The Three Cultures

Natural Sciences, Social Sciences, and the Humanities in the 21st Century

JEROME KAGAN

The Three Cultures

NATURAL SCIENCES, SOCIAL SCIENCES, AND THE HUMANITIES IN THE 21ST CENTURY

Jerome Kagan
Harvard University


CAMBRIDGE
UNIVERSITY PRESS

The Three Cultures

NATURAL SCIENCES, SOCIAL SCIENCES, AND THE HUMANITIES IN THE 21ST CENTURY

Jerome Kagan

Harvard University


CAMBRIDGE
UNIVERSITY PRESS

CAMBRIDGE UNIVERSITY PRESS
Cambridge, New York, Melbourne, Madrid, Cape Town, Singapore, São Paulo, Delhi

Cambridge University Press
32 Avenue of the Americas, New York, NY 10013-2473, USA

www.cambridge.org
Information on this title: www.cambridge.org/9780521732307

First published 2009

Printed in the United States of America

A catalog record for this publication is available from the British Library.

Library of Congress Cataloging in Publication data
Kagan, Jerome.
The three cultures : natural sciences, social sciences, and the humanities in the
21st century / Jerome Kagan.
p. cm.
Includes index.
ISBN 978-0-521-51842-0 (hardcopy) – ISBN 978-0-521-73230-7 (pbk.) 1. Biology – History –
21st century. 2. Social sciences – History – 21st century. 3. Humanities – History –
21st century. 4. Science – History – 21st century. I. Title.
QH305.K34 2009
001–dc22 2009001263

ISBN 978-0-521-51842-0 hardback
ISBN 978-0-521-73230-7 paperback

Preface

On a gray March afternoon in 2006 I saw a copy of C. P. Snow's *The Two Cultures* on a shelf above the location of the two books I was searching for in the cavernous Widener Library at Harvard. Recalling the debate it provoked when published more than fifty years ago, and aware that I was looking for a theme to probe during the coming summer, I added it to the pair of books I had come to borrow. After reading Snow's essay the following weekend, it became clear that the changes in the sciences and research universities over the past half-century had rendered Snow's analysis a bit archaic, and a comparison of his views with the current reality seemed to be a worthwhile pursuit.

The most obvious change was the ascent of big science projects in physics, chemistry, and molecular biology that required expensive machines and teams of experts with varied talents and motives. The typical scientist during my graduate years went to the basement of the university building where the shop was housed and constructed himself, or had built by the department's technician, whatever apparatus was required for an experiment designed and run by the faculty member or with the help of a graduate student who assisted with the gathering and analysis of the evidence and the writing and rewriting of a paper reporting an interesting result. Two minds and four hands, often with no outside funds, performed all the work. Under these conditions the pride savored if the experiment were successful, or the blend of frustration and sadness if not, was restricted to a pair of agents.

These emotions are seriously diluted when hundreds of experts design experiments to be executed by teams visiting the international space station, preparing the Hadron Collider for probes that might reveal new particles, documenting the human genome, or studying the brain with magnetic scanners. The joy or pain felt in these settings is dispersed among many, not unlike the mood of the bank managers who bundled and sold thousands of mortgages to hedge funds in order to reduce the risk of any one of them defaulting.

The observations produced by the machines of big science have changed the ease of imagining the concepts invented to explain the mysterious signals they produced. Strings oscillating in ten dimensions, the Higgs boson, and genetic drift in a population are examples of concepts that are more difficult to imagine than concepts like bacteria, planetary orbit, molecules, or genes. A majority of scientific ideas, from Galileo to Mendel, were friendly to the human capacities for imagery and, therefore, easier to understand and to explain to a curious public.

The machines created two additional problems. Their high cost meant that investigators needed large grants from the federal government and/or private philanthropies, and only the small number of fortunate investigators working at settings with these machines would be able to make important discoveries. Thus, a young, ambitious scientist had to be at the right place in order to enjoy the advantage of these magical, powerful probes. This situation created a division between the small number of privileged investigators and the majority interested in the same question who happened to be too far from the action. The odds of a monk in an isolated monastery making a major discovery in genetics are far lower today than they were when Mendel experimented with pea plants.

It did not take long for deans and provosts to appreciate that their physicists, chemists, and biologists were bringing large amounts of overhead monies to their institutions, and they felt an obligation to reciprocate the kindness by allowing them more relaxed teaching

responsibilities and a bit more respect. Predictably, many natural scientists interpreted their new status as justly earned, and a few began to display some arrogance in their pronouncements.

Snow had celebrated the natural scientists because he thought the products of their research would reduce world hunger and perhaps hasten international peace. He did not anticipate the narrative that history composed during the next two generations. Each university campus in Snow's era was a family with which many faculty members identified. When the federal government and philanthropies became major sources of research funds, hosting conferences in exotic places, many scientists shifted their primary loyalties from their institutions to these generous organizations.

The asymmetry in the largesse available to natural scientists, compared with that accorded social scientists and humanists, created status differentials that eroded collegiality and provoked defensive strategies by the two less advantaged cultures. The social scientists, whom Snow had ignored completely, had enjoyed a moment of exuberance, from about 1940 to the 1970s, when it was thought that their ideas might solve some of the stubborn problems that plagued society, especially mental illness, crime, alcoholism, and the high failure rate of school-age children growing up in economically compromised families. However, the crude synthesis of Freudian concepts with the more empirically rigorous ideas of behaviorism, on which that faith had been based, were too weak to carry their hopes to fruition. Eventually the scaffold collapsed, leaving social scientists without a protective theoretical cloak to cover their wounds or an ideological guide for the next investigation. The next cohort of social scientists, therefore, split into two groups. One rushed to join the natural scientists by studying the relations between brain activity and psychological phenomena. The biologists welcomed these new recruits, assuming they would adopt their language and conform to their rules. The larger group, who had chosen the social sciences because of a love affair with the mystery of human motives, thoughts,

or emotions, rather than a curiosity about any aspect of nature that would yield its secret to a powerful mind, chose to study the complex, messier problems disturbing the public's serenity. Unfortunately, they were handicapped by a lack of powerful methods appropriate to the task and resembled farmers with pitchforks and hoes trying to grow fruit trees on a dry plateau.

The scholars who had chosen philosophy, literature, or history took a more severe beating because they were not privy to the generous grants that brought many millions of dollars to their campuses. Moreover, the public, aided by the media, had become persuaded that the answers to society's serious problems could be provided only by natural scientists. When the postmodernists, such as Derrida and Foucault, attacked the claims made by members of their own intellectual family, the loss of confidence among humanists became catastrophic.

The civil protests of the 1960s, which Snow did not anticipate, contributed to an ethic of political correctness in which justice began to compete with individual merit. Deans, research review committees, and honorary societies decided it was important to try to divide their rewards in rough correspondence to the population proportions for gender, ethnicity, and region of the country. Fairness was to be added to talent and motivation as a relevant criterion when promotions, honors, and grant funds were allocated. All of these events sculpted new structures and procedures that Snow might not recognize. Newton would have been astonished.

I had written favorably on Bohr's suggestion that the meaning of every scientific concept depended on its source of evidence. The natural sciences, social sciences, and humanities often used the same word to name different phenomena, and therefore a word could have different meanings in the three communities. Many failed to appreciate that the neuroscientists' understandings of the terms "consciousness," "fear," and "memory" were not shared by social scientists or humanists using the same vocabulary. Thus, scholars and the larger public

had to be reminded that each of the intellectual communities had something important to contribute to an understanding of human nature and societies.

These reflections motivated this brief book, which had three primary goals: to analyze the meanings of the vocabularies used by the three cultures, to describe and critique the seminal assumptions the three communities bring to their work, and, finally, to list each group's unique contributions. The first chapter considers the differences among the cultures in their vocabularies, mental tools, and balance of interest in patterns or single features; the influence of history on problems probed; and, finally, the motive hierarchies of each group. The second chapter analyzes the natural sciences, especially their four seminal premises, their wish to avoid an entanglement with ethics, their insistence on minimizing the differences between humans and other animals, the challenges to their prior hegemony, and the ambivalence among youths interested in natural science toward research that requires team cooperation.

The next two chapters on the social sciences consider the initial reluctance to regard collectives as legitimate phenomena, the problems with their metrics and methods, the loss of confidence following the dramatic advances in biology, the problems surrounding the formal models of economists, and also the significant contributions of social scientists.

The penultimate chapter explains the loss of status among humanists following the ascent of the social sciences and the postmodernist challenge to the validity of claims based on narratives, as well as their seminal contributions to an understanding of the human condition. The final chapter describes the recent disturbing developments in the university, especially the diluted identification with the institution, the crass search for celebrity, and the confusion over the current mission in undergraduate education. The final pages turn skeptical by asking whether life on this planet is better today than it was 200 years earlier and fails to arrive at an unequivocally affirmative

reply. The text ends with a plea to all three communities to recognize the special forms of enlightenment each brings to a world of diverse societies. I hope readers will find something of interest in an effort that taught me more than I anticipated when I took Snow's paperback from the library shelf.

I thank Robert Le Vine, Steven Reznick, and Jay Schulkin for comments on the full text, Gerald Holton for a critique of the chapter on the natural sciences, and David Warsh for patiently re-reading many versions of the section on economics. I am indebted to Nancy Snidman, Paula Mabee, and Sabiha Imran for help with manuscript preparation; to Eric Schwartz, now at Princeton University Press, for being my advocate with the Syndics at Cambridge University Press; and to Terry Kornak for editing of the text.

Contents

1

Characterizing the Three Cultures

The influential British novelist and science administrator C. P. Snow, who had trained as a natural scientist, published a lecture delivered in Cambridge University in 1959 titled "The Two Cultures." The lecture and the fifty-one-page book that followed provoked heated discussion because of its brash dismissal of the humanities as an intellectual mission lacking in rigor and unable to contribute to the welfare of those living in economically underdeveloped regions. Not surprisingly, humanists resented Snow's allegations that world peace and prosperity would profit from training more scientists and engineers and fewer historians, philosophers, and literary critics. Three years later, F. R. Leavis, an admired literary critic at Cambridge University, delivered an unusually harsh, occasionally impolite, rebuttal that caricatured Snow as a failed chemist, incompetent novelist, and social commentator who was ignorant of the world's serious problems.

Snow composed his essay as America was about to experience an extraordinary expansion in higher education that led to a fourfold increase in faculty (from 250,000 to more than 1 million) and a sevenfold increase in students to a total of 15 million, compared with only 50,00 Americans who were attending colleges in 1870.[1] These changes were due primarily to the establishment of new community colleges and rising enrollments in state universities trying to accommodate the many World War II veterans who, assisted by the government's decision to subsidize their education in gratitude for their service,

chose to attend college rather than return to the working-class jobs held by their fathers.

There was a proportionate swelling in the funds available for research and in the numbers of scientists, research administrators, practitioners, journalists, and teachers managing, utilizing, disseminating, or teaching the products of science. More than 5 million scientific papers were published worldwide from 1992 to 2002, and 40 percent of that very large number were written by American investigators.[2] Most youths who choose a life in science in 2009 do not appreciate that the term *scientist* (as distinct from a physician or philosopher), as well as the opportunity to pursue a research career independent of one's social class or ethnicity, are less than 170 years old. These facts, combined with a public that had become more skeptical of select scientific claims and the idealistic depiction of scientists as pure of motive in their pursuit of truth, invite a re-examination of Snow's bold thesis.

Although the primary concerns, sources of evidence, and concepts remain the most important nodes of difference among natural scientists (physicists, chemists, and biologists), social scientists, and humanists, the three communities vary on six additional dimensions less pertinent to their epistemologies. (I consider the investigators who study the biological bases for, or evolutionary contributions to, animal or human behavior as natural scientists.) The nine dimensions follow:

1. The primary questions asked, including the degree to which prediction, explanation, or description of a phenomenon is the major product of inquiry
2. The sources of evidence on which inferences are based and the degree of control over the conditions in which the evidence is gathered
3. The vocabulary used to present observations, concepts, and conclusions, including the balance between continuous

properties and categories and the degree to which a functional relation was presumed to generalize across settings or was restricted to the context of observation

4. The degree to which social conditions, produced by historical events, influence the questions asked
5. The degree to which ethical values penetrate the questions asked and the conclusions inferred or deduced
6. The degree of dependence on external financial support from government or industry
7. The probability that the scholar works alone, with one or two others, or as a member of a large team
8. The contribution to the national economy
9. The criteria members of each group use when they judge a body of work as elegant or beautiful

Most intellectual efforts consist of three components: (1) a set of unquestioned premises that create preferences for particular questions and equally particular answers, (2) a favored collection of analytical tools for gathering evidence, and (3) a preferred set of concepts that are the core of explanations. A naïve observer who held no premises about the nature of solid objects might conclude that the bottom half of a pencil resting in a half-filled glass of water had been bent by the liquid. Social scientists and humanists share more premises, analytic tools, and concepts, as well as more of the other criteria in Table 1, than each does with natural scientists. Natural scientists emphasize material processes, minimize the influences of historical and cultural contexts and their associated ethical values, and are primarily concerned with the relations between a concept and a set of observations. Social scientists and humanists resist awarding biology too much influence, rely heavily on semantic networks and, therefore, are often as concerned with the relations among a set of semantic terms as they are with the relation between a concept and evidence, and frequently seek answers that affirm or disconfirm an

TABLE 1. *Comparison of the three cultures on nine dimensions*

Dimension	Natural Scientists	Social Scientists	Humanists
1. Primary interests	Prediction and explanation of all natural phenomena	Prediction and explanation of human behaviors and psychological states	An understanding of human reactions to events and the meanings humans impose on experience as a function of culture, historical era, and life history
2. Primary sources of evidence and control of conditions	Experimentally controlled observations of material entities	Behaviors, verbal statements, and less often biological measures, gathered under conditions in which the contexts cannot always be controlled	Written texts and human behaviors gathered under conditions of minimal control
3. Primary vocabulary	Semantic and mathematical concepts whose referents are the material entities of physics, chemistry, and biology, and assumed to transcend particular settings	Constructs referring to psychological features, states, and behaviors of individuals or groups, with an acceptance of the constraints that the context of observation imposes on generality	Concepts referring to human behavior, and the events that provoke them with serious contextual restrictions on inferences
4. The influence of historical conditions	Minimal	Modest	Serious

Dimension	Natural Scientists	Social Scientists	Humanists
5. Ethical influence	Minimal	Major	Major
6. Dependence on outside support	Highly dependent	Moderately dependent	Relatively independent
7. Work conditions	Both small and large collaborations	Small collaborations and solitary	Solitary
8. Contribution to the national economy	Major	Modest	Minimal
9. Criteria for beauty	Conclusions that involve the most fundamental material components in nature inferred from evidence produced by machines and amenable to mathematical descriptions.	Conclusions that support a broad theoretical view of human behavior.	Semantically coherent arguments described in elegant prose.

implicit ethical ideal. However, the meanings of the concepts used by the three groups deserve special attention because the communities use different sources of evidence.

THREE VOCABULARIES

The meaning of a sentence, for speakers and listeners, is based on the actual events that are named, as well as the network of ideas that was the origin of the statement. The meaning of the declaration, "The bulls

were beaten yesterday" depends on whether the referents for bulls were animals or the Chicago basketball team. The three cultures represent language communities that impose distinct meaning networks on their important concepts and, like the dispersed Indian groups of fifth century Meso-America, compete with each other for dominance. One of the insights of the twentieth century, due in large measure to Ludwig Wittgenstein, is that the meanings of most statements are not transparent. Application of this idea to a scientific proposition implies that meaning depends on the specific observations to which a statement refers, and, therefore, the procedure that generated the evidence and the web of meanings that define a theory.

The vocabularies of each culture contain a number of concepts with technical definitions that are of primary interest to only one group (e.g., gluon and transposon for natural scientists, attribution error and gross domestic product for social scientists, and antinomy and historical era for humanists). The vocabulary of psychoanalysts attributed a unique meaning to *energy* that was neither the one implied by the Chinese concept *ch'i*, nor the meaning physicists understood in the principles of thermodynamics. But the three cultures also use terms with exactly the same sound and spelling that have different meanings for each culture, even though the scholars may not recognize that fact. The terms *fear*, *capacity*, *arousal*, *memory*, and *count* are examples. The meaning of "fear" in T. S. Eliot's line: "I'll show you fear in a handful of dust" is not the meaning intended by the social scientist who writes that "The heritability of realistic fears is less than the heritability of unrealistic fears," nor the meaning understood by the biological scientist who states that "Rats that stop moving when they hear a tone that had predicted electric shock are in a state of fear."

Even though the poet, psychologist, and biologist use the same word, each is naming a distinctly different phenomenon. Eliot was naming the subjective feeling that pierced consciousness when he reflected on the value confusion and spiritual emptiness that