred at the same time that inequalities in income and education in America and Europe were widening. Youths growing up in families occupying the bottom 25 percent of the income distribution were finding it harder than their grandparents to ascend in status despite their willingness to work. The gap in academic proficiencies between poor and affluent youths was significantly larger in 2012 than in the decades before World War II. One reason was that the quality of the public schools in urban areas, which had provided a path to status mobility in the mid-twentieth century, began to erode partly because talented women could now choose any vocation they wished. Sex-role stereotypes no longer limited them to a career as a teacher, nurse, or secretary.

At present, Americans and Europeans can select one of two explanations for the thicker barrier to status mobility. They can blame neglectful or uninformed parents and indifferent or poorly trained teachers. Or they may conclude that children who have difficulty learning to read or inhibiting impulsive acts of aggression were born with genes that compromised the brain sites that contribute to language and the regulation of impulsive behavior.

A psychologist who suggests that poor fifth-grade children with deficient reading skills and a disobedient inclination had indifferent parents who neither read to them nor taught them the control of impulses might be accused of holding a prejudiced attitude toward the poor, especially if the parents belonged to a minority group. And a social scientist who argues that the federal government has an obligation to do more to help disadvantaged families might generate resistance among those worried about the federal deficit. In short, blaming defective genes that lowered a child's intelligence or contributed to impulsivity is a more politically correct solution. This explanation has become popular, despite the fact that scientists have not discovered the genes that contribute to variation in intelligence or impulsivity. I suspect that investigators will never discover these genes because concepts like intelligence and impulsivity are simply too broad and heterogeneous to be the kinds of phenomena that are linked to a particular collection of genes. When scientists do

discover how nature carved up the domain of human properties, they will find that neither intelligence nor impulsivity are in the collection.

The historical era often has a significant influence on a scientist's answer to the question: "What conditions are responsible for the variation in traits among children and adults?" When Freud's influence was strong, from about 1910 to 1960, psychologists studied the untoward consequences of early weaning, thumb-sucking, and harsh toilet training. When many fathers were serving in the armed forces during World War II, scientists studied the effects of fathers' absence on young children. When divorce rates rose after the war, scholars probed the effects of parental separation. When large numbers of mothers joined the work force and placed their young children in day care centers, psychologists worried about the deleterious effects of surrogate care.

History also affects the kinds of evidence that scientists are likely to use in arriving at conclusions. Readers untrained in the sciences do not appreciate that the meaning, and therefore the validity, of every scientific conclusion depends on the nature and source of the evidence. Scientists cannot separate what they think they know from their reasons for knowing. The age of dogs, for example, varies with the sources of evidence. Fossil data imply that the first dogs evolved from wolves about 12,000 years ago whereas recent studies of the DNA of various species imply that the first dogs appeared about 135,000 years ago. A difference of 123,000 years is not trivial.

Scientists and nonscientists alike rely on three major sources of evidence as the basis for their beliefs. Most inferences originate in perception—for example, seeing an apple fall from a branch. Language—reading that gravity causes an apple to fall—is a second source of evidence. Mathematical statements comprise a third source: the equations of general relativity imply that the mass of an object distorts the shape of space-time to produce the phenomenon of gravity. Many semantic and mathematical concepts—including truth and infinity—cannot be perceived. And some perceptions—say, a richly colored sunset over a mountain—cannot be described with words or equations. The scientist's inability to measure a person's private feelings pleased the poet e. e. cummings, who wrote:

Who pays any attention
To the syntax of things
Will never wholly kiss you.

Psychologists base their conclusions on behaviors, biological reactions, and verbal descriptions. But these sources of evidence do not always invite the same conclusions. When psychologists write that children reared by depressed mothers are more anxious than those growing up with nondepressed mothers, the evidence usually comes from questionnaires or interviews rather than from direct observations of the parents and children. The meaning of the statement "Depressed mothers are likely to have anxious children," when based on direct observations, is not synonymous with the meaning of the same sentence when based on replies to questionnaires. Young children who are described as shy by their mothers are not always shy when observed with a stranger; many adolescents who deny being shy on a questionnaire behave shyly when they are observed interacting with another, and many who say they are shy show no evidence of this trait in their behavior.

Despite these inconsistencies, verbal descriptions of traits dominate research in personality, mental illness, and social psychology. Unfortunately, a person's words provide an incomplete and less-than-faithful index of their knowledge, behaviors, and emotions. One reason is that psychologists often ask individuals to evaluate a trait in ways that might not correspond to the person's style. For example, psychologists ask adults to assess the strength of a feeling or attitude on a continuous scale—say, from 1 to 10, as in "In general, how do you feel about your life these days? Please rate your judgment on a scale from 1, indicating very dissatisfied, to 10, meaning very satisfied." I suspect that many adults do not ask themselves that question and those who do have a two-category answer—either "satisfied" or "dissatisfied." Very few decide that they are six-tenths satisfied. The form of the question forces answers that are not always faithful to the person's private judgment.

Niels Bohr argued in the 1920s that the inference drawn from an observation cannot be separated from the procedure that produced it. Because the source of the observation and the evidence form a seamless whole, different procedures can lead to different conclusions about the presence or absence of a psychological property. This explains why many studies find that a friend's evaluation of a person is often different from, and occasionally more accurate than, the person's own judgment.

White residents of London who forcefully deny any prejudice against Muslims respond more quickly to the word *Muslim* after seeing the word *terrorist* on a monitor than they do to the word *pacifist.* Some psychologists regard this observation as meaning that the Londoners are prejudiced against Muslims, despite their strong verbal denial of bigotry. Bohr's principle is helpful in this example. Psychologists cannot separate a conclusion about a person's attitude toward Muslims from the

procedure that produced the evidence. The reaction-time measure is not a more accurate index of prejudice than the verbal reply. Rather, it is simply a different answer to the question of whether the person is prejudiced against Muslims.

A second reason for the disconnect between verbal descriptions and direct observations of behavior is that most respondents want to give logically consistent replies to a series of questions. Behaviors are not bound by a need to be consistent, however. Adolescents who report giving money to a friend in need may be tempted to deny anger toward the friend. Those who feel ambivalent toward a friend to whom they gave money might show that ambivalence in their actions but not in their verbal answers.

A third reason is that most research on human personality, morality, and emotion is conducted in English by American scientists on American participants, usually college students. This is unfortunate because most English words naming psychological states do not specify the origin of the state or the target person to whom a behavior is directed. A parent who reports on a questionnaire that "My son is aggressive" does not reveal the reason for the aggression, the setting in which it occurred, or whether she observed her child hit other children or was told about these actions by a teacher. The words in most languages try to balance a need to be informative with a desire to avoid complexity. The word *aunt,* for example, does not specify whether the woman comes from the husband's or the wife's family. Similarly, the term *anxious* implies an uncomfortable state but does not specify the source or the intensity of the feeling.

Other languages do include words that specify the cause of an emotion—for example, the difference between the anger evoked by a personal mistake and the anger that arises when the same individual is insulted. The ancient Greeks had separate words for each of the five emotions created by: anger over being slighted by another, anger over making a mistake, chronic resentment, justified anger, and the anger of one of the gods. By contrast, the English words *mad, angry, peeved,* and *irritated* are silent on the cause of the emotion or the target of an action.

The desire to describe the self in a desirable light is a fourth reason to question the accuracy of a verbal description. Most descriptions of self are influenced by what individuals regard as good traits. The typical respondent is reluctant to admit to actions, traits, or feelings that might be embarrassing or evoke a critical appraisal from an examiner. This frame of mind leads most respondents to admit to personality traits that reflect their understanding of the desirable traits possessed by the typical person in their region or society. Each respondent possesses a notion of the

ideal form of a particular trait, much as a painter has an image of the perfect cloud. Most respondents have difficulty inhibiting a tendency to describe themselves in terms that approach their understanding of the ideal.

Because the regions of the United States vary in income, education, population density, proportion of minority adults, political affiliation, and style of social interaction, it is not surprising that the residents of different regions give slightly different replies to personality questionnaires. For example, many residents of San Francisco think of themselves as extraverted and would describe themselves on questionnaires as more extraverted than residents of Augusta, Maine.

In a study performed at Cambridge University, Peter Rentfrow and his colleagues gathered the self-descriptions of more than 500,000 young adults (most of whom were white and middle class) on the popular personality questionnaire known as the *Big Five* because it measures five personality dimensions: openness to new ideas, conscientiousness, extraversion, agreeableness, and neuroticism.[7] Respondents from the Midwest and Plains states described themselves as high on extraversion and low on openness to new ideas; New England residents were high on neuroticism and openness to new ideas but low on agreeableness and conscientiousness. These findings suggest that individuals are influenced by the ambience of the region in which they live. For example, residents of Massachusetts would find it more difficult than those living in North Dakota to admit to a stranger that they are not open to the idea of gay marriage because opposition to this idea is inconsistent with the values of many who live in New England.

My colleagues and I once studied a small group of boys from several local schools whose classmates and teachers unanimously agreed were unpopular and poor readers. Close to one-half of these boys denied both traits when asked directly, insisting they had many friends and were excellent readers.

In another investigation one of my students presented mothers from different social-class backgrounds a two-minute audio recording of an essay describing the advantages and disadvantages of displaying physical affection toward infants. The student then surprised each woman by asking her to recall everything she remembered from the essay. The college-educated women—many of whom believed that kisses and embraces are required for psychological health—remembered more words describing the benevolent consequences of physical affection. By contrast, many of the working-class women with only a high school diploma believed that children must learn to cope with the difficult challenges of American society and,

therefore, did not want to spoil young children by giving them too much affection. These women remembered more words describing the disadvantages of too much kissing and hugging. Yet both groups of women gave the same affirmative answer when asked directly whether physical affection was good for infants because they sensed that this reply was the socially desirable answer.[8]

The disinclination to admit to an undesirable trait explains another phenomenon as well. When a questionnaire asks about a less desirable trait several times, but uses different words to name the trait, many respondents who answered affirmatively on the first question were reluctant to affirm the same trait when it was repeated later. For example, an adolescent who admits that she felt "nervous at parties with strangers" is tempted to deny that she feels "anxious with people she does not know" when this question appears later because she does not want the psychologist to conclude that she is an extremely anxious person.

Even the form of a question can influence the answers. Most people have a natural bias to select the middle value and to avoid the extremes when responding to a question with multiple answers. For example, in a survey investigating the average amount of time spent watching television each day, only one of six adults admitted to watching two and a half hours or more when that was the highest value. However, when two and a half hours or more was the second of six alternatives with four more extreme values, twice as many respondents confessed that they watched television for at least that long.

The language of the questionnaire or interview is always relevant because different languages can contain slightly different semantic networks for the same concept—whether friend, parent, or self. The English term for *self,* for example, is usually understood to refer to personal qualities rather than to relationships with others, whereas the Chinese term for *self* includes this feature. Hong Kong adolescents who were proficient in both English and Chinese described their personalities on two occasions, once in Chinese and once in English. These youths described themselves as autonomous agents when interviewed in English but as interdependent with others when asked the same questions in Chinese.[9]

These problems with verbal evidence explain why the correspondence between what people say about themselves and what they actually do, believe, or feel ranges from negligible to modest. Adults from fifty-five countries filled out the popular Big Five questionnaire. The sex differences in the five personality traits were larger in wealthy, egalitarian societies, such as the United States, than in economically poor traditional societies, such as Indonesia. However, direct observations of the

behaviors of men and women in these two nations would lead to the opposite conclusion. Sex differences in extraversion, agreeableness, and openness to new ideas are far more obvious in Indonesia than in the United States.

Members of my research group filmed interviews with fifteen-year-old adolescents who had been classified as having either a high- or low-reactive temperament when they were four months old. I noted that high-reactive infants tend to become shy, anxious children; low-reactives are likely to become sociable, fearless children. Several of the high-reactive adolescents told an interviewer that they were neither shy nor anxious with strangers. However, the same youths often looked away from the interviewer. Some never looked directly at her at all during the three-hour session. By contrast, not one low-reactive who denied being shy shifted his or her gaze away from the interviewer's face. The addition of the behavioral observations permitted us to distinguish between two groups of adolescents who gave exactly the same verbal description of this personality trait.

Scientists cannot even trust the accuracy of a person's statement that he or she put sunscreen on several hours earlier, upon arriving at a swimming pool. If adults are inaccurate when providing information about their use of sunscreen, they are unlikely to be more accurate when describing their personality traits or the traits of their children. Yet about one-third of the studies of humans published in America's leading journals between 2007 and 2012 relied on questionnaires as the only source of evidence.[10]

The denial of the problems trailing sole reliance on verbal reports is not surprising. It took many years for Jean Paul Sartre to recognize the flaw in his belief as a young man that naming something was equivalent to verifying its existence. A youthful Sartre had confused what he read in books with what existed in reality. A story by the French writer Marguerite Yourcenar, which shares elements with the legend surrounding the experience of the young Buddha, captures Sartre's insight. The emperor of a kingdom restricted his first-born son to a large apartment whose walls were covered with the paintings of the kingdom's most acclaimed artist. After the emperor died, the prince left the apartment for the first time to assume power. A few months later, he asked one of his attendants to bring the artist to the palace. When the artist appeared, the new emperor told him he would be shot the next day. The artist asked why the emperor had arrived at such a harsh decision. The new ruler explained that for the first twenty years of his life the artist's paintings represented his only knowledge of the outside world. Because these paintings were so beautiful, the prince had assumed that the world was beautiful as well. After

experiencing the world directly, the young emperor concluded that the artist had lied and so he had to die. Many answers to questionnaires, like the artist's paintings, are insufficiently faithful reflections of a person's knowledge, emotions, or past experiences. The unique features of verbal evidence render it an inadequate foundation on which to construct fully satisfying explanations of human properties and their variation. Yet many psychologists continue to rely on this information and assume that it accurately reflects the respondents' properties. Neuroscientists aren't ashamed to admit that they do not fully understand the meanings of blood flow patterns in the brain, and some are trying to uncover these meanings. Investigators who use questionnaires should be equally concerned with the meanings of verbal descriptions of feelings, beliefs, actions, and past experiences.

The psychologists who gather only verbal information and the neuroscientists who measure the brain often ask similar questions, but because they rely on different evidence they arrive at different conclusions. Missing from the efforts of both groups are observations of behavior that might provide the critical information needed to understand both the verbal and the brain data.

Consider, for example, the fact that the brain activity in individuals who say that they are minimally anxious differs from the brain activity in individuals who, after receiving a dose of oxytocin, report feeling minimally anxious. Observations of the behaviors of the adults who say they are minimally anxious, whether on a questionnaire or after receiving oxytocin, could reveal the different behavioral correlates of the same verbal description.

The phenomena that psychologists wish to understand rest behind a thick curtain containing a large number of tiny holes. The view through a single hole in the curtain, analogous to the information provided by one type of evidence, cannot provide a full comprehension of the events scientists want to understand. This richer understanding requires views through many holes. Unfortunately, about three of every four studies published in the major psychological journals over the past decade have relied on only one source of evidence. There may come a time in the future, after theory is stronger and the web of facts denser, when social scientists, like physicists, will be able to rely on a single source of evidence to affirm or refute a particular idea. No domain in the social sciences is at that level of maturity at the present time.

A majority of psychological concepts, especially those based on verbal reports, fail to specify the contexts in which a behavior, talent, or emotion will be displayed.

This fact poses a problem because the probability that a psychological property will be displayed always depends on the nature of the setting. Adolescents are far more likely to commit an aggressive action if they attend a school where aggression is frequent. Chinese-Americans living in the United States have a lower probability of committing suicide than those who live in the People's Republic of China. And easy access to pornographic websites, a phenomenon that is less than a quarter-century old, has created a historically unique human condition. At this or any other moment at least 28,000 individuals, usually males, are watching one of 4 million porn sites.[11] This behavior was impossible during earlier historical eras, despite no change in the human genome.

Most seven-month-old infants cry when they see an unfamiliar man with a neutral facial expression walk toward them quickly. Few infants cry if the stranger is a woman who smiles as she walks toward them slowly. Six-month-old infants who see their mother and a stranger push a button on a box to produce a sound are likely to imitate the mother if both are in the familiar home setting, but likely to imitate the stranger if the same event occurs in a laboratory.

A detail as seemingly irrelevant as the size of a room affects conclusions regarding the ability of two-year-olds to use a landmark, such as a colored wall, to find a toy hidden in one corner of a room. Children tested in a large room that had windows and three light-colored walls and one dark-blue wall noticed the blue wall and used it as a landmark to find the hidden toy. Children tested in a small, windowless room did not use the blue wall to locate the toy.

Yet despite these and other similar observations, many psychologists persist in assuming that what individuals do or say in one setting is a good predictor of what they will do or say in a different setting. Unfortunately, this optimistic assumption is not affirmed by evidence. Many psychological concepts are valid only in the settings that gave rise to the evidence. This idea can be phrased differently. Most of the time, individuals can display more than one behavior in response to an event—say, a smiling face. Contexts vary in the number of responses they permit to a person who is smiling. Hiking with a partner in an open meadow is maximally permissive; a crowded restaurant is a bit more limiting; a computer screen in a windowless laboratory room instructing an individual to hit a button as quickly as possible when a smiling face appears eliminates most of the behaviors that could occur in reaction to a smiling face.

Not surprisingly, settings affect the information that brains process. A site in the posterior region of the left hemisphere, located between the visual and temporal

regions, is active whenever someone sees printed words. The first modern humans possessed this slice of cortex but were not exposed to printed words until relatively late in human history. What events activated this site in those who lived 50,000 years ago? The site is biologically prepared to process simple shapes that have acquired a meaning. Hence, this site was probably activated in early humans when they saw footprints left by the animals they were tracking. When surfaces with hieroglyphs and, later, printed words became more frequent than footprints in the earth, this site became dedicated to processing words rather than footprints.

Social scientists studying cooperation or altruism are tempted to base their conclusions on the reactions of two strangers interacting in brief, game-like procedures in an unfamiliar laboratory. Many of the investigators who conduct this research are indifferent to the fact that each of their participants belongs to a variety of social categories that includes a familial, work, ethnic, religious, or recreational group. The level of cooperation or altruism displayed toward someone who is a member of one of these groups can be very different from the altruism exhibited toward a stranger in a laboratory. Nonetheless, the scientists conducting these experiments make strong claims about human cooperation and altruism that are presumed to apply across many settings.

In one popular game-like procedure, a psychologist gives one participant $10 with the instruction to decide how much to offer to a partner, who is a stranger. The partner, in turn, must decide whether to accept or reject the offer. Most Americans placed in this odd setting as the partner reject an offer of $1. I doubt, however, that these same adults would reject an offer of $1,000 if the participant had been given $10,000. Nor is it likely that the head of a charity requesting a $50,000 donation from a wealthy individual would reject a donation of $5,000. I am certain that a scientist who had requested $1 million from a wealthy philanthropy would not send back a check for $100,000.

Humans enjoy playing games because these activities allow them to cast off the demands of living. But the conclusions about human nature that originate in thirty-minute games between strangers negotiating small amounts of money are often invalidated in life contexts where decisions are governed by a person's social categories, intimate relationships, and concerns about one's reputation under conditions in which the size of the reward that could be gained or lost is large.

Psychologists made an important discovery, called the *attribution error,* in which an individual interprets a behavior as reflecting a firm trait when it is displayed by

another person but as reflecting the demands of the setting when displayed by the self. For example, a woman who notices that a man is talking very loudly in a restaurant is prone to assume that the man's inappropriate behavior reflects a stable personality trait, whereas if she noticed herself talking too loudly in a restaurant she would likely attribute her behavior to the idiosyncratic features of the restaurant at that moment. Scientists who announce bold conclusions about human nature based on the behaviors of two strangers who accepted a psychologist's request to play games for small stakes are committing a version of the attribution error.

Psychologists are fond of a strategy in which they try to prove the correctness of a favored hypothesis by placing humans, or animals, in one setting and exposing them to a single procedure in which an agent can make one of two responses. If the evidence supports their hypothesis, they conclude that it is true under all circumstances and are reluctant to disprove their intuition by changing the context in a significant way. Too many psychological assessments resemble the "Have you stopped beating your wife?" query, in which respondents are allowed only a "yes" or "no" reply.

Not surprisingly, the probability of a crime is also affected by the nature of the context. Franklin Zimring, an expert on crime at the University of California, points out in *The City That Became Safe* that adding extra police to crime-ridden New York City neighborhoods led to a dramatic reduction in the crimes committed over the past decade.[12] An analogous phenomenon occurs among elephants. Young male elephants experience periodic surges of testosterone that are accompanied by aggressive rampages that can last as long as six months if no older males are nearby. The presence of older males shortens the duration of these wild displays by a significant amount.

The current rate of imprisonment in the United States is a little over seven out of every one thousand adults. It is believed that only one or two of these seven prisoners possesses a temperament that rendered them vulnerable to low levels of fear, empathy, and guilt. When this biological bias is wedded to a life history of school failure and marginalization, criminal acts become more likely. Such individuals commit at least two-thirds of all crimes. For the remaining prisoners who do not possess these temperaments or life histories, the local context exerts a major influence on the likelihood that they will break the law.

The local context also predicts the likelihood of a successful suicide. The presence of firearms in an American home is an excellent predictor of a suicide. There

are more guns per resident in the four states with the highest suicide rates—Alaska, Nevada, Wyoming, and New Mexico—than in the four states with the lowest suicide deaths—New Jersey, New York, Massachusetts, and Rhode Island.

The context in which psychological interventions designed to help children are implemented affects the effectiveness of the intervention. Many social scientists have provided varied educational or therapeutic experiences to needy children. The long-term consequences of most of these efforts have been disappointing. The problem, as Kenneth Dodge notes, is that the interventions were conducted by strangers in a university laboratory or Head Start center for periods lasting from a few weeks to a few months.[13] The children, however, live in settings characterized by crowded schools, unmotivated teachers, playgrounds with bullies, and homes with marital conflict and violence. The majority of African-American and Hispanic youths who drop out of high school come from poor families and are attending schools where the majority of pupils also come from disadvantaged families, often from the same ethnic group. The contexts in which the children live differ significantly from the contexts in which the interventions were implemented. This is one reason for the fragile effects of these well-intentioned efforts.

One notable exception is an unusually extensive educational intervention with poor African-American children from North Carolina that lasted from infancy to five years of age. The thirty-year-olds who had enjoyed the enriched preschool experience, compared with equally poor black adults who did not, had slightly higher incomes and a few more years of education. About one in four children were permanently helped by the program. The remaining 75 percent, by thirty years of age, had lost whatever early advantages the intervention produced because the social contexts in which they lived from age five to thirty were far more powerful than the skills they had acquired when they entered the first grade.[14]

Lisa Barrett and her colleagues have provided a lovely example of the power of context to influence inferences about a person's emotional state.[15] A photograph of the face of Serena Williams without any background reveals closed eyes, mouth wide-open, and tense forehead muscles, which would lead an observer to infer that Serena was in a state of pain. However, this photo was taken on a tennis court the moment Williams won the 2008 US Open championship. A viewer seeing Serena's face in the context in which it was photographed would never infer a state of pain.

Barrett's example has implications for conclusions about the meaning of blood flow patterns in the brain evoked by faces with emotional expressions such as fear, happiness, anger, or disgust. The participants, who usually do not know the kind of picture that will appear on a screen, suddenly see a face with no body and no clue as

to the context in which the expression might have occurred. This kind of stimulus never occurs in a natural setting. The brain's reaction to a man's face with a fearful expression will depend on whether the participants did or did not expect to see a face, did or did not expect to see a face without a body, did or did not expect to see a man's face with a fearful expression, or could not determine whether the expression was fear or surprise inasmuch as these two facial patterns are often confused.

Nonetheless, scientists who conduct studies of this type often arrive at bold inferences about the participants' emotional states from their brain profiles. Apparently, they believe that a face with eyes and mouth wide-open, bereft of any background information, has a privileged, automatic link to a biological response independent of the person's expectations. The evidence does not support that premise. A facial expression consisting of eyes and mouth wide-open would be judged as reflecting *fear* if the setting was a jungle trail with a snake curled around a tree, *surprise* if the context was a roomful of people looking at a birthday cake, and *wonder* if the background was a pink sky at dawn over a lagoon. Scientists who base their conclusions on one source of evidence in one setting resemble an observer standing in one place judging the properties of a rainbow; an observer in another location will have a different perception of the rainbow.

Each culture represents a context, albeit a complex one, that affects the life histories of its members. A person's career, for example, is occasionally determined by a society's values during a particular historical era. For a brief interval from 1870 to 1910, the city of Budapest possessed an ambience of tolerance toward Jews and other minorities along with a number of outstanding gymnasia (analogous to high schools in the United States). These social conditions allowed a number of talented youths from minority groups to become unusually eminent in a variety of fields. This group includes the scientists John von Neumann, Eugene Wigner, Edward Teller, and Leo Szilard; the conductors Fritz Reiner and George Szell; and the actress Zsa Zsa Gabor. Had these individuals grown up in Warsaw, they might not have had the opportunity to develop such distinguished careers. In a similar vein, Peter Galison notes that Sigmund Freud's invention of the concept of repression of unacceptable desires may have been aided by the fact that, at the time he was composing his theory, Austria and Russia were severely censoring newspapers and private correspondence sent through the mail. In a letter to a friend he likened the idea of repression to Russian censorship.[16]

This chapter makes three important claims. First, all children, healthy at birth, possess the potential for acquiring a large number of psychological properties that

are inherent in their genome. These include the abilities to perceive events, detect bodily feelings, recall the past, anticipate the future, infer the thoughts of others, speak and understand a language, and make moral judgments. It is rare to find a three-year-old in any society, no matter how remotely located, who cannot imitate an adult's action or infer that someone needs help, or a twelve-year-old who cannot remember four unrelated words.

Nevertheless, culture and historical era exert a strong influence on the content of perceptions, beliefs, and values. Megumi Kuwabara and Linda Smith of Indiana University report that Japanese four-year-olds possess a bias toward attending to the spatial relations among a central object and the other elements in a scene.[17] For example, they are likely to note that a bicycle in the foreground is leaning against the door of a house on a city street that ends with three adjoining houses and two stores. The Japanese language has many terms for relationships, and Japanese parents emphasize the obligatory social relationships among individuals. By contrast, American four-year-olds are biased toward focusing on the central object in a scene—in this case, the bicycle—and ignoring its spatial relations to the other objects. Compared with Japanese, the English language has more terms for single objects, fewer words for relationships, and American parents stress the importance of each child's individuality and autonomy rather than his or her relationships to others.

Second, the variation among children that originates in their temperaments, like the clay from different quarries, is molded into different forms by the culture, parental practices, and the family's class position.

Third, members of different cultures hold some beliefs that they regard as universal verities. The premises of Mohandas Gandhi and Winston Churchill provide an example. Gandhi could not understand why Churchill was suspicious of the sincerity of his spirituality and hostile toward his desire for Indian independence. Churchill, in turn, could not understand the sincerity of Gandhi's spirituality and his conviction that Indians could handle independence.

As these themes are elaborated in the chapters that follow, I will return many times to four principles. The first, which I call the *90 percent rule,* is that the initial expression of a trait or talent is usually restricted to a small number of contexts. Brain maturation and experience expand the generality of a trait or ability so that, in time, it will be observed in 90 percent of the settings in which it is appropriate. For example, a four-month-old will grab a rattle close to her body, but she does not possess the adolescent's understanding of all the properties that define a material object. A nine-month-old will display a brain response signifying surprise if his

mother says "Look at the duck" when a cat appears on a screen, but he cannot say the word *duck* and will not retrieve a toy duck if asked to do so. A three-year-old knows that a cow is alive but is not sure that the same is true of algae on a pond.

The incompleteness of the child's knowledge leaves psychologists with one of two choices. They can either describe each competence in combination with the settings in which it is displayed or specify the probability that a talent will be expressed in a given context. It is misleading to write that young children possess a competence—say, knowing how to make a noun plural or understanding the concept of number—when the talent is expressed in a limited number of situations. Psychologists are "lumpers" who yearn for generality, whereas nature is a "splitter" preferring particularity. I side with Bohr, who tried—unsuccessfully—to persuade Einstein that the scientist's task is to describe how matter behaves in the settings the scientist creates. Einstein, the idealist, insisted that physicists have a responsibility to discover what nature *is* rather than describe its properties in certain settings.

The second principle, which I call the *tipping point,* is that most relations between phenomena are not linear. The formation of ice is a classic example. Ice will not form in a vessel as the temperature falls until the tipping point of 32 degrees Fahrenheit is reached. Analogously, the probability of a suicide attempt rises to a moderately high value for the small proportion of people who are extremely unhappy with their lives. Those who are only a little unhappy are not at higher risk than those who are not at all unhappy. A parent's occasional spanking of a child is not on a continuum with chronic physical abuse. The former is unlikely to have any important effects on a child's future, whereas the latter is likely to produce an unfavorable outcome. The human mind and brain, like a bridge designed to bear weights up to 5,000 pounds but cracks under heavier loads, can tolerate some stressors without serious cost. Only after the tipping point is passed do particular outcomes, desirable or undesirable, become more probable.

Rare events, such as a suicide or a school massacre carried out by an angry youth are impossible to predict because they require a combination of many conditions acting together to exceed a tipping point. Nassim Taleb refers to these rare events as "black swans."[18]

The third principle is that a *contrast* between anticipated and actual events, feelings, traits, or ideas almost always evokes a brain response, an alert state, and a psychological response. This principle operates even within the retina, for ganglia cells respond to a change in illumination rather than to the intensity of light entering the eye.

Consider some examples of the power of contrast.

1. Many of the events that psychologists call rewards are unexpected experiences that alert the individual and, therefore, are remembered. Fifty-year-olds asked to recall memories of their past typically retrieve experiences that occurred during the decade between ten and twenty years of age—an interval marked by a variety of events that occurred for the first time, including high school graduation, leaving home for college or a job, and the first sexual experience.
2. Children and adults arrive at conclusions regarding their personal traits and skills by comparing their properties with select others, and by noticing a difference between their properties and their conception of the ideal. Children need to know the reading ability of others in order to know if their reading ability is high, moderate, or low. Danes report one of the highest levels of satisfaction with their lives because they compare their high incomes, literacy rates, and good health with citizens of other nations. If Danes were informed that thirty other nations had higher incomes, superior literacy, and better health, they would report feeling less satisfied even if conditions in Danish society remained exactly the same.
3. Later-born children are vulnerable to doubt over their adequacy because they compare their traits and talents with those of the older first-born child and notice their deficiencies. Had they been the first-born they would be more confident and less anxious or resentful, even if their talents had not changed. A similar dynamic can occur between couples when one spouse, after many years, has achieved much more than the other—whether worldly accomplishment, occupational status, or health. Spouses who feel less adequate typically adopt one of two defenses. They either become hostile and argumentative or are driven to prove their contribution to the marital partnership through zealous attention either to the responsibilities of home or work.
4. The power of contrast explains why the introduction of words that name colors follows a universal order across the world's languages.[19] Some languages have only two color words, one for dark and another for light. When a language invents a third name, it is always for red. If a fourth name is introduced it is for green, followed by names for yellow and blue in that order. A team of Italian scientists led by Vittorio Loreto offered an explanation of this phenomenon by noting that the order of color words appears to be influenced

by the magnitude of difference in wavelengths between successive pairs of colors.[20] The wavelength for red, which is the third color name, is maximally different from the wavelength for dark blue (a difference of 180 nanometers). Green takes precedence over yellow because the difference in wavelength between green and red (100 nanometers) is larger than that between yellow and red (60 nanometers). And the term for yellow is introduced before blue because the difference in wavelength between yellow and dark blue is larger than that between light blue and dark blue.

The fourth principle is that *patterns* of conditions, not single events, are the most useful way to think about the causes of behaviors, emotions, and beliefs. For example, the consequences of being a victim of bullying or harsh parental criticism depends on the child's gender, social class, ethnicity, and/or culture. Recall that the boys from the New Guinea tribe required to perform fellatio on older adolescents developed normally because what might be viewed as an experience of victimization in most cultures was for them a culturally approved ritual.

The societies of the world represent distinctive patterns that combine at least nine properties: climate, dominant economy, the ethnic and religious homogeneity of the population, hierarchical versus egalitarian institutions, gender relations, the magnitude of status and income inequality, the balance between favoring the self's interests and those of family and community, primary signs of virtue, and the degree of diversity with respect to primary ethical values. There are many ways to combine these properties and, therefore, a large number of distinct societies. The children growing up in each setting will establish different values, skills, moods, and personalities.

It is also useful to base conclusions on patterns of measurements, rather than on one source of evidence, because almost all behaviors, verbal reports, and brain measures can be the result of more than a single condition. Hence, it is necessary to gather a pattern of measures in order to figure out the most likely cause of a phenomenon. That is why physicians consider blood samples, urine samples, and X-rays when a patient complains of pain in the joints and why parents' descriptions of their children should always be combined with direct observations of the same children. It is especially important to look for patterns of brain measures. A team of German scientists had to examine the pattern of blood flow to nine different sites in order to differentiate pedophiles from normal men when both groups were

looking at pictures of nude children. In another study, a pattern of four features—being a male, possessing a specific gene, having permissive parents, and socializing with delinquent peers—was needed to predict which Russian adolescents would seek the thrill that accompanies committing asocial behavior. The reason for the ritual killing of a young woman as a sacrifice to a Mayan god is not the reason for the slaughter of a Tutsi woman by a band of Hutu men. The number of men killed in duels defending their honor has decreased over the past four hundred years, but the number of young men killed by soldiers under orders from the state to shoot protesters in a crowd has probably increased over the same interval. The best predictor of murder in the United States is the number of available firearms. In Sudan and Iraq it is ethnic conflict, and in Mexico and Columbia it is the amount of illicit drugs being trafficked.

The suggestion to examine patterns of causes and outcomes was ignored by social scientists who asserted that a nation's average IQ explains a country's wealth. This claim ignores the fact that the mean IQ of a nation has many causes, including the prevalence of infectious diseases, availability of health care, number and quality of public schools and universities, and proportion of the population with a high school diploma. The decision to pluck the average IQ out of this pattern and argue that it is the cause of a society's wealth is analogous to declaring that the prevalence of chronic diarrhea in a nation is the cause of famine, premature births, infection load, poor infrastructure, and a corrupt government.

Readers are urged to remember this quartet of principles as they reflect on what scientists have learned about the properties that all humans share; the developmental course these properties follow; and the contributions of biology, culture, historical era, and idiosyncratic experiences to the variation among children and adults that is present in every community.