

*THE* \_\_\_\_\_  
*ADAPTED*  
*MIND*

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*Evolutionary  
Psychology  
and the  
Generation  
of Culture*

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Jerome H. Barkow  
Leda Cosmides  
John Tooby

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*Evolutionary Psychology and the  
Generation of Culture*

*Edited by*

Jerome H. Barkow

Leda Cosmides

John Tooby

New York Oxford  
OXFORD UNIVERSITY PRESS

Oxford University Press

Oxford New York Toronto  
Delhi Bombay Calcutta Madras Karachi  
Kuala Lumpur Singapore Hong Kong Tokyo  
Nairobi Dar es Salaam Cape Town  
Melbourne Auckland Madrid

and associated companies in  
Berlin Ibadan

Copyright © 1992 by Oxford University Press, Inc.

First published in 1992 by Oxford University Press, Inc.,  
198 Madison Avenue, New York, NY 10016

First issued as an Oxford University Press Paperback, 1995

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Library of Congress Cataloging-in-Publication Data

The adapted mind: evolutionary psychology and the generation of  
culture / edited by Jerome H. Barkow, Leda Cosmides, John Tooby.  
p. cm. Includes bibliographical references and index.

ISBN 0-19-506023-7

ISBN 0-19-510107-3 (PBK)

1. Genetic psychology. 2. Cognition and culture. 3. Behavior  
evolution. 4. Sociobiology. I. Barkow, Jerome H. II. Cosmides,  
Leda. III. Tooby, John.

BF711.A33 1992 155.7—dc20 91-25307

19 18 17 16 15 14

Printed in the United States of America  
on acid-free paper

# ACKNOWLEDGMENTS

Jerome H. Barkow thanks his wife Irma and his children Philip and Sarah for their patience and support during the never-ending preparation of this volume. Much thanks, too, to the Dalhousie colleagues who listened to ideas and made suggestions, and to Dalhousie University's Research Development Fund which provided some financial support.

This volume was prepared, in part, while Leda Cosmides and John Tooby were Fellows at the Center for Advanced Study in the Behavioral Sciences in Stanford, California, and they are deeply indebted to the Center's staff for their many kindnesses. They are grateful for the Center's financial support during this period, as well as that provided by the Gordon P. Getty Trust, the Harry Frank Guggenheim Foundation, and NSF Grant BNS87-00864 to the Center. In addition, they would like to thank NSF Grant BNS85-11685 to Roger Shepard and NSF Grant BNS9157-449 to John Tooby for research support.

The research and thinking of Cosmides and Tooby about the convergence between evolutionary biology, psychology, and the social sciences have been shaped and sustained by many friends and colleagues. Outstanding among these have been Donald Brown, David Buss, Martin Daly, Irven DeVore, Paul Ekman, Gerd Gigerenzer, Steven Pinker, Paul Romer, Paul Rozin, Roger Shepard, Dan Sperber, John Staddon, Valerie Stone, Donald Symons, George Williams, and Margo Wilson. Cosmides and Tooby are particularly grateful for the institutional shelter as well as the intellectual comradeship provided by Irven DeVore of Harvard University and Roger Shepard of Stanford University. The final stages of editing were completed at the Zentrum für interdisziplinäre Forschung (ZiF) of the University of Bielefeld, and Cosmides and Tooby would like to thank Peter Weingart and the ZiF for their support and assistance.

The editors owe a special debt of gratitude to Joan Bossert of Oxford University Press, whose encouragement and enthusiasm for this project have been extraordinary. We also thank Louise Page, Melodie Wertelet, and Constance Devanthéry-Lewis who, together with Joan, have unflinchingly attended to all aspects of the production of this book. Thanks also to Larry and Michelle Sugiyama for their invaluable assistance in the final hours of preparation.

Finally, the editors would like to express their heartfelt gratitude to the contributors to the volume, who labored far above and beyond the call of duty. The unusual plan for this volume and its chapters, involving the attempt to integrate levels of explanation within a single structured format (one that began with selection pressures, then moved to mechanisms and to cultural output) placed a heavy burden on the contributors. Their willingness to work with the editors, often through an extended series of drafts, in order to accommodate this conceptual organization is deeply appreciated.

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# Contents

<i>Contributors</i>	xi
Introduction: Evolutionary Psychology and Conceptual Integration Leda Cosmides, John Tooby, and Jerome H. Barkow	3
<b>I. THE EVOLUTIONARY AND PSYCHOLOGICAL FOUNDATIONS OF THE SOCIAL SCIENCES</b>	
1. The Psychological Foundations of Culture John Tooby and Leda Cosmides	19
2. On the Use and Misuse of Darwinism in the Study of Human Behavior Donald Symons	137
<b>II. COOPERATION</b>	
3. Cognitive Adaptations for Social Exchange Leda Cosmides and John Tooby	163
4. Two Nonhuman Primate Models for the Evolution of Human Food Sharing: Chimpanzees and Callitrichids W. C. McGrew and Anna T. C. Feistner	229
<b>III. THE PSYCHOLOGY OF MATING AND SEX</b>	
5. Mate Preference Mechanisms: Consequences for Partner Choice and Intrasexual Competition David M. Buss	249
6. The Evolution of Sexual Attraction: Evaluative Mechanisms in Women Bruce J. Ellis	267
7. The Man Who Mistook His Wife for a Chattel Margo Wilson and Martin Daly	289

**IV. PARENTAL CARE AND CHILDREN**

8. Pregnancy Sickness as Adaptation: A Deterrent to Maternal Ingestion of Teratogens 327  
Margie Profet
9. Nurturance or Negligence: Maternal Psychology and Behavioral Preference Among Preterm Twins 367  
Janet Mann
10. Human Maternal Vocalizations to Infants as Biologically Relevant Signals: An Evolutionary Perspective 391  
Anne Fernald
11. The Social Nature of Play Fighting and Play Chasing: Mechanisms and Strategies Underlying Cooperation and Compromise 429  
Michael J. Boulton and Peter K. Smith

**V. PERCEPTION AND LANGUAGE AS ADAPTATIONS**

12. Natural Language and Natural Selection 451  
Steven Pinker and Paul Bloom
13. The Perceptual Organization of Colors: An Adaptation to Regularities of the Terrestrial World? 495  
Roger N. Shepard
14. Sex Differences in Spatial Abilities: Evolutionary Theory and Data 533  
Irwin Silverman and Marion Eals

**VI. ENVIRONMENTAL AESTHETICS**

15. Evolved Responses to Landscapes 555  
Gordon H. Orians and Judith H. Heerwagen
16. Environmental Preference in a Knowledge-Seeking, Knowledge-Using Organism 581  
Stephen Kaplan

**VII. INTRAPSYCHIC PROCESSES**

17. The Evolution of Psychodynamic Mechanisms 601  
Randolph M. Nesse and Alan T. Lloyd

**VIII. NEW THEORETICAL APPROACHES TO CULTURAL PHENOMENA**

<b>18. Beneath New Culture Is Old Psychology: Gossip and Social Stratification</b> Jerome H. Barkow	627
Author Index	639
Subject Index	657

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# CONTRIBUTORS

Jerome H. Barkow  
Department of Anthropology  
Dalhousie University  
Halifax, Nova Scotia B3H 1T2  
Canada

Paul Bloom  
Department of Psychology  
University of Arizona  
Tucson, AZ 85721

Michael J. Boulton  
Psychology Section  
School of Health and Community  
Studies  
Sheffield City Polytechnic  
Sheffield S10 2TN  
United Kingdom

David M. Buss  
Department of Psychology  
University of Michigan  
Ann Arbor, MI 48109

Leda Cosmides  
Department of Psychology  
University of California  
Santa Barbara, CA 93106

Martin Daly  
Department of Psychology  
McMaster University  
Hamilton, Ontario L8S 4K1  
Canada

Marion Eals  
Department of Psychology  
York University  
North York, Ontario M3J 1P3  
Canada

Bruce J. Ellis  
Department of Psychology  
University of Michigan  
Ann Arbor, MI 48109

Anna T. C. Feistner  
Jersey Wildlife Preservation Trust  
Trinity, Jersey  
Channel Islands

Anne Fernald  
Department of Psychology  
Stanford University  
Stanford, CA 94305

Judith H. Heerwagen  
Departments of Architecture and  
Psychosocial Nursing  
University of Washington  
Seattle, WA 98195

Stephen Kaplan  
Department of Psychology  
University of Michigan  
Ann Arbor, MI 48109

Alan T. Lloyd  
Fox Run Hospital  
St. Clairsville, OH 43950

Janet Mann  
Department of Psychology  
Georgetown University  
Washington, DC 20057

W. C. McGrew  
Scottish Primate Research Group  
Department of Psychology  
University of Stirling  
Stirling FK9 4LA  
Scotland

Randolph M. Nesse  
Department of Psychiatry  
University of Michigan Medical  
Center  
Ann Arbor, MI 48109

Gordon H. Orians  
Department of Zoology and  
Institute for Environmental  
Studies  
University of Washington  
Seattle, WA 98195

Steven Pinker  
Department of Brain and Cognitive  
Sciences  
Massachusetts Institute of  
Technology  
Cambridge, MA 02139

Margie Profet  
Division of Biochemistry and  
Molecular Biology  
University of California  
Berkeley, CA 94720

Roger N. Shepard  
Department of Psychology  
Stanford University  
Stanford, CA 94305

Irwin Silverman  
Department of Psychology  
York University  
North York, Ontario M3J 1P3  
Canada

Peter K. Smith  
Department of Psychology  
University of Sheffield  
Sheffield S10 2TN  
United Kingdom

Donald Symons  
Department of Anthropology  
University of California  
Santa Barbara, CA 93106

John Tooby  
Department of Anthropology  
University of California  
Santa Barbara, CA 93106

Margo Wilson  
Department of Psychology  
McMaster University  
Hamilton, Ontario L8S 4K1  
Canada

# **THE ADAPTED MIND**

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# Introduction: Evolutionary Psychology and Conceptual Integration

LEDA COSMIDES, JOHN TOOBY, AND JEROME H. BARKOW

*The Adapted Mind* is an edited volume of original, commissioned papers centered on the complex, evolved psychological mechanisms that generate human behavior and culture. It has two goals: The first is to introduce the newly crystallizing field of evolutionary psychology to a wider scientific audience. Evolutionary psychology is simply psychology that is informed by the additional knowledge that evolutionary biology has to offer, in the expectation that understanding the process that designed the human mind will advance the discovery of its architecture. It unites modern evolutionary biology with the cognitive revolution in a way that has the potential to draw together all of the disparate branches of psychology into a single organized system of knowledge. The chapters that follow, for example, span topics from perception, language, and reasoning to sex, pregnancy sickness, and play. The second goal of this volume is to clarify how this new field, by focusing on the evolved information-processing mechanisms that comprise the human mind, supplies the necessary connection between evolutionary biology and the complex, irreducible social and cultural phenomena studied by anthropologists, sociologists, economists, and historians.

Culture is not causeless and disembodied. It is generated in rich and intricate ways by information-processing mechanisms situated in human minds. These mechanisms are, in turn, the elaborately sculpted product of the evolutionary process. Therefore, to understand the relationship between biology and culture one must first understand the architecture of our evolved psychology (Barkow, 1973, 1980a, 1989a; Tooby & Cosmides, 1989). Past attempts to leapfrog the psychological—to apply evolutionary biology directly to human social life—have for this reason not always been successful. Evolutionary psychology constitutes the missing causal link needed to reconcile these often warring perspectives (Cosmides & Tooby, 1987).

With evolutionary psychology in place, cross-connecting biology to the social sciences, it is now possible to provide conceptually integrated analyses of specific questions: analyses that move step by step, integrating evolutionary biology with psychology, and psychology with social and cultural phenomena (Barkow, 1989a; Tooby & Cosmides, 1989). Each chapter in this volume is a case study of the difficult task of integrating across these disciplinary boundaries. Although it has been said that the first expressions of new and better approaches often look worse than the latest and most elaborated expressions of older and more deficient ones, we think these chapters are

illuminating contributions to the human sciences that stand up well against prevailing approaches. Nevertheless, readers should bear in mind that none of these chapters are meant to be the last word “from biology” or “from psychology”; they are not intended to definitively settle issues. They are better thought of as “first words,” intended to open new lines of investigation and to illustrate the potential inherent in this new outlook.

## CONCEPTUAL INTEGRATION IN THE BEHAVIORAL AND SOCIAL SCIENCES

*Conceptual integration*—also known as *vertical integration*<sup>1</sup>—refers to the principle that the various disciplines within the behavioral and social sciences should make themselves mutually consistent, and consistent with what is known in the natural sciences as well (Barkow, 1980b, 1982, 1989a; Tooby & Cosmides, this volume). The natural sciences are already mutually consistent: the laws of chemistry are compatible with the laws of physics, even though they are not reducible to them. Similarly, the theory of natural selection cannot, even in principle, be expressed solely in terms of the laws of physics and chemistry, yet it is compatible with those laws. A conceptually integrated theory is one framed so that it is compatible with data and theory from other relevant fields. Chemists do not propose theories that violate the elementary physics principle of the conservation of energy: Instead, they use the principle to make sound inferences about chemical processes. A compatibility principle is so taken for granted in the natural sciences that it is rarely articulated, although generally applied; the natural sciences are understood to be continuous.

Such is not the case in the behavioral and social sciences. Evolutionary biology, psychology, psychiatry, anthropology, sociology, history, and economics largely live in inglorious isolation from one another: Unlike the natural sciences, training in one of these fields does not regularly entail a shared understanding of the fundamentals of the others. In these fields, paying attention to conceptual integration and multidisciplinary compatibility, while not entirely unknown, is unusual (Campbell, 1975; Hinde, 1987; Symons, 1979). As a result, one finds evolutionary biologists positing cognitive processes that could not possibly solve the adaptive problem under consideration, psychologists proposing psychological mechanisms that could never have evolved, and anthropologists making implicit assumptions about the human mind that are known to be false. The behavioral and social sciences borrowed the idea of hypothesis testing and quantitative methodology from the natural sciences, but unfortunately not the idea of conceptual integration (Barkow, 1989a; Tooby & Cosmides, this volume).

Yet to propose a psychological concept that is incompatible with evolutionary biology is as problematic as proposing a chemical reaction that violates the laws of physics. A social science theory that is incompatible with known psychology is as dubious as a neurophysiological theory that requires an impossible biochemistry. Nevertheless, theories in the behavioral and social sciences are rarely evaluated on the grounds of conceptual integration and multidisciplinary, multilevel compatibility.

With *The Adapted Mind*, we hope to provide a preliminary sketch of what a con-

ceptually integrated approach to the behavioral and social sciences might look like. Contributors were asked to link evolutionary biology to psychology and psychology to culture—a process that naturally entails consistency across fields.

The central premise of *The Adapted Mind* is that there is a universal human nature, but that this universality exists primarily at the level of evolved psychological mechanisms, not of expressed cultural behaviors. On this view, cultural variability is not a challenge to claims of universality, but rather data that can give one insight into the structure of the psychological mechanisms that helped generate it. A second premise is that these evolved psychological mechanisms are adaptations, constructed by natural selection over evolutionary time. A third assumption made by most of the contributors is that the evolved structure of the human mind is adapted to the way of life of Pleistocene hunter-gatherers, and not necessarily to our modern circumstances.

What we think of as all of human history—from, say, the rise of the Shang, Minoan, Egyptian, Indian, and Sumerian civilizations—and everything we take for granted as normal parts of life—agriculture, pastoralism, governments, police, sanitation, medical care, education, armies, transportation, and so on—are all the novel products of the last few thousand years. In contrast to this, our ancestors spent the last two million years as Pleistocene hunter-gatherers, and, of course, several hundred million years before that as one kind of forager or another. These relative spans are important because they establish which set of environments and conditions defined the adaptive problems the mind was shaped to cope with: Pleistocene conditions, rather than modern conditions. This conclusion stems from the fact that the evolution of complex design is a slow process when contrasted with historical time. Complex, functionally integrated designs like the vertebrate eye are built up slowly, change by change, subject to the constraint that each new design feature must solve a problem that affects reproduction better than the previous design. The few thousand years since the scattered appearance of agriculture is only a small stretch in evolutionary terms, less than 1% of the two million years our ancestors spent as Pleistocene hunter-gatherers. For this reason, it is unlikely that new complex designs—ones requiring the coordinated assembly of many novel, functionally integrated features—could evolve in so few generations (Tooby & Cosmides, 1990a, 1990b). Therefore, it is improbable that our species evolved complex adaptations even to agriculture, let alone to postindustrial society. Moreover, the available evidence strongly supports this view of a single, universal panhuman design, stemming from our long-enduring existence as hunter-gatherers. If selection had constructed complex new adaptations rapidly over historical time, then populations that have been agricultural for several thousand years would differ sharply in their evolved architecture from populations that until recently practiced hunting and gathering. They do not (Barkow, 1980a, 1989a, 1990).

Accordingly, the most reasonable default assumption is that the interesting, complex functional design features of the human mind evolved in response to the demands of a hunting and gathering way of life. Specifically, this means that in relating the design of mechanisms of the mind to the task demands posed by the world, “the world” means the Pleistocene world of hunter-gatherers. That is, in considering issues of functionality, behavioral scientists need to be familiar with how foraging people lived. We cannot rely on intuitions honed by our everyday experiences in the modern world. Finally, it is important to recognize that behavior generated by mechanisms that are adaptations to an ancient way of life will not necessarily be adaptive in the

modern world. Thus, our concern in this volume is with adaptations—mechanisms that evolved by natural selection—and not with modern day adaptiveness (Symons, this volume; see also Barkow, 1989a, 1989b).

Aside from the two opening, orienting chapters and the concluding one, each chapter of *The Adapted Mind* focuses on an adaptive problem that our hunter-gatherer ancestors would have faced: a problem that affected reproduction, however distally, such as finding mates, parenting, choosing an appropriate habitat, cooperating, communicating, foraging, or recovering information through vision. We asked each contributor to consider three questions: (1) What selection pressures are most relevant to understanding the adaptive problem under consideration?; (2) What psychological mechanisms have evolved to solve that adaptive problem?; and (3) What is the relationship between the structure of these psychological mechanisms and human culture? We chose these three questions because there are interesting causal relationships between selection pressures and psychological mechanisms on the one hand, and between psychological mechanisms and cultural forms on the other.

There is now a rich literature in evolutionary biology and paleoanthropology that allows one to develop useful models of selection pressures, and there have been for many decades in anthropology, sociology and other social sciences rich descriptions of social and cultural phenomena. Using the above three questions, *The Adapted Mind* is intended to supply the missing middle: the psychological mechanisms that come between theories of selection pressures on the one hand and fully realized sociocultural behavior on the other. By concentrating on evolved mechanisms, this collection represents a departure from both traditional anthropology and various evolutionarily inspired theories of culture and behavior. Although both of these fields recognize that culture and cultural change depend critically upon the transmission and generation of information, they have frequently ignored what should be the causal core of their field: the study of the evolved information-processing mechanisms that allow humans to absorb, generate, modify, and transmit culture—the psychological mechanisms that take cultural information as input and generate behavior as output (Barkow, 1978, 1989a; Tooby & Cosmides, 1989). Our goal in this collection is to focus on these mechanisms in order to see where a more precise understanding of their structure will lead.

Because an evolutionary perspective suggests that there will be a close functional mesh between adaptive problems and the design features of the mechanisms that evolved to solve them, each chapter of *The Adapted Mind* focuses on an adaptive problem, and each discusses what kind of psychological mechanisms one might expect natural selection to have produced to solve that problem. Evidence from the literatures of psychology, anthropology, and evolutionary biology was brought to bear on these hypotheses whenever possible. Many of the authors also addressed a few of the implications that the psychological mechanisms they studied might have for culture. The relationship between psychology and culture can be complex, and in some cases the psychological mechanisms are not yet sufficiently well-understood to make any meaningful statement. Nevertheless, in the interests of conceptual integration, the contributors to *The Adapted Mind* have tried, insofar as it has been possible, to bring data from cross-cultural studies to bear on their psychological hypotheses, to point out when the psychological mechanisms discussed can be expected to cause variation or uniformity in practices, preferences, or modes of reasoning across cultures, or to discuss what implications the psychological mechanisms concerned might have for various theories of cultural change.

## BASIC CONCEPTS IN EVOLUTIONARY PSYCHOLOGY AND BIOLOGY

The organization of *The Adapted Mind* is unusual: Few works in psychology or the social sciences are organized around adaptive problems. The decision to do so was theoretically motivated. The first two chapters, "The Psychological Foundations of Culture," by Tooby and Cosmides, and "On the Use and Misuse of Darwinism in the Study of Human Behavior," by Symons, as well as the last chapter, "Beneath New Culture Is Old Psychology," by Barkow, present the theoretical program that animates this volume (see also Barkow, 1989a, 1990; Brown, 1991; Cosmides & Tooby, 1987; Daly & Wilson, 1988; Sperber, 1985; Symons, 1979; Tooby & Cosmides, 1989, 1990b). But because this volume is aimed at a broad social science audience, each discipline of which is familiar with different concepts and terms, it may prove helpful to begin with a brief orientation to what the contributors to this volume mean when they use terms such as *mind*, *selection*, *adaptive problem*, and *evolutionary psychology*.

Evolutionary psychology is psychology informed by the fact that the inherited architecture of the human mind is the product of the evolutionary process. It is a conceptually integrated approach in which theories of selection pressures are used to generate hypotheses about the design features of the human mind, and in which our knowledge of psychological and behavioral phenomena can be organized and augmented by placing them in their functional context. Evolutionary psychologists expect to find a functional mesh between adaptive problems and the structure of the mechanisms that evolved to solve them. Moreover, every psychological theory—even the most doctrinairely "anti-nativist"—carries with it implicit or explicit evolutionary hypotheses. By making these hypotheses explicit, one can evaluate whether psychological theories are consistent with evolutionary biology and paleoanthropology and, if not, investigate which field needs to make changes.

There are various languages within psychology for describing the structure of a psychological mechanism, and many evolutionary psychologists take advantage of the new descriptive precision made possible by cognitive science. Any system that processes information can be described in at least two different, mutually compatible and complementary ways. If asked to describe the behavior of a computer, for example, one could characterize the ways in which its physical components interact—how electrons flow through circuits on chips. Alternatively, one could characterize the programs that the system runs—what kind of information the computer takes as input, what rules or algorithms it uses to transform that information, what kinds of data structures (representations) those rules operate on, what kinds of output it generates. Naturally, programs run by virtue of the physical machine in which they are embodied, but an information-processing description neither reduces to nor can replace a physical description, and vice versa. Consider the text-editing program "Wordstar." Even though it can run on a variety of different hardware architectures, it always has the same functional design—the same key strokes will delete a line, move a block of text, or print out your file. It processes information in the same way no matter what kind of hardware it is running on. Without an information-processing description of Wordstar, you will not know how to use it or what it does, even if you are intimately acquainted with the hardware in which it is embodied. A physical description cannot tell one what the computer was designed to do; an information-processing description cannot tell one the physical processes by virtue of which the programs are run.

In psychology, it has become common to describe a brain as a system that processes information—a computer made out of organic compounds rather than silicon chips. The brain takes sensorily derived information from the environment as input, performs complex transformations on that information, and produces either data structures (representations) or behavior as output. Consequently, it, too, can be described in two mutually compatible and complementary ways. A neuroscience description characterizes the ways in which its physical components interact; a cognitive, or information-processing, description characterizes the “programs” that govern its operation. In cognitive psychology, the term *mind* is used to refer to an information-processing description of the functioning of the brain, and not in any colloquial sense. Behavioral descriptions can be illuminating, but manifest behavior is so variable that descriptions that capture and explain this variability inevitably require an explication of the psychological mechanisms and environmental conditions that generate it (see Symons, this volume).

An account of the evolution of the mind is an account of how and why the information-processing organization of the nervous system came to have the functional properties that it does. Information-processing language—the language of cognitive psychology—is simply a way of getting specific about what, exactly, a psychological mechanism does. In this volume, most psychological mechanisms are described in information-processing terms, either explicitly or implicitly. Research in some areas of psychology is so new that it is too early to develop hypotheses about the exact nature of the rules and representations involved. Nevertheless, the contributors have focused on the kinds of questions that will allow such hypotheses to be developed, questions such as: What kinds of information are available in the environment for a psychological mechanism designed for habitat selection, or mate selection, or parenting to use? Is there evidence that this information *is* used? If so, how is it evaluated? What kinds of affective reactions does it generate? How do people reason about this information? What information do they find memorable? What kinds of information are easy to learn? What kinds of decision rules guide human behavior? What kinds of cross-cultural patterns will these mechanisms produce? What kinds of information will they cause to be socially transmitted?

One doesn't have to look far to find minds that are profoundly different from our own: The information-processing mechanisms that collectively comprise the human mind differ in many ways from those that comprise the mind of an alligator or a bee or a sparrow or a wolf. The minds of these different species have different *design features*: different perceptual processes, different ways of categorizing the world, different preferences, different rules of inference, different memory systems, different learning mechanisms, and so on. These differences in psychological design cause differences in behavior: Upon perceiving a rattlesnake, a coyote might run from it, but another rattlesnake might try to mate with it.

Darwin provided a naturalistic explanation for the design features of organisms, including the properties of the minds of animals, not excepting humans. He wanted to explain how complex functional design could emerge in species spontaneously, without the intervention of an intelligent artificer, such as a divine creator. Darwin's explanation—natural selection—provides an elegant causal account of the relationship between adaptive problems and the design features of organisms. An *adaptive problem* is a problem whose solution can affect reproduction, however distally. Avoiding predation, choosing nutritious foods, finding a mate, and communicating with

others are examples of adaptive problems that our hominid ancestors would have faced.

The logic of his argument seems inescapable. Imagine that a new design feature arises in one or a few members of a species, entirely by chance mutation. It could be anything—a more sensitive retina, a new digestive enzyme, a new learning mechanism. Let's say that this new design feature solves an adaptive problem better than designs that already exist in that species: The more sensitive retina allows one to see predators faster, the new digestive enzyme allows one to extract more nutrients from one's food, the new learning mechanism allows one to find food more efficiently. By so doing, the new design feature causes individuals who have it to produce more offspring, on average, than individuals who have alternative designs. If offspring can inherit the new design feature from their parents, then it will increase in frequency in the population. Individuals who have the new design will tend to have more offspring than those who lack it, those of their offspring who inherit the new design will have more offspring, and so on, until, after enough generations, every member of the species will have the new design feature. Eventually, the more sensitive retina, the better digestive enzyme, the more reliable learning mechanism will become universal in that species, typically found in every member of it.

Darwin called this process *natural selection*. The organism's interaction with the environment—with "nature"—sets up a feedback process whereby nature "selects" one design over another, depending on how well it solves an adaptive problem (a problem that affects reproduction).

Natural selection can generate complex designs that are *functionally organized*—organized so that they can solve an adaptive problem—because the criterion for the selection of each design feature is functional: A design feature will spread only if it solves an adaptive problem better than existing alternatives. Over time, this causal feedback process can create designs that solve adaptive problems well—designs that "fit" the environment in which the species evolved. Random processes, such as mutation and drift, cannot, by themselves, produce complex designs that are functionally organized because the probability that all the right design features will come together simply by chance is vanishingly small. By definition, random processes contain no mechanism for choosing one design over another based on its functionality. Evolution by natural selection is the only presently validated explanation for the accumulation of functional design features across generations.

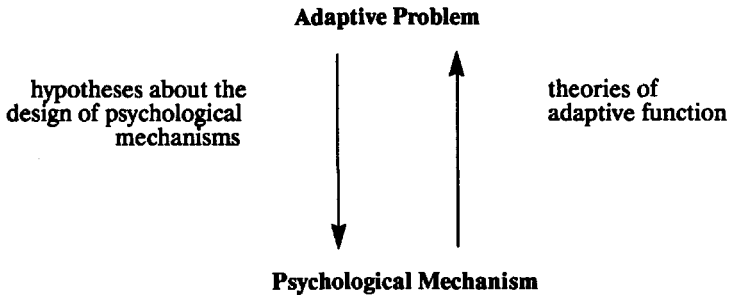
The emerging field of evolutionary psychology attempts to take advantage of Darwin's crucial insight that there should be a functional mesh between the design features of organisms and the adaptive problems that they had to solve in the environment in which they evolved. By understanding the selection pressures that our hominid ancestors faced—by understanding what kind of adaptive problems they had to solve—one should be able to gain some insight into the design of the information-processing mechanisms that evolved to solve these problems. In doing so, one can begin to understand the processes that underlie cultural phenomena as well.

## COMPLEMENTARY APPROACHES TO FUNCTIONAL ANALYSIS

The most common approach that evolutionarily oriented behavioral scientists have taken is to start with a known phenotypic phenomenon, such as pregnancy sickness,

language, or color vision, and to try to understand what its adaptive function was—why that design was selected for rather than alternative ones. To do this, one must show that it is well designed for solving a specific adaptive problem, and that it is not more parsimoniously explained as a by-product of a design that evolved to solve some other adaptive problem (Williams, 1966; Symons, this volume). This is a difficult enterprise, but a necessary one: Until one understands a mechanism's adaptive function, one does not have a fully satisfying, conceptually integrated account of why it exists and what it does. More critically, asking functional questions and placing the phenomenon in a functional context often prompts important new insights about its organization, opening up new lines of investigation and bringing to light previously unobserved aspects and dimensions of the phenomenon. A number of contributions to *The Adapted Mind* take this approach (e.g., Boulton & Smith, Nesse & Lloyd, Profet, Pinker & Bloom, and Shepard). Going from a known psychological phenomenon to a theory of adaptive function is the most common form of conceptual integration between evolutionary biology and psychology.

With equal validity, however, one can take the analysis in the opposite direction as well (see Figure I.1). One can use theories of adaptive function to help one discover psychological mechanisms that were previously unknown. When one is trying to discover the structure of an information-processing system as complex as the human brain, knowing what its components were “designed” to do is like being given an aerial map of a territory one is about to explore by foot. If one knows what adaptive functions the human mind was designed to accomplish, one can make many educated guesses about what design features it should have, and can then design experiments to test for them. This can allow one to discover new, previously unsuspected, psychological mechanisms.



**Figure I.1** The consideration of adaptive function can inform research into human behavior and psychological architecture in a variety of ways. The two most direct paths are schematized here. First, knowledge of the adaptive problems and ancestral conditions that human hunter-gatherers faced can lead to new hypotheses about the design of psychological mechanisms that evolved to solve them. Such heuristic analyses can supply crucial guidance in the design of experiments to discover previously unknown psychological mechanisms—investigations that researchers who neglect functional analysis would not have thought to conduct. Secondly, researchers can start with a known psychological phenomenon, and begin to investigate its adaptive function, if any, by placing it in the context of hunter-gatherer life and known selection pressures. The discovery of the functional significance of a psychological phenomenon is not only worthwhile in its own right, but clarifies the organization of the phenomenon, and prompts the discovery of new associated phenomena.

Empirically minded researchers, distrustful of “theory” (by which they often mean facts or principles drawn from unfamiliar fields), frequently ask why they should bother thinking about evolutionary biology: Why not just investigate the mind and behavior, and simply report what is found? The answer is that understanding function makes an important and sometimes pivotal contribution to understanding design in systems that are otherwise bewildering in their complexity. This point is illustrated by a story from the engineering community about the utility of knowing something’s function. Reportedly, at a conference, an engineering professor carried a relatively simple circuit around to the various participants, asking them each to guess what its function was. Despite many guesses, none of the assembled engineers was able to figure it out. Finally, on the last day of the conference, the professor went up to the podium and asked the audience members to sketch the design of a circuit that would be able to perform a function that he then named. Everyone was able to do this rapidly, and when they were finished they were surprised to see that they had just drawn a picture of the same circuit that he had been showing them, the circuit whose function they had been unable to guess.<sup>2</sup> Behavioral scientists have been nearly defeated by the complexity of the behavior they confront. Guidance as to function vastly simplifies the problem of organizing the data in a way that illuminates the structure of the mind.

Our hominid ancestors had to be able to solve a large number of complex adaptive problems, and do so with special efficiency. By combining data from paleontology and hunter-gatherer studies with principles drawn from evolutionary biology, one can develop a task analysis that defines the nature of the adaptive information-processing problem to be solved. David Marr (1982) called this kind of task analysis a *computational theory*. Once one understands the nature of the problem, one can then generate very specific, empirically testable hypotheses about the structure of the information-processing mechanisms that evolved to solve it. A number of contributors to *The Adapted Mind* adopted this research strategy (e.g., Buss, Cosmides & Tooby, Mann, Silverman & Eals). One virtue of this approach is that it is immune to the usual (but often vacuous) accusation of post hoc storytelling: The researcher has predicted in advance the properties of the mechanism.

Using an evolutionarily derived task analysis to generate hypotheses about the structure of our cognitive processes can lead one to look for mechanisms that would otherwise have been overlooked. Silverman and Eals’s chapter on spatial cognition is a good example. Research on spatial cognition has been proceeding for 100 years without the benefit of an evolutionary perspective, and the only kinds of mechanisms discovered were ones that produced a male performance advantage. But by asking what kind of spatial cognition a Pleistocene woman would have needed to be good at solving the adaptive problem of foraging for plant foods, Silverman and Eals were able to discover a new class of mechanisms involved in spatial cognition, which produce a 60% female advantage.

Psychologists should be interested in evolutionary biology for the same reason that hikers should be interested in an aerial map of an unfamiliar territory that they plan to explore on foot. If they look at the map, they are much less likely to lose their way.

## THE HARVEST OF CONCEPTUAL INTEGRATION

Conceptual integration has been such a powerful force in the natural sciences not only because it allows scientists to winnow out improbable hypotheses or build aesthetically

pleasing bridges between disciplines, but because it has been crucial to the discovery of new knowledge. For example, the atomic theory allowed chemists to see thermodynamics in a new way: The atomic theory was connected to Newtonian mechanics through the kinetic theory of heat, and thermodynamics was recast as statistical mechanics. When quantum theory was subsequently developed in physics, statistical mechanics was modified in such a way that it could explain not only the thermal and mechanical properties of matter, but its magnetic and electrical properties as well (Holton, 1973). The emergence of Mendelian genetics at the turn of the century solved a major puzzle in Darwinian theory. By showing that pre-Mendelian theories of blending inheritance were false—i.e., that tall and short plants need not produce medium offspring, that red and white flowers need not produce pink flowers, and so on—Mendelian genetics showed that natural selection could, in fact, create new species, a proposition that theories of blending inheritance had called into question. Subsequently, the combination of Mendelian genetics, Darwinian theory, and newly developed approaches to statistics led to the Modern Synthesis, which in turn made possible a family of new sciences, from population genetics to behavioral ecology.

Conceptual integration generates this powerful growth in knowledge because it allows investigators to use knowledge developed in other disciplines to solve problems in their own. The causal links between fields create anchor points that allow one to bridge theoretical or methodological gaps that one's own field may not be able to span. This can happen in the behavioral and social sciences, just as it has happened in the natural sciences. Evidence about cultural variation can help cognitive scientists decide between competing models of universal cognitive processes; evidence about the structure of memory and attention can help cultural anthropologists understand why some myths and ideas spread quickly and easily while others do not (e.g., Mandler et al., 1980; Sperber, 1985, 1990); evidence from evolutionary biology can help social psychologists generate new hypotheses about the design features of the information-processing mechanisms that govern social behavior; evidence about cognitive adaptations can tell evolutionary biologists something about the selection pressures that were present during hominid evolution; evidence from paleoanthropology and hunter-gatherer studies can tell developmental psychologists what kind of environment our developmental mechanisms were designed to operate in; and so on.

At present, crossing such boundaries is often met with xenophobia, packaged in the form of such familiar accusations as “intellectual imperialism” or “reductionism.” But by calling for conceptual integration in the behavioral and social sciences we are neither calling for reductionism nor for the conquest and assimilation of one field by another. Theories of selection pressures are not theories of psychology; they are theories about some of the causal forces that produced our psychology. And theories of psychology are not theories of culture; they are theories about some of the causal mechanisms that shape cultural forms (Barkow, 1973, 1978, 1989a; Daly & Wilson, 1988; Sperber, 1985, 1990; Tooby & Cosmides, 1989, this volume). In fact, not only do the principles of one field not reduce to those of another, but by tracing the relationships between fields, additional principles often appear.

Instead, conceptual integration simply involves learning to accept with grace the irreplaceable intellectual gifts offered by other fields. To do this, one must accept the tenet of mutual consistency among disciplines, with its allied recognition that there are causal links between them. Compatibility is a misleadingly modest requirement, however, for it is an absolute one. Consequently, accepting these gifts is not always

easy, because other fields may indeed bring the unwelcome news that favored theories have problems that require reformulation. Inattention to the compatibility requirement has led to many conceptual wrong turns in the social sciences (Barkow, 1989a; Tooby & Cosmides, this volume) as well as in evolutionary biology (Symons, this volume; Tooby & Cosmides 1990b). But fortunately errors can be avoided in the future by scrutinizing hypotheses in each field in the light of what is known in other fields. Investigators planning to apply such an approach will need to develop simultaneous expertise in at least two “adjacent” fields. Toward this end we hope that training in the behavioral and social sciences will move away from its present fragmented and insular form and that students will be actively encouraged to gain a basic familiarity with relevant findings in allied disciplines.

In the final analysis, it is not unaided empiricism that has made the natural sciences so powerful, but empiricism wedded to the power of inference. Every field has holes and gaps. But when there are causal links that join fields, the holes that exist in one discipline can sometimes be filled by knowledge developed in another. What the natural sciences have discovered is that this is a process with positive feedback: The more that is known—the more that can be simultaneously brought to bear on a question—the more that can be deduced, explained, and even observed. If we, as behavioral and social scientists, change our customs and accept what mutual enrichment we can offer one another, we can be illuminated by the same engine of discovery that has made the natural sciences such a signal human achievement.

## NOTES

1. The idea that two statements cannot contradict each other and both be true was old when Aristotle formalized it, and it is only a small step from that to the commonplace idea that claims from different scientific disciplines should not contradict each other either, without at least one of them being suspected of being in error. Such a notion would seem too obvious to discuss were it not for the bold claims of autonomy made for the social sciences, accompanied by the institutionalized neglect of neighboring disciplines (Barkow, 1989c). It is, perhaps, one of the astonishing features of intellectual life in our century that cross-disciplinary consistency should be treated as a radical claim in need of defense, rather than as a routine tool of inference (Tooby & Cosmides, this volume). In any case, the central idea is simply one of consistency or compatibility across sciences, and conceptual integration and vertical integration are simply different names for this principle.

The adjective *vertical* in *vertical integration* (Barkow, 1980b, 1982, 1989a) emphasizes, alongside the notion of mutual compatibility, the notion that certain disciplines exist in a structured relationship with each other, such as physics to chemistry, and chemistry to biology. Each field “lower” in such a structure deals with principles that govern more inclusive sets of phenomena. For example, the laws of physics apply to chemical phenomena, and the principles of physics and chemistry apply to biological phenomena, but not the reverse. By the same token, however, each field “higher” up in the structure requires additional principles special to its more restricted domain (e.g., living things, humans) that are not easily reduced to the principles found in the other fields (e.g., natural selection is not derivable from chemistry).

We will generally use the term “conceptual integration” to avoid the connotation that vertical relationships between disciplines imply some epistemological or status hierarchy among sciences. For example, Lord Kelvin’s criticism of Darwinism was based on Kelvin’s erroneous calculation of the age of the earth. This case demonstrates that when physics and biology conflict, it is certainly possible that physics is in error. Moreover, the array of modern disciplines (from

geochemistry to astrophysics to paleodemography to neuropharmacology) makes heterarchical relationships often seem more natural than any vertical ordering. Sciences should learn from and strive for consistency with every other field, from those existing in a clearly vertical relationship, such as chemistry is to physics, to those standing in more complex relationships, such as paleontology to psychology.

2. Our thanks to Jim Stellar for passing on to us this parable about the usefulness of functional approaches.

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I

**THE EVOLUTIONARY AND  
PSYCHOLOGICAL FOUNDATIONS OF  
THE SOCIAL SCIENCES**

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# The Psychological Foundations of Culture

JOHN TOOBY AND LEDA COSMIDES

## INTRODUCTION: THE UNITY OF SCIENCE

One of the strengths of scientific inquiry is that it can progress with any mixture of empiricism, intuition, and formal theory that suits the convenience of the investigator. Many sciences develop for a time as exercises in description and empirical generalization. Only later do they acquire reasoned connections within themselves and with other branches of knowledge. Many things were scientifically known of human anatomy and the motions of the planets before they were scientifically explained.

—GEORGE WILLIAMS,  
*Adaptation and Natural Selection*

Disciplines such as astronomy, chemistry, physics, geology, and biology have developed a robust combination of logical coherence, causal description, explanatory power, and testability, and have become examples of how reliable and deeply satisfying human knowledge can become. Their extraordinary florescence throughout this century has resulted in far more than just individual progress within each field. These disciplines are becoming integrated into an increasingly seamless system of interconnected knowledge and remain nominally separated more out of educational convenience and institutional inertia than because of any genuine ruptures in the underlying unity of the achieved knowledge. In fact, this development is only an acceleration of the process of conceptual unification that has been building in science since the Renaissance. For example, Galileo and Newton broke down the then rigid (and now forgotten) division between the celestial and the terrestrial—two domains that formerly had been considered metaphysically separate—showing that the same processes and principles applied to both. Lyell broke down the distinction between the static present and the formative past, between the creative processes operating in the present and the geological processes that had operated across deep time to sculpt the earth. Maxwell uncovered the elegant principles that unified the many disparate electrical and magnetic phenomena into a single system.

And, one by one, the many gulfs separating life from nonlife were bridged and then closed: Harvey and others found that the macrostructure of the body turned out to operate according to comprehensible mechanical principles. Wöhler's synthesis of urea showed that the chemistries of the living and the nonliving were not forever separated by the occult operation of special vitalistic forces. In Wöhler's wake, the unraveling of the molecular biology of the gene and its regulation of cellular processes has shown how many of the immensely complex and functionally intricate mechanisms that constitute life are realized in molecular machinery: the *élan vital* turned out to be

nothing other than this microscopic functional intricacy. Most critically, Darwin showed how even the intricately articulated functional organization of living systems (then only observable at the macroscopic level) could be explained as the product of intelligible natural causes operating over the expanse of deep time. In so doing, he conceptually united the living and the nonliving into a single system of principled causation, and the entire diversity of plant, animal, and microbial species into a single tree of descent. Darwin took an equally radical step toward uniting the mental and physical worlds, by showing how the mental world—whatever it might be composed of—arguably owed its complex organization to the same process of natural selection that explained the physical organization of living things. Psychology became united with the biological and hence evolutionary sciences.

The rise of computers and, in their wake, modern cognitive science, completed the conceptual unification of the mental and physical worlds by showing how physical systems can embody information and meaning. The design and construction of artificial computational systems is only a few decades old, but already such systems can parallel in a modest way cognitive processes—such as reason, memory, knowledge, skill, judgment, choice, purpose, problem-solving, foresight, and language—that had supposedly made mind a metaphysical realm forever separated from the physical realm, and humans metaphysically disconnected from the causal network that linked together the rest of the universe. These intellectual advances transported the living, the mental, and the human—three domains that had previously been disconnected from the body of science and mystified because of this disconnection—into the scientifically analyzable landscape of causation.

One useful way to organize this knowledge is as a principled history of the universe. Starting with some characterizable initial condition (like the Big Bang), each successive state of the system is described, along with the principles that govern the transitions from state to state. To the extent that our scientific model is well-developed, we should be able to account for the types of entities that emerge (pulsars, tectonic plates, ribosomes, vision, incest avoidance) and their distribution and location in the causal matrix. Such a history—in its broadest outlines—is well on its way to being constructed, from an initial quantum state, to the formation and distribution of particles during the early expansion, to the cooling and formation of atoms, the formation of galaxies, stellar evolution, the synthesis of heavier nuclei, and, of parochial interest to us, the local history of the solar system. This includes the formation of the sun and planets; the geochemistry of prebiotic earth; the generation of complex organic compounds; the emergence of the initial ancestral reproducing chemical system; the evolution of the genetic code and prokaryotic design; the emergence of eukaryotic sexual organisms, multicellular plants, animals, and fungi; and the rest of the history of life on earth.

In this vast landscape of causation, it is now possible to locate “Man’s place in nature” to use Huxley’s famous phrase and, therefore, to understand for the first time what humankind is and why we have the characteristics that we do. From this vantage point, humans are self-reproducing chemical systems, multicellular heterotrophic mobile organisms (animals), appearing very late in the history of life as somewhat modified versions of earlier primate designs. Our developmental programs, as well as the physiological and psychological mechanisms that they reliably construct, are the natural product of this evolutionary history. Human minds, human behavior, human

artifacts, and human culture are all biological phenomena—aspects of the phenotypes of humans and their relationships with one another.

The rich complexity of each individual is produced by a cognitive architecture, embodied in a physiological system, which interacts with the social and nonsocial world that surrounds it. Thus humans, like every other natural system, are embedded in the contingencies of a larger principled history, and explaining any particular fact about them requires the joint analysis of all the principles and contingencies involved. To break this seamless matrix of causation—to attempt to dismember the individual into “biological” versus “nonbiological” aspects—is to embrace and perpetuate an ancient dualism endemic to the Western cultural tradition: material/spiritual, body/mind, physical/mental, natural/human, animal/human, biological/social, biological/cultural. This dualistic view expresses only a premodern version of biology, whose intellectual warrant has vanished.

This expansive new landscape of knowledge has not always been welcome, and many have found it uncongenial in one respect or another. The intellectual worlds we built and grew attached to over the last 3,000 years were laid out before much was known about the nature of the living, the mental, and the human. As a result, these intellectual worlds are, in many important respects, inconsistent with this new unified scientific view and, hence, are in need of fundamental reformulation. These established intellectual traditions and long-standing habits of mind seem, to many, to be more nourishing, more comfortable and, therefore, more valuable than the alternative prospect of new and unfamiliar scientific knowledge. To pick a single example, the shift from a universe designed to embody a moral and spiritual order to a universe that is undesigned and is structured only by a causal order engendered an immeasurably greater cultural dislocation than that which occurred when Copernicus identified the sun rather than the earth as the center of the planetary orbits. Consequently, the demystifications that have taken place since 1859 have been painful and have precipitated considerable resistance to accepting these discoveries and their implications. With the appearance of Darwinism, the full scope of the emerging unified account was, for the first time, apparent. Therefore, much of the opposition has specifically revolved around evolution and its application to humans. Gladstone, for example, in a debate with Huxley, captured in his choice of language the widely shared, visceral sense of revulsion caused by the claim “that natural selection and the survival of the fittest, all in the physical order, exhibit to us the great arcanum of creation, the sun and the center of life, so that mind and spirit are dethroned from their old supremacy, are no longer sovereign by right, but may find somewhere by charity a place assigned them, as appendages, perhaps only as excrescences, of the material creation” (Gladstone, quoted in Gould, 1988, p. 14). The dislocations in world view stemming from this process of conceptual unification led to a growing demand for, and production of, conceptual devices and rationales to divorce the natural sciences from the human social and inner landscape, to blunt the implications of monism and Darwinism, and to restore a comfortable distance between the human sciences and the world of natural causation. To many scholarly communities, conceptual unification became an enemy, and the relevance of other fields a menace to their freedom to interpret human reality in any way they chose.

Thus, despite some important exceptions, the social sciences have largely kept themselves isolated from this crystalizing process of scientific integration. Although

social scientists imitated many of the outward forms and practices of natural scientists (quantitative measurement, controlled observation, mathematical models, experimentation, etc.), they have tended to neglect or even reject the central principle that valid scientific knowledge—whether from the same or different fields—should be mutually consistent (see Cosmides, Tooby, & Barkow, this volume). It is this principle that makes different fields relevant to each other, and part of the same larger system of knowledge. In consequence, this insularity is not just an accident. For many scholars, it has been a conscious, deeply held, and strongly articulated position, advanced and defended since the inception of the social sciences, particularly in anthropology and sociology. Durkheim, for example, in his *Rules of the Sociological Method*, argued at length that social phenomena formed an autonomous system and could be only explained by other social phenomena (1895/1962). The founders of American anthropology, from Kroeber and Boas to Murdock and Lowie, were equally united on this point. For Lowie, “the principles of psychology are as incapable of accounting for the phenomena of culture as is gravitation to account for architectural styles,” and “culture is a thing *sui generis* which can be explained only in terms of itself. . . . *Omnis cultura ex cultura*” (1917/1966, p. 25–26; p. 66). Murdock, in his influential essay “The science of culture,” summed up the conventional view that culture is “independent of the laws of biology and psychology” (1932, p. 200).

Remarkably, while the rest of the sciences have been weaving themselves together through accelerating discoveries of their mutual relevance, this doctrine of intellectual isolationism, which has been the reigning view in the social sciences, has only become more extreme with time. With passionate fidelity, reasoned connections with other branches of knowledge are dismissed as ignorant attempts at crude reductionism, and many leading social scientists now openly call for abandoning the scientific enterprise instead. For example, Clifford Geertz advocates abandoning the ground of principled causal analysis entirely in favor of treating social phenomena as “texts” to be interpreted just as one might interpret literature: We should “turn from trying to explain social phenomena by weaving them into grand textures of cause and effect to trying to explain them by placing them into local frames of awareness” (1983, p. 6). Similarly, Edmund Leach rejects scientific explanation as the focus of anthropology: “Social anthropology is not, and should not aim to be, a ‘science’ in the natural science sense. If anything it is a form of art . . . . Social anthropologists should not see themselves as seekers after objective truth . . . .” (Leach, 1982, p. 52). These positions have a growing following, but less, one suspects, because they have provided new illumination than because they offer new tools to extricate scholars from the unwelcome encroachments of more scientific approaches. They also free scholars from all of the arduous tasks inherent in the attempt to produce scientifically valid knowledge: to make it consistent with other knowledge and to subject it to critical rejection on the basis of empirical disproof, logical inconsistency, and incoherence. In any case, even advocates of such avenues of retreat do not appear to be fully serious about them because few are actually willing to accept what is necessarily entailed by such a stance: Those who jettison the epistemological standards of science are no longer in a position to use their intellectual product to make any claims about what is true of the world or to dispute the others’ claims about what is true.

Not only have the social sciences been unusual in their self-conscious stance of intellectual autarky but, significantly, they have also been relatively unsuccessful as

sciences. Although they were founded in the 18th and 19th centuries amid every expectation that they would soon produce intellectual discoveries, grand “laws,” and validated theories to rival those of the rest of science, such success has remained elusive. The recent wave of antiscientific sentiment spreading through the social sciences draws much of its appeal from this endemic failure. This disconnection from the rest of science has left a hole in the fabric of our organized knowledge of the world where the human sciences should be. After more than a century, the social sciences are still adrift, with an enormous mass of half-digested observations, a not inconsiderable body of empirical generalizations, and a contradictory stew of ungrounded, middle-level theories expressed in a babel of incommensurate technical lexicons. This is accompanied by a growing malaise, so that the single largest trend is toward rejecting the scientific enterprise as it applies to humans.

We suggest that this lack of progress, this “failure to thrive,” has been caused by the failure of the social sciences to explore or accept their logical connections to the rest of the body of science—that is, to causally locate their objects of study inside the larger network of scientific knowledge. Instead of the scientific enterprise, what should be jettisoned is what we will call the Standard Social Science Model (SSSM): The consensus view of the nature of social and cultural phenomena that has served for a century as the intellectual framework for the organization of psychology and the social sciences and the intellectual justification for their claims of autonomy from the rest of science. Progress has been severely limited because the Standard Social Science Model mischaracterizes important avenues of causation, induces researchers to study complexly chaotic and unordered phenomena, and misdirects study away from areas where rich principled phenomena are to be found. In place of the Standard Social Science Model, there is emerging a new framework that we will call the Integrated Causal Model. This alternative framework makes progress possible by accepting and exploiting the natural connections that exist among all the branches of science, using them to construct careful analyses of the causal interplay among all the factors that bear on a phenomenon. In this alternative framework, nothing is autonomous and all the components of the model must mesh.

In this chapter, we argue the following points:

1. There is a set of assumptions and inferences about humans, their minds, and their collective interaction—the Standard Social Science Model—that has provided the conceptual foundations of the social sciences for nearly a century and has served as the intellectual warrant for the isolationism of the social sciences.
2. Although certain assumptions of this model are true, it suffers from a series of major defects that make it a profoundly misleading framework. These defects have been responsible for the chronic difficulties encountered by the social sciences.
3. Advances in recent decades in a number of different disciplines, including evolutionary biology, cognitive science, behavioral ecology, psychology, hunter-gatherer studies, social anthropology, biological anthropology, primatology, and neurobiology have made clear for the first time the nature of the phenomena studied by social scientists and the connections of those phenomena to the principles and findings in the rest of science. This allows a new model to be

constructed—the Integrated Causal Model—to replace the Standard Social Science Model.

4. Briefly, the ICM connects the social sciences to the rest of science by recognizing that:
  - a. the human mind consists of a set of evolved information-processing mechanisms instantiated in the human nervous system;
  - b. these mechanisms, and the developmental programs that produce them, are adaptations, produced by natural selection over evolutionary time in ancestral environments;
  - c. many of these mechanisms are functionally specialized to produce behavior that solves particular adaptive problems, such as mate selection, language acquisition, family relations, and cooperation;
  - d. to be functionally specialized, many of these mechanisms must be richly structured in a content-specific way;
  - e. content-specific information-processing mechanisms generate some of the particular content of human culture, including certain behaviors, artifacts, and linguistically transmitted representations;
  - f. the cultural content generated by these and other mechanisms is then present to be adopted or modified by psychological mechanisms situated in other members of the population;
  - g. this sets up epidemiological and historical population-level processes; and
  - h. these processes are located in particular ecological, economic, demographic, and intergroup social contexts or environments.

On this view, culture is the manufactured product of evolved psychological mechanisms situated in individuals living in groups. Culture and human social behavior is complexly variable, but not because the human mind is a social product, a blank slate, or an externally programmed general-purpose computer, lacking a richly defined evolved structure. Instead, human culture and social behavior is richly variable because it is generated by an incredibly intricate, contingent set of functional programs that use and process information from the world, including information that is provided both intentionally and unintentionally by other human beings.

## THE STANDARD SOCIAL SCIENCE MODEL

### The Central Logic of the Standard Social Science Model

But one would be strangely mistaken about our thought if, from the foregoing, he drew the conclusion that sociology, according to us, must, or even can, make an abstraction of man and his faculties. It is clear, on the contrary, that the general characteristics of human nature participate in the work of elaboration from which social life results. But they are not the cause of it, nor do they give it its special form; they only make it possible. Collective representations, emotions, and tendencies are caused not by certain states of the consciousnesses of individuals but by the conditions in which the social group, in its totality, is placed. Such actions can, of course materialize only if the individual natures are not resistant to them; *but these individual natures are merely the indeterminate material that the social factor molds*

*and transforms. Their contribution consists exclusively in very general attitudes, in vague and consequently plastic predispositions which, by themselves, if other agents did not intervene, could not take on the definite and complex forms which characterize social phenomena.*

—DURKHEIM, 1895/1962,  
pp. 105–106, emphasis added.

Humans everywhere show striking patterns of local within-group similarity in their behavior and thought, accompanied by profound intergroup differences. The Standard Social Science Model (SSSM or Standard Model) draws its enduring persuasive power by starting with these and a few other facts, rooted in direct experience and common knowledge. It then focuses on one salient causal and temporal sequence: how individuals change over their development from “unformed” infants into complexly competent adult members of their local social group, and how they do so in response to their local human environment. The central precepts of the SSSM are direct and seemingly inescapable conclusions drawn from these facts (D. E. Brown, 1991), and the same reasoning appears in author after author, from perhaps its most famous early expression in Durkheim (1895/1962), to its fully conventional modern adherents (with updated conceptual ornamentation) such as Geertz (1973).

The considerations that motivate the Standard Social Science Model are as follows:

*Step 1.* The existence of rapid historical change and the multitude of spontaneous human “cross-fostering experiments” effectively disposes of the racialist notion that human intergroup behavioral differences of any significance are attributable to genetic differences between groups. Infants everywhere are born the same and have the same developmental potential, evolved psychology, or biological endowment—a principle traditionally known as *the psychic unity of humankind*. The subsequent growth of knowledge over this century in genetics and human development has given strong empirical support to the conclusion that infants from all groups have essentially the same basic human design and potential. Human genetic variation, which is now directly detectable with modern electrophoretic techniques, is overwhelmingly sequestered into functionally superficial biochemical differences, leaving our complex functional design universal and species-typical (Tooby & Cosmides, 1990a). Also, the bulk of the variation that does exist is overwhelmingly inter-individual and within-population, and not between “races” or populations. By the nature of its known distribution, then, genetic variation cannot explain why many behaviors are shared within groups, but not between groups. That is, genetic variation does not explain why human groups dramatically differ from each other in thought and behavior. (Significantly, this is the only feature of the SSSM that is correct as it stands and that is incorporated unmodified into the Integrated Causal Model. Why it turns out to be true, however, depends on the existence of complex evolved psychological and physiological adaptations—something explicitly or implicitly denied by adherents of the SSSM.)

*Step 2.* Although infants are everywhere the same, adults everywhere differ profoundly in their behavioral and mental organization.

These first two steps, just by themselves, have led to the following widely accepted deduction: Because, it is reasoned, a “constant” (the human biological endowment observable in infants) cannot explain a “variable” (intergroup differences in complex adult mental or social organization) the SSSM concludes that “human nature” (the

evolved structure of the human mind) cannot be the cause of the mental organization of adult humans, their social systems, their culture, historical change, and so on.

*Step 3.* Even more transparently, these complexly organized adult behaviors are absent from infants. Infants do not emerge speaking, and they appear to lack virtually every recognizable adult competency. Whatever “innate” equipment infants are born with has traditionally been interpreted as being highly rudimentary, such as an unorganized set of crude urges or drives, plus the ability to learn—certainly nothing resembling adult mental organization. Because adult mental organization (patterned behavior, knowledge, socially constructed realities, and so on) is clearly absent from the infant, infants must “acquire” it from some source outside themselves in the course of development.

*Step 4.* That source is obvious: This mental organization is manifestly present in the social world in the form of the behavior and the public representations of other members of the local group. Thus, the stuff of mental organization is categorizable according to its source: (1) the “innate” (or inborn or genetically determined, etc.), which is supplied “biologically” and is what you see in the infant, and (2) the social (or cultural or learned or acquired or environmental), which contains everything complexly organized and which is supplied by the social environment (with a few exceptions supplied by the physical environment and nonsocial learning). “[C]ultural phenomena . . . are in no respect hereditary but are characteristically and without exception acquired” (Murdock, 1932, p. 200). This line of reasoning is usually supported by another traditional argument, the deprivation thought experiment: “Undirected by culture patterns—organized systems of significant symbols—man’s behavior would be virtually ungovernable, a mere chaos of pointless acts and exploding emotions, his experience virtually shapeless” (Geertz, 1973, p. 46). Humans raised without a social or cultural environment would be “mental basket cases” with “few useful instincts, fewer recognizable sentiments, and no intellect” (Geertz, 1973, p. 49). Because, it is reasoned, an effect disappears when its cause is withdrawn, this thought experiment is believed to establish that the social world is the cause of the mental organization of adults.

*Step 5.* The causal arrow in this process has a clear directionality, which is directly observable in the individual’s development. The cultural and social elements that mold the individual precede the individual and are external to the individual. The mind did not create them; they created the mind. They are “given,” and the individual “finds them already current in the community when he is born” (Geertz, 1973, p. 45). Thus, the individual is the creation of the social world and, it appears to follow, the social world cannot be the creation of “the individual.” If you are reading this chapter, you learned English and did not create it. Nor did you choose to learn English (assuming you are a native speaker) any more than any effect chooses its cause; this action of the social world on the individual is compulsory and automatic—“coercive,” to use Durkheim’s phrase. Adult mental organization is socially determined. Moreover, by looking at social processes in the vast modern societies and nation-states, it is obvious that the “power asymmetry” between “the individual” and the social world is huge in the determination of outcomes and that the reciprocal impact of the individual on the social world is negligible. The causal flow is overwhelmingly or entirely in one direction. The individual is the acted upon (the effect or the outcome) and the sociocultural world is the actor (the cause or the prior state that determines the subsequent state).

*Step 6.* Accordingly, what complexly organizes and richly shapes the substance of human life—what is interesting and distinctive and, therefore, worth studying—is the variable pool of stuff that is usually referred to as “culture.” Sometimes called “extrasomatic” or “extragenetic” (e.g., Geertz, 1973) to emphasize its nonbiological origins and nature, this stuff is variously described as behavior, traditions, knowledge, significant symbols, social facts, control programs, semiotic systems, information, social organization, social relations, economic relations, intentional worlds, or socially constructed realities. However different these characterizations may appear to be in some respects, those who espouse them are united in affirming that this substance—whatever its character—is (in Durkheim’s phrase) “external to the individual.” Even so psychological a phenomenon as thinking becomes external: “Human thought is basically both social and public—. . . its natural habitat is the house yard, the marketplace, and the town square. Thinking consists not of ‘happenings in the head’ (though happenings there and elsewhere are necessary for it to occur) but of a traffic in what have been called, by G.H. Mead and others, significant symbols—words for the most part. . . .” (Geertz, 1973, p. 45). “The individual” contributes only the infant’s impoverished drives, unformed tendencies, and capacity to be socialized.

These first six steps constitute the SSSM’s account of the causal process whereby what is assumed to be an initially formless infant is transformed into a fully human (i.e., fully cultural) being. The next important element in the SSSM is its approach to answering the question, “If culture creates the individual, what then creates culture?”

Before describing the SSSM’s answer to this question, however, we need to make an important aspect of the question explicit: Human life is complexly and richly ordered. Human life is not (solely) noise, chaos, or random effect (contra Macbeth). Although the substance of human life, like human speech, is various and contingent, it is still, like human speech, intricately patterned. Many attempt to capture this perception with the phrase that human cultures (e.g., human symbol systems) are “meaningful.” Human conduct does not resemble white noise. In a way that is analogous to William Paley’s argument from design in his *Natural Theology*, one must ask: If there is complex and meaningful organization in human sociocultural life, what is the creator or artificer of it? Entropy, perturbation, error, noise, interaction with other systems, and so on, are always operating to influence culture (and everything else), so clearly not everything in culture is orderly. Equally, if these processes were all that were operating, complex order would never appear and would quickly degrade even if it did. Just as finding a watch on the heath, already complexly organized, requires that one posit a watchmaker (Paley, 1828), finding out that human life is complexly ordered necessitates the search for the artificer or source of this order (see Dawkins, 1986, for an exceptionally lucid general analysis of the problem of explaining complex order, its importance as a question, and the extremely narrow envelope of coherent answers). So, the question is not so much, What are the forces that act on and influence human culture and human affairs? but rather, What is the generator of complex and significant *organization* in human affairs?

*Step 7.* The advocates of the Standard Social Science Model are united on what the artificer is not and where it is not: It is not in “the individual”—in human nature or evolved psychology—which, they assume, consists of nothing more than what the infant comes equipped with, bawling and mewling, in its apparently unimpressive initial performances. Because the directional flow of the organization is from the outer world inward into “the individual,” the direction toward which one looks for the

source of the organization is likewise clear: outward into the social world. As Durkheim says, “[w]hen the individual has been eliminated, society alone remains” (1895/1962, p. 102).

*Step 8.* The SSSM maintains that the generator of complex and meaningful organization in human life is some set of emergent processes whose determinants are realized at the group level. The sociocultural level is a distinct, autonomous, and self-caused realm: “Culture is a thing *sui generis* which can be explained only in terms of itself. . . . *Omnis cultura ex cultura*” (Lowie, 1917/1966, p. 25–26). For Alfred Kroeber, “the only antecedents of historical phenomena are historical phenomena” (Kroeber, 1917). Durkheim was equally emphatic: “The determining cause of a social fact should be sought among the social facts preceding it and not among the states of individual consciousness”; that is, phenomena at the sociocultural level are mostly or entirely caused by other phenomena at the sociocultural level (Durkheim, 1895/1962, p. 110). It must be emphasized that this claim is not merely the obvious point that social phenomena (such as tulip bulb mania, the contagious trajectory of deconstructionist fashions, or the principles of supply and demand) cannot be understood simply by pointing inside the head of a single individual. It is, instead, a claim about the *generator* of the rich organization everywhere apparent in human life. What is generated even includes individual adult psychological phenomena, which are themselves simply additional social constructions. For Durkheim (and for most anthropologists today), even emotions such as “sexual jealousy” and “paternal love” are the products of the social order and have to be explained “by the conditions in which the social group, in its totality, is placed.” As Geertz argues, “Our ideas, our values, our acts, even our emotions, are, like our nervous system itself, cultural products—products manufactured, indeed, out of tendencies, capacities, and dispositions with which we were born, but manufactured nonetheless” (1973, p. 50). Similarly, Shweder describes “cultural psychology” as “the study of the way cultural traditions and social practices regulate, express, transform, and permute the human psyche, resulting less in psychic unity for humankind than in ethnic divergences in mind, self and emotion” (Shweder, 1990, p. 1).

*Step 9.* Correspondingly, the SSSM denies that “human nature”—the evolved architecture of the human mind—can play any notable role as a generator of significant organization in human life (although it is acknowledged to be a necessary condition for it). In so doing, it removes from the concept of human nature all substantive content, and relegates the architecture of the human mind to the delimited role of embodying “the capacity for culture.” Human nature is “merely the indeterminate material that the social factor molds and transforms. [This] contribution consists exclusively in very general attitudes, in vague and consequently plastic predispositions which, by themselves, if other agents did not intervene, could not take on the definite and complex forms which characterize social phenomena” (Durkheim, 1895/1962, p. 106). As Hatch comments, the “view that the Boasians had struggled to foster within the social sciences since almost the turn of the century” was that the human mind is “almost infinitely malleable” (1973, p. 236). Socialization is the process of externally supplied “conceptual structures molding formless talents” (Geertz, 1973, p. 50).

Social scientists who paid any attention to neuroscience, ethology, and cognitive psychology were increasingly, if uneasily, aware of the evidence that the nervous system was complex and not well characterized by the image of the “blank slate.” Nonetheless, aside from paying some lip service to the notion that *tabula rasa* empiricism

was untenable, this changed nothing important in the SSSM. The blank slate was traded in for blank cognitive procedures.<sup>2</sup> The mind could be seen as complex, but its procedures were still assumed to be content-free. As long as environmental input could enter and modify the system, as it clearly could, environmental input was presumed to orchestrate the system, giving it its functional organization. It doesn't matter if the clay of the human mind has some initial shape (tendencies, dispositions), so long as it is soft enough to be pounded by the external forces into any new shape required. Thus, for Geertz, who is attracted to the language if not the actual substance of cognitive science, the mind is not a slate, blank or otherwise (he dismisses this as a straw man position "which no one of any seriousness holds" or perhaps ever held [Geertz, 1984, p. 268]), but it is instead the tabula rasa's fully modern equivalent, a general-purpose computer. Such a computer doesn't come pre-equipped with its own programs, but instead—and this is the essential point—it obtains the programs that tell it what to do from the outside, from "culture." Thus, the human mind is a computer that is "desperately dependent upon such extragenetic, outside-the-skin control mechanisms" or "programs" "for the governing of behavior" (Geertz, 1973, p. 44).

This eliminates the concept of human nature or its alternative expression, the evolved psychological architecture, as useful or informative concepts. As Geertz puts it, "[t]he rise of the scientific concept of culture amounted to . . . the overthrow of the view of human nature dominant in the Enlightenment . . .", that is, that "[man] was wholly of a piece with nature and shared in the general uniformity of composition which natural science . . . had discovered there" with "a human nature as regularly organized, as thoroughly invariant, and as marvelously simple as Newton's universe" (Geertz, 1973, p. 34). Instead, the view entailed in the modern "scientific concept of culture" is that "humanity is as various in its essence as in its expression" (Geertz, 1973, p. 37). Geertz does not mean, of course, that infants vary due to genetic differences, but that all significant aspects of adult mental organization are supplied culturally. As deeply as one can go into the mind, people here are different from people there, leading to "the decline of the uniformitarian view of man" (Geertz, 1973, p. 35).

The conclusion that human nature is an empty vessel, waiting to be filled by social processes, removed it as a legitimate and worthwhile object of study. Why study paper when what is interesting is the writing on it and, perhaps even more important, the author (the perennially elusive generative social processes)? Since there could be no content, *per se*, to the concept of human nature, anything claimed to be present in human nature was merely an ethnocentric projection of the scholar making the claim. Thus, attempts to explore and characterize human nature became suspect. Such efforts were (and are) viewed as simply crude attempts to serve ideological ends, to manufacture propaganda, or to define one way of being as better and more natural than others.

*Step 10.* In the SSSM, the role of psychology is clear. Psychology is the discipline that studies the process of socialization and the set of mechanisms that comprise what anthropologists call "the capacity for culture" (Spuhler, 1959). Thus, the central concept in psychology is learning. The prerequisite that a psychological theory must meet to participate in the SSSM is that any evolved component, process, or mechanism must be equipotential, content-free, content-independent, general-purpose, domain-general, and so on (the technical terms vary with movement and era). In short, these mechanisms must be constructed in such a way that they can absorb any kind of cultural message or environmental input equally well. Moreover, their structures must themselves impose no particular substantive content on culture. As Rindos (1986, p.

315) puts it, “the specifics that we learn are in no sense predetermined by our genes.” Learning is thus the window through which the culturally manufactured pre-existing complex organization outside of the individual manages to climb inside the individual. Although this approach deprives psychological mechanisms of any possibility of being the generators of significant organization in human affairs, psychologists get something very appealing in exchange. Psychology is the social science that can hope for general laws to rival those of the natural sciences: general laws of learning, or (more recently) of cognitive functioning. The relationship of psychology to biology is also laid out in advance by the SSSM: In human evolution, natural selection removed “genetically determined” systems of behavior and replaced them with general-purpose learning mechanisms or content-independent cognitive processes. Supposedly, these more general systems were favored by evolution because they did not constrain human behavior to be maladaptively inflexible (e.g., Geertz, 1973; Harris, 1979; Montagu, 1964). Neurobiology is the account of how these general mechanisms are instantiated in our nervous system.

Consequently, the concepts of learning, socialization, general-purpose (or content-independent) cognitive mechanisms, and environmentalism have (under various names and permutations) dominated scientific psychology for at least the last 60 years. Skinnerian behaviorism, of course, was one of the most institutionally successful manifestations of the SSSM’s program for psychology, but its antimentalism and doctrinaire scientism made it uncongenial to those who wanted an account of their internal experience. More importantly, its emphasis on individual histories of reinforcement limited the avenues through which culture could have its effect. It proved an easy target when cognitive science provided precise ways of characterizing and investigating the mental as a system that processes information, a characterization that seemed to offer easier avenues for cultural transmission than laboriously organized schedules of reinforcement. Although cognitive psychologists threw out behaviorism’s cumbersome antimentalism, they uncritically adopted behaviorism’s equipotentiality assumption. In mainstream cognitive psychology, it is *assumed* that the machine is free of content-specialized processes and that it consists primarily of general-purpose mechanisms. Psychologists justify this assumption by an appeal to parsimony: It is “unscientific” to multiply hypothesized mechanisms in the head. The goal, as in physics, is for as few principles as possible to account for as much as possible. Consequently, viewing the mind as a collection of specialized mechanisms that perform specific tasks appears to be a messy approach, one not worth pursuing. Anthropologists and sociologists easily accommodated themselves to these theoretical changes in psychology: Humans went from being viewed as relatively simple equipotential learning systems to very much more complex equipotential information-processing systems, general-purpose computers, or symbol manipulators (see, e.g., Sahlins, 1976a, 1976b).

Within psychology there are, of course, important research communities that fall outside of the SSSM and that have remained more strongly connected to the rest of science, such as physiological psychology, perception, psychophysics, (physiological) motivation, psycholinguistics, much of comparative psychology, and a few other areas. Moreover, to explain how organisms remain alive and reproduce (and to make some minimal attempt to account for the focused substance of human life), psychologists have found it necessary to posit a few content-oriented mechanisms: hunger, thirst, sexual motivation, and so on. Nevertheless, the tendency has been to keep these elements restricted to as small a class as possible and to view them as external to the

important central learning or cognitive processes. They are incorporated as, for example, reinforcers operating by drive reduction. Cognitive psychologists have, for the most part, labored to keep any such content-influenced elements extrinsic to the primary cognitive machinery. Indeed, they have usually avoided addressing how functional action—such as mate choice, food choice, or effort calculation—takes place at all. The principles of concept formation, of reasoning, of remembering, and so forth, have traditionally been viewed as uninfected prior to experience with any content, their procedures lacking features designed for dealing with particular types of content. Modular or domain-specific cognitive psychologists, in dissenting from this view, are abandoning the assumptions of the Standard Social Science Model.

Of course, readers should recognize that by so briefly sketching large expanses of intellectual history and by so minimally characterizing entire research communities, we are doing violence to the specific reality of, and genuine differences among hundreds of carefully developed intellectual systems. We have had to leave out the qualifications and complexities by which positions are softened, pluralisms espoused, critical distinctions lost, and, for that matter, lip service paid. This is inevitable in attempting so synoptic a view. In what is surely a graver defect, we have had to omit discussion of the many important dissident subcommunities in sociology, anthropology, economics, and other disciplines, which have sloughed off or never adopted the Standard Social Science Model. In any case, we simply hope that this sketch captures a few things that are true and important, to compensate for the unavoidable simplifying distortions and omissions. Most obviously, there are no pure types in the world, and scholars are quoted not to characterize the full richness of their individual views, which usually undergo considerable evolution over their intellectual development anyway, but rather to illustrate instances of a larger intellectual system. It is the larger intellectual system we are criticizing, and not the multitude of worthwhile research efforts that have gone on inside its structure. We think the roof of the Standard Social Science Model has collapsed, so to speak, because the overall architectural plan is unsound, not because the bricks and other building materials are defective. The detailed research efforts of hundreds of scientists have produced critically important knowledge that has transformed our understanding of the world. In this criticism, we are looking for an architectural design for the social sciences that is worthy of the intelligence and labor of those whose research goes on within their compass.

### **The Standard Social Science Model's Treatment of Culture**

This logic has critically shaped how nearly every issue has been approached and debated in the social sciences. What we are concerned with here, however, is the impact of the Standard Social Science Model on the development of modern conceptions of culture, its causal role in human life, and its relationship to psychology. Briefly, standard views of culture are organized according to the following propositions (see also D. E. Brown, 1991, p. 146; Tooby & Cosmides, 1989a):

1. Particular human groups are properly characterized typologically as having "a" culture, which consists of widely distributed or nearly group-universal behavioral practices, beliefs, ideational systems, systems of significant symbols, or informational substance of some kind. Cultures are more or less bounded entities, although cultural elements may diffuse across boundaries.

2. These common elements are maintained and transmitted “by the group,” an entity that has cross-generational continuity.
3. The existence of separate streams of this informational substance, culture, transmitted from generation to generation, is the explanation for human within-group similarities and between-group differences. In fact, all between-group differences in thought and behavior are referred to as cultural differences and all within-group similarities are regarded as the expressions of a particular culture. Since these similarities are considered to be “cultural,” they are, either implicitly or explicitly, considered to be the consequence of informational substance inherited jointly from the preceding generation by all who display the similarity.
4. Unless other factors intervene, the culture (like the gene pool) is accurately replicated from generation to generation.
5. This process is maintained through learning, a well-understood and unitary process, that acts to make the child like the adult of her culture.
6. This process of learning can be seen, from the point of view of the group, as a group-organized process called socialization, imposed by the group on the child.
7. The individual is the more or less passive recipient of her culture and is the product of that culture.
8. What is organized and contentful in the minds of individuals comes from culture and is socially constructed. The evolved mechanisms of the human mind are themselves content-independent and content-free and, therefore, whatever content exists in human minds originally derives from the social or (sometimes) nonsocial environment.
9. The features of a particular culture are the result of emergent group-level processes, whose determinants arise at the group level and whose outcome is not given specific shape or content by human biology, human nature, or any inherited psychological design. These emergent processes, operating at the sociocultural level, are the ultimate generator of the significant organization, both mental and social, that is found in human affairs.
10. In discussing culture, one can safely neglect a consideration of psychology as anything other than the nondescript “black box” of learning, which provides the capacity for culture. Learning is a sufficiently specified and powerful explanation for how any behavior acquires its distinct structure and must be the explanation for any aspect of organized human life that varies from individual to individual and from group to group.
11. Evolved, “biological,” or “innate” aspects of human behavior or psychological organization are negligible, having been superseded by the capacity for culture. The evolution of the capacity for culture has led to a flexibility in human behavior that belies any significant “instinctual” or innate component (e.g., Geertz, 1973; Montagu, 1968, p. 11; Sahlins, 1976a & b), which, if it existed, would have to reveal itself as robotlike rigid behavioral universals. To the extent that there may be any complex biological textures to individual psychology, these are nevertheless organized and given form and direction by culture and, hence, do not impart any substantial character or content to culture.

### **On the Reasonableness of the Standard Social Science Model**

There are, of course, many important elements of truth in the tenets of the SSSM, both in its core logic and in its treatment of culture. The SSSM would not have become as decisively influential if it did not have a strong surface validity, anchored in important realities. For example: It is true that infants are everywhere the same. Genetic differences are superficial. There is within-group similarity of behavior and there are between-group differences, and these persist across generations, but also change over historical time. Highly organized socially communicated information exists outside of any particular individual at any one time (in the cognitive mechanisms of other individuals), and over time this information can be internalized by the specific individual in question. And so on.

Nevertheless, the Standard Social Science Model contains a series of major defects that act to make it, as a framework for the social sciences, deeply misleading. As a result, it has had the effect of stunting the social sciences, making them seem falsely autonomous from the rest of science (i.e., from the “natural sciences”) and precluding work on answering questions that need to be answered if the social sciences are to make meaningful progress as sciences. After a century, it is time to reconsider this model in the light of the new knowledge and new understanding that has been achieved in evolutionary biology, development, and cognitive science since it was first formulated. These defects cluster into several major categories, but we will limit our discussion to the following three:

1. The central logic of the SSSM rests on naive and erroneous concepts drawn from outmoded theories of development. For example, the fact that some aspect of adult mental organization is absent at birth has no bearing on whether it is part of our evolved architecture. Just as teeth or breasts are absent at birth, and yet appear through maturation, evolved psychological mechanisms or modules (complex structures that are functionally organized for processing information) could develop at any point in the life cycle. For this reason, the many features of adult mental organization absent at birth need not be attributed to exposure to transmitted culture, but may come about through a large number of causal avenues not considered in traditional analyses.

2. More generally, the SSSM rests on a faulty analysis of nature-nurture issues, stemming from a failure to appreciate the role that the evolutionary process plays in organizing the relationship between our species-universal genetic endowment, our evolved developmental processes, and the recurring features of developmental environments. To pick one misunderstanding out of a multitude, the idea that the phenotype can be partitioned dichotomously into genetically determined and environmentally determined traits is deeply ill-formed, as is the notion that traits can be arrayed along a spectrum according to the degree that they are genetically versus environmentally caused. The critique of the SSSM that has been emerging from the cognitive and evolutionary communities is not that traditional accounts have underestimated the importance of biological factors relative to environmental factors in human life. Instead, the target is the whole framework that assumes that “biological factors” and “environmental factors” refer to mutually exclusive sets of causes that exist in some kind of explanatory zero-sum relationship, so that the more one explains “biologically” the less there is to explain “socially” or “environmentally.” On the contrary,

as we will discuss, environmentalist claims necessarily require the existence of a rich, evolved cognitive architecture.

3. The Standard Social Science Model requires an impossible psychology. Results out of cognitive psychology, evolutionary biology, artificial intelligence, developmental psychology, linguistics, and philosophy converge on the same conclusion: A psychological architecture that consisted of nothing but equipotential, general-purpose, content-independent, or content-free mechanisms could not successfully perform the tasks the human mind is known to perform or solve the adaptive problems humans evolved to solve—from seeing, to learning a language, to recognizing an emotional expression, to selecting a mate, to the many disparate activities aggregated under the term “learning culture” (Cosmides & Tooby, 1987; Tooby & Cosmides, 1989a). It cannot account for the behavior observed, and it is not a type of design that could have evolved.

The alternative view is that the human psychological architecture contains many evolved mechanisms that are specialized for solving evolutionarily long-enduring adaptive problems and that these mechanisms have content-specialized representational formats, procedures, cues, and so on. These richly content-sensitive evolved mechanisms tend to impose certain types of content and conceptual organization on human mental life and, hence, strongly shape the nature of human social life and what is culturally transmitted across generations. Indeed, a post-Standard Model psychology is rapidly coalescing, giving a rapidly expanding empirical foundation to this new framework. In fact, historically, most of the data already gathered by psychologists supports such a view. It required a strongly canalized interpretative apparatus to reconcile the raw data of psychology with the central theoretical tenets of SSSM psychology.

Before examining in detail what is wrong with the SSSM and why the recognition of these defects leads to the formulation of a new model with greater explanatory power, it is necessary first to alleviate the fears of what would happen if one “falls off the edge” of the intellectual world created by the SSSM. These fears have dominated how alternative approaches to the SSSM have been treated in the past and, unless addressed, will prevent alternatives from being fairly evaluated now. Moreover, the Standard Model has become so well-internalized and has so strongly shaped how we now experience and interpret social science phenomena that it will be difficult to free ourselves of the preconceptions that the Standard Model imposes until its Procrustean operations on psychology and anthropology are examined.

## **THE WORLD BUILT BY THE STANDARD SOCIAL SCIENCE MODEL**

### **The Moral Authority of the Standard Social Science Model**

#### ***The Case Against Nativism***

The overwhelming success of the Standard Social Science Model is attributable to many factors of which, arguably, the most significant has been its widespread moral appeal. Over the course of the century, its strong stand against explaining differences between races, classes, sexes, or individuals by hypothesizing underlying biological differences has been an important element in combating a multitude of searing horrors and oppressions, from the extermination of ethnic groups and the forced sterilization

of the poor to restrictive immigration laws and legally institutionalized sex and race discrimination. The depth of these tragedies and the importance of the issues involved have imbued the SSSM and its central precept, “environmentalism,” with an imposing moral stature. Consequently, the positions of individual scholars with respect to the SSSM have been taken to imply allegiances with respect to the larger social and moral conflicts around the world. Thus, to support the SSSM was to oppose racism and sexism and to challenge the SSSM was, intentionally or not, to lend support to racism, sexism, and, more generally (an SSSM way of defining the problem), “biological determinism.” If biological ideas could be used to further such ends, then ideas that minimized the relevance of biology to human affairs, such as the tenets of the SSSM, could only be to the good.

In this process, all approaches explicitly involving nativist elements of whatever sort became suspect. In consequence, fundamentally divergent—even opposing—programs and claims have become enduringly conflated in the minds of 20th-century social scientists. Most significant was the failure to distinguish adaptationist evolutionary biology from behavior genetics. Although the adaptationist inquiry into our universal, inherited, species-typical design is quite distinct from the behavior genetics question about which differences between individuals or sets of individuals are caused by differences in their genes, the panspecific nativism typical of adaptationist evolutionary biology and the idiotypic nativism of behavior genetics became confused with each other (Tooby and Cosmides, 1990a). Obviously, claims about a complexly organized, universal human nature, by their very character, cannot participate in racist explanations. Indeed, they contradict the central premises of racialist approaches. Yet, despite this fact, adaptationist approaches and behavior genetics remain inextricably intertwined in the minds of the majority of social scientists.

The second strong moral appeal of the Standard Social Science Model derives from its emphasis on human malleability and the hope it, therefore, gave for social melioration or social revolution. The claim of John B. Watson, the founder of behaviorism, exemplifies this optimism about the power of scientifically directed socialization (as well as the usual implicit conflation of idiotypic and panspecific nativism):

Give me a dozen healthy infants, well-formed, and my own specified world to bring them up in and I'll guarantee to take any one at random and train him to become any type of specialist I might select—doctor, lawyer, artist, merchant-chief, and yes, even beggar-man and thief, regardless of his talents, penchants, tendencies, abilities, vocations, and race of his ancestors (Watson, 1925, p. 82).

As D. E. Brown (1991, p. 61) comments, “In hindsight it is clear that this famous statement about the influence of the environment on individual differences is entirely compatible with the most extreme of the faculty or modular views of the human mind—in which it comprises numerous innate and highly specific mechanisms.” But this thought experiment was interpreted by the social science mainsteam, Watson included, as demonstrating that “people are the products of their societies or cultures.” Therefore, “change society or culture and you change people. . . . Intelligent, scientific socialization can make us whatever we want to be” (D. E. Brown, 1991, p. 61). Moreover, “[t]he equation of an arch environmentalism (including cultural relativism) with optimism about the practical application of social science to the problems of society remains a force to the present” (D. E. Brown, 1991, p. 62). More critically, the belief that the mind is “almost infinitely malleable” (or, in more modern terms, is a general-

purpose computer) means that humans are not condemned to the status quo, and need not inevitably fight wars, or have social classes, or manifest sex-differentiated roles, or live in families, and so on.

If the “happy” ability of the mind to “quite readily take any shape that is presented” (Benedict, 1934/1959, p. 278) is the ameliorator’s ideal because it is believed to be logically necessary to allow social change, then dissent from the SSSM tends to be framed as claims about “constraints” or limits on this malleability. This, in turn, is taken to imply a possible intractability to social problems—the stronger the biological forces are, the more we may be constrained to suffer from certain inevitable expressions of human darkness. Thus, the debate on the role of biology in human life has been consistently framed as being between optimistic environmentalists who plan for human betterment and sorrowful, but realistic nativists who lament the unwelcome inevitability of such things as aggression (e.g., Ardrey, 1966; Lorenz, 1966), or who (possibly even gleefully) defend the status quo as inevitable and natural (e.g., Goldberg, 1973, on patriarchy). These nativists are, in turn, “debunked” by the tireless opponents of “biological determinism” (e.g., Chorover, 1979; Lewontin, Rose, & Kamin, 1984; Montagu, 1968, 1978), who place each new biological intrusion onto social science territory in the context of the bitter lessons of the century. (Environmental holocausts are, of course, edited out of this chronology.)

This morality play, seemingly bound forever to the wheel of intellectual life, has been through innumerable incarnations, playing itself out in different arenas in different times (rationalism versus empiricism, heredity versus environment, instinct versus learning, nature versus nurture, human universals versus cultural relativism, human nature versus human culture, innate behavior versus acquired behavior, Chomsky versus Piaget, biological determinism versus social determinism, essentialism versus social construction, modularity versus domain-generality, and so on). It is perennial because it is inherent in how the issues have been defined in the SSSM itself, which even governs how the dissidents frame the nature of their dissent. Accordingly, the language of constraint and limitation is usually adopted by biologically oriented behavioral scientists themselves in describing the significance of their own work. Thus we even have titles such as *The Tangled Wing: Biological Constraints on the Human Spirit* (Konner, 1982), *Biological Boundaries of Learning* (Seligman and Hager, 1972), “Constraints on Learning” (Shettleworth, 1972), and “Structural Constraints on Cognitive Development” (Gelman, 1990a). Biologically oriented social and behavioral scientists often see themselves as defining limits on the possible. Environmentalists see themselves as expanding the borders of the possible. As we will see, this framing is profoundly misleading.

### **Wrong Diagnosis, Wrong Cure**

Driven by these fears to an attitude that Daly and Wilson (1988) have termed “biophobia,” the social science community lays out implicit and sometimes explicit ground rules in its epistemological hierarchy: The tough-minded and moral stance is to be skeptical of panspecific “nativist” claims; that is, of accounts that refer in any way to the participation of evolved psychological mechanisms together with environmental variables in producing outcomes, no matter how logically inescapable or empirically well-supported they may be. They are thought to be explanations of last resort and, because the tough-minded and skeptical can generate particularistic alter-

native accounts for any result at will, this last resort is rarely ever actually arrived at. For the same reason, it is deemed to be the moral stance to be correspondingly credulous of “environmentalist” accounts, no matter how vague, absurd, incoherent, or empirically contradicted they may be. These protocols have become second nature (so to speak) to nearly everyone in the social science community. This hierarchy is driven by the fear of falling off the edge of the Standard Social Science Model, into unknown regions where monsters such as “biological” or “genetic determinism” live.

What, in fact, is an environmentalist account? There are two brands of environmentalism: coherent environmentalism and incoherent environmentalism, which correspond approximately to environmentalism as defended and environmentalism as practiced. As Daly and Wilson (1988, p. 8) comment, “[a]ll social theorists, including the staunchest antinativists, seek to describe human nature at some cross-culturally general level of abstraction” and would be “distressed should their theories . . . prove applicable to Americans but not to Papuans.” Both Skinner (1957) and Chomsky (1975)—opponents in a paradigmatic case of an environmentalist-nativist debate—posit the existence of universal evolved psychological mechanisms, or what cognitive psychologists have called “innate mechanisms.” As Symons (1987) points out, most of what passes for the nature-nurture debate is not about the need to posit evolved mechanisms in theories. Everyone capable of reasoning logically about the problem accepts the necessity of this. As Symons makes clear, what the debate often seems to be about is how general or content-specific the mechanisms are: Skinner proposes conditioning mechanisms that apply to all situations, while Chomsky proposes specialized mechanisms particularly designed for language. Consequently, coherent environmentalists acknowledge that they are positing the existence of evolved developmental or psychological mechanisms and are willing to describe (1) the explicit structure of these mechanisms, and (2) what environmental variables they interact with to produce given outcomes. By this standard, of course, Chomsky is an environmentalist, as was Skinner, as are we, along with most other evolutionary psychologists and evolutionarily informed behavioral scientists. Equally, all coherent behavioral scientists of whatever orientation must be nativists in this same sense, and no coherent and fully specified hypothesis about behavior can avoid making nativist claims about the involvement of evolved structure.

Incoherent environmentalists, on the other hand, are those who propose theories of how environments regulate behavior or even psychological phenomena without describing or even mentioning the evolved mechanisms their theories would require to be complete or coherent. In practice, communities whose rules of discourse are governed by incoherent environmentalism consider any such trend toward explicitness to be introducing vague and speculative variables and—more to the point—to be in bad taste as well. The simple act of providing a complete model is to invoke evolved design and, hence, to court being called a genetic or biological determinist. Given that all coherent (fully specified) models of psychological processes necessarily entail an explication of how environmental variables relate to the inherited architecture or developmental machinery, this attitude has the effect of portraying psychologists who are clear about all causal steps as more soft-minded and speculative than those who remain vague about the crucial elements necessary to make their theories coherent (e.g., Cheng & Holyoak, 1989). (This criticism is, of course, fully symmetrical: Incoherent nativists are those scholars who talk about how evolution structures behavior

without attempting to describe the structure of the evolved adaptations that link evolution, environment, and behavior in adaptively patterned ways; for discussion, see Symons, this volume; Tooby & Cosmides, 1990b.)

The problem with an epistemological hierarchy that encourages incoherence and discourages coherence (aside from the fully sufficient objection that it has introduced major distortions into the body of scientific knowledge) is that it is completely unnecessary, even on its own terms. Not only is the cure killing the patient—social science—but also the diagnosis is wrong and the patient is not menaced by the suspected malady. In the first place, as discussed, models of a robust, universal human nature by their very character cannot participate in racist explanations of intergroup differences. This is not just a definitional trick of defining human nature as whatever is universal. There are strong reasons to believe that selection usually tends to make complex adaptations universal or nearly universal, and so humans must share a complex, species-typical and species-specific architecture of adaptations, however much variation there might be in minor, superficial, nonfunctional traits. As long-lived sexual reproducers, complex adaptations would be destroyed by the random processes of sexual recombination every generation if the genes that underlie our complex adaptations varied from individual to individual. Selection in combination with sexual recombination tends to enforce uniformity in adaptations, whether physiological or psychological, especially in long-lived species with an open population structure, such as humans (Tooby & Cosmides, 1990b). Empirically, of course, the fact that any given page out of *Gray's Anatomy* describes in precise anatomical detail individual humans from around the world demonstrates the pronounced monomorphism present in complex human physiological adaptations. Although we cannot yet directly “see” psychological adaptations (except as described neuroanatomically), no less could be true of them. Human nature is everywhere the same.

### ***The Malleability of Psychological Architecture versus the Volatility of Behavioral Outcomes***

If the fear that leaving the Standard Social Science Model will lead to racist doctrines is unfounded, what of the issue of human malleability? Does a biologically informed approach necessarily imply an intractability of undesired social and behavioral outcomes and an inevitability of the status quo? After all, isn't the basic thrust of biologically informed accounts against malleability and in favor of constraints and limits on human aspirations?

No. The central premise of an opposition between the mind as an inflexible biological product and the mind as a malleable social product is ill-formed: The notion that inherited psychological structure constrains is the notion that without it we would be even more flexible or malleable or environmentally responsive than we are. This is not only false but absurd. Without this evolved structure, we would have no competences or contingent environmental responsiveness whatsoever. Evolved mechanisms do not prevent, constrain, or limit the system from doing things it otherwise would do in their absence. The system could not respond to “the environment” (that is, to selected parts of the environment in an organized way) without the presence of mechanisms designed to create that connection. Our evolved cognitive adaptations—our inherited psychological mechanisms—are the means by which things are affirmatively accomplished. It is an absurd model that proposes that the potentially unfettered human mind operates by flailing around and is only given structure and direction by

the “limits” and “constraints” built in by “biology.” Instead, any time the mind generates any behavior at all, it does so by virtue of specific generative programs in the head, in conjunction with the environmental inputs with which they are presented. Evolved structure does not constrain; it creates or enables (Cosmides & Tooby, 1987).

Given that we are all discussing universal human design and if, as Symons argues, all coherent behavioral scientists accept the reality of evolved mechanisms, then the modern nature-nurture debate is really about something else: the character of those evolved mechanisms (Symons, 1987). Does the mind consist of a few, general-purpose mechanisms, like operant conditioning, social learning, and trial-and-error induction, or does it also include a large number of specialized mechanisms, such as a language acquisition device (Chomsky, 1975; Pinker, 1984; Pinker & Bloom, this volume), mate preference mechanisms (Buss, 1989, this volume; Ellis, this volume; Symons, 1979), sexual jealousy mechanisms (Daly, Wilson, & Weghorst, 1982; Wilson & Daly, this volume), mother-infant emotion communication signals (Fernald, this volume), social contract algorithms (Cosmides, 1989; Cosmides & Tooby, 1989, this volume; Gigerenzer & Hug, in press), and so on? This is the point of separation between the Standard Social Science Model and the Integrated Causal Model, and it is the main focus of this volume.

How, then, does the issue of the number and specificity of evolved mental mechanisms bear on the issue of the inevitability of undesired behavioral outcomes? As we will discuss and review later, the same answer applies: General mechanisms turn out to be very weak and cannot unassisted perform at least most and perhaps all of the tasks humans routinely perform and need to perform. Our ability to perform most of the environmentally engaged, richly contingent activities that we do depends on the guiding presence of a large number of highly specialized psychological mechanisms (Cosmides & Tooby, 1987; Rozin, 1976; Symons, 1987; Tooby & Cosmides, 1990b). Far from constraining, specialized mechanisms enable competences and actions that would not be possible were they absent from the architecture. This rich array of cognitive specializations can be likened to a computer program with millions of lines of code and hundreds or thousands of functionally specialized subroutines. It is because of, and not despite, this specificity of inherent structure that the output of computational systems is so sensitively contingent on environmental inputs. It is just this sensitive contingency to subtleties of environmental variation that make a narrow intractability of outcomes unlikely.

The image of clay, and terms such as “malleability,” “flexibility,” and “plasticity” confuse two separate issues: (1) the detailed articulation of human evolved psychological design (i.e., what is the evolved design of our developmental programs and of the mechanisms they reliably construct), and (2) the fixity or intractability of expressed outcomes (what must people do, regardless of circumstance). The first question asks what evolved organization exists in the mind, while the second asks what events will inevitably occur in the world. Neither “biology,” “evolution,” “society,” or “the environment” directly impose behavioral outcomes, without an immensely long and intricate intervening chain of causation involving interactions with an entire configuration of other causal elements. Each link of such a chain offers a possible point of intervention to change the final outcome. For this reason, computer programs present a far better model of the situation: The computer does nothing without them, they frequently involve superbly complex contingent branching and looping alternatives, they can (and the procedures in the human mind certainly do) take as input environmental

variables that create cascading changes in subsequent computational events and final outcomes, and the entire system may respond dramatically and dynamically to direct intervention (for example, the alteration of even a single instruction) at any of a great number of locations in the program.

Moreover, we know in advance that the human psychological system is immensely flexible as to outcome: Everything that every individual has ever done in all of human history and prehistory establishes the minimum boundary of the possible. The maximum, if any, is completely unknown. Given the fact that we are almost entirely ignorant of the computational specifics of the hundreds or thousands of mechanisms that comprise the human mind, it is far beyond the present competence of anyone living to say what are and are not achievable outcomes for human beings.

It is nevertheless very likely to be the case that we will find adaptive specializations in the human mind that evolved to make, under certain circumstances, choices or decisions that are (by most standards) ethically unacceptable and often lead to consensually undesirable outcomes (e.g., male sexual proprietariness, Wilson & Daly, this volume; discriminative parental solicitude, Daly & Wilson, 1981; Mann, this volume). If one is concerned about something like family violence, however, knowing the details of the mechanisms involved will prove crucial in taking any kind of constructive or amelioratory action. “Solutions” that ignore causation can solve nothing.

In any case, the analysis of the morality or practicality of intervention to prevent undesired outcomes—“ontogenetic engineering” (Daly, Wilson & Weghorst, 1982)—is beyond the scope of this discussion. Our point here is simply that leaving behind the SSSM does not entail accepting the inevitability of any specific outcome, nor does it entail the defense of any particular aspect of the status quo. Instead, for those genuinely concerned with such questions, it offers the only realistic hope of understanding enough about human nature to eventually make possible successful intervention to bring about humane outcomes. Moreover, a program of social melioration carried out in ignorance of human complex design is something like letting a blindfolded individual loose in an operating room with a scalpel—there is likely to be more blood than healing. To cure, one needs to understand; lamenting disease or denouncing the researchers who study its properties has never yet saved a life. At present, we are decades away from having a good model of the human mind, and this is attributable in no small measure to a misguided antinativism that has, for many, turned from being a moral stance into a tired way of defending a stagnated and sterile intellectual status quo. There are, of course, no guarantees, and it is at least logically possible that understanding our complex array of evolved mechanisms will offer no way to improve the human condition. But, if that is the case, it will be the first time in history that major sets of new discoveries turned out to be useless.<sup>3</sup>

## **The Empirical Authority of the Standard Social Science Model**

### ***The Division of Labor: Content-Independent Psychology***

One major consequence of the adoption of the Standard Social Science Model has been the assignment of a division of labor among the social sciences. It gave each field its particular mission, stamped each of them with its distinctive character, and thereby prevented them from making much progress beyond the accumulation of particularistic knowledge. Anthropology, as well as sociology and history, study both the impor-

tant and variable content of human life (the signal) and the more vaguely defined processes and contingent events that generated it (the artificer or author of the signal). Psychology studies the medium on which this socially generated content is inscribed, the process of inscription, and the mechanisms that enable the inscription to take place. (The SSSM also assigns to psychology and to psychological anthropology the task of cataloging, at the individual level, the particularistic psychological phenomena that are created by the action of each culture on individuals; e.g., what do American college sophomores get anxious about?).

In advance of any data, the Standard Model defined for psychology the general character of the mechanisms that it was supposed to find (general-purpose, content-independent ones), its most important focus (learning), and how it would interpret the data it found (no matter what the outcome, the origin of content was to be located externally—for example, in the unknowably complex unobserved prior history of the individual—and not “internally” in the mind of the organism). Psychologists certainly were not forced by the character of their data into these types of conclusions (e.g., Breland & Breland, 1961). Instead, they had to carefully design their experiments so as to exclude evolutionarily organized responses to biologically significant stimuli by eliminating such stimuli from their protocols (e.g., by using stimulus-impoverished Skinner boxes or the currently widespread practice of eliminating “emotionally charged” stimuli from cognitive experiments). This was done in the name of good experimental design and with the intention of eliminating contaminating “noise” from the exploration of the content-independent mechanisms that were thought to exist.

### ***The Division of Labor: Particularistic, Content-Specific Anthropology***

Even more than psychology, anthropology was shaped by the assumptions inherent in the SSSM’s division of labor: A content-independent (or content-free) psychology symbiotically requires a content-supplying anthropology to provide the agent—culture—that transforms malleable generalized potential into specifically realized human beings. So anthropology’s mission was to study the particular (Geertz, 1973, p. 52). Consequently, anthropology became the custodian of the key explanatory concept in the paradigm, “culture.” Belief in culture, as a substance passed across generations causing the richly defined particularity of adult mental and social organization defines one’s membership in the modern social science community. The invocation of culture became the universal glue and explanatory variable that held social science explanations together: Why do parents take care of their children? It is part of the social role their culture assigns to them. Why are Syrian husbands jealous? Their culture tied their status to their wife’s honor. Why are people sometimes aggressive? They learn to be because their culture socializes them to be violent. Why are there more murders in America than in Switzerland? Americans have a more individualistic culture. Why do women want to look younger? Youthful appearance is valued in our culture. And so on.

Although using culture as an all-purpose explanation is a stance that is difficult or impossible to falsify, it is correspondingly easy to “confirm.” If one doubts that the causal agent for a particular act is transmitted culture, one can nearly always find similar prior acts (or attitudes, or values, or representations) by others, so a source of the contagion can always be identified. Culture is the protean agent that causes everything that needs explaining in the social sciences, apart from those few things that can be

explained by content-general psychological laws, a few drives, and whatever superorganic processes (e.g., history, social conflict, economics) that are used to explain the particularities of a specific culture. Psychologists, then, need not explain the origin of complexly specific local patterns of behavior. They can be confident that anthropologists have done this job and have tracked, captured, defined, and analyzed the causal processes responsible for explaining why men are often sexually jealous or why women often prefer to look youthful.

In defining culture as the central concept of anthropology, the SSSM precluded the development of the range of alternative anthropologies that would have resulted if, say, human nature, economic and subsistence activity, ecological adaptation, human universals, the organization of incentives inside groups, institutional propagation, species-typical psychology, or a host of other reasonable possibilities had been selected instead. More critically, because of the way in which the SSSM frames the relationship between culture and the human mind, anthropology's emphasis on relativity and explanatory particularism becomes inescapable, by the following logic: If the psyche is general-purpose, then all organized content comes from the outside, from culture. Therefore, if something is contentful, then it must be cultural; if it is cultural, then—by the nature of what it is to be cultural—it is plastically variable; if it is plastically variable, then there can be no firm general laws about it. Ergo, there can be no general principles about the content of human life (only the contentless laws of learning). The conclusion is present in the premises. The relativity of human behavior, far from being the critical empirical discovery of anthropology (Geertz, 1973, 1984), is something imposed *a priori* on the field by the assumptions of the SSSM, because its premises define a program that is incapable of finding anything else. Relativity is no more “there” to be found in the data of anthropologists than a content-independent architecture is “there” to be found in the data of psychologists. These conclusions are present in the principles by which these fields approach their tasks and organize their data, and so are not “findings” or “discoveries” at all.

The consequences of this reasoned arrival at particularism reverberate throughout the social sciences, imparting to them their characteristic flavor, as compared with the natural sciences. This flavor is not complexity, contingency, or historicity: Sciences from geology to astronomy to meteorology to evolutionary biology have these in full measure. It is, instead, that social science theories are usually provisional, indeterminate, tentative, indefinite, enmeshed in an endlessly qualified explanatory particularism, for which the usual explanation is that human life is much more complex than mere Schrödinger equations or planetary ecosystems. Because culture was held to be the proximate (and probably the ultimate) cause of the substance and rich organization of human life, the consensus was, naturally, that documenting its variability and particularity deserved to be the primary focus of anthropological study (e.g., Geertz, 1973). This single proposition alone has proven to be a major contributor to the failure of the social sciences (Tooby & Cosmides, 1989a). Mainstream sociocultural anthropology has arrived at a situation resembling some nightmarish short story Borges might have written, where scientists are condemned by their unexamined assumptions to study the nature of mirrors only by cataloging and investigating everything that mirrors can reflect. It is an endless process that never makes progress, that never reaches closure, that generates endless debate between those who have seen different reflected images, and whose enduring product is voluminous descriptions of particular phenomena.

### ***The Empirical Disproof of a Universal Human Nature***

The view that the essence of human nature lies in its variousness and the corresponding rejection of a complex, universal human nature is not advanced by anthropologists simply as an assertion. Instead, it is presented as a dramatic and empirically well-supported scientific discovery (Geertz, 1984) and is derived from a particular method through which the limits of human nature are explored and defined. This method, a logical process of elimination, “confirmed” that the notion of human nature was empirically almost vacuous. Since infants are everywhere the same, then anything that varies in adults can only (it was reasoned) be cultural and, hence, socially inherited and, hence, socially manufactured. The method depends on accepting the premise that behavior can only be accounted for in these two ways: (1) as something “biological,” or inborn, which is, therefore, inflexibly rigid regardless of environment and (because of the psychic unity of humankind) everywhere the same, or (2) as sociocultural, which includes everything that varies, at a minimum, and perhaps many things that happen by accident to be universal as well.

Whenever it is suggested that something is “innate” or “biological,” the SSSM-oriented anthropologist or sociologist rifles through the ethnographic literature to find a report of a culture where the behavior (or whatever) varies (for a classic example, see Mead’s 1949 *Male and Female*). Upon finding an instance of reported variation (or inventing one through strained interpretation; see again, Mead, 1949), the item is moved from the category of “innate,” “biological,” “genetically determined,” or “hardwired” to the category of “learned,” “cultural,” or “socially constructed.” Durkheim succinctly runs through the process, discussing why sexual jealousy, filial piety, and paternal love must be social constructions, despite claims to the contrary: “History, however, shows that these inclinations, far from being inherent in human nature, are often totally lacking. Or they may present such variations in different human societies that the residue obtained after eliminating all these differences—which alone can be considered of psychological origin—is reduced to something vague and rudimentary and far removed from the facts that need explanation” (Durkheim, 1895/1962, p. 106). Because almost everything human is variable in one respect or another, nearly everything has been subtracted from the “biologically determined” column and moved to the “socially determined” column. The leftover residue of “human nature,” after this process of subtraction has been completed, is weak tea indeed, compared to the rich and engaging list of those dimensions of life where humans vary. No wonder Geertz (1973) finds such watered-down universals no more fundamental or essential to humans than the behaviors in which humans vary. Psychologists have, by and large, accepted the professional testimony of anthropologists and have, as part of their standard intellectual furniture, the confidence that other cultures violate virtually every universal claim about the content of human life. (D. E. Brown [1991] offers a pivotal examination of the history and logic of anthropological approaches to human universals, cultural variation, and biology, and this entire discussion is informed by his work.)

### ***Discovering Regularities Depends on Selecting Appropriate Frames of Reference***

Because of the moral appeal of antinativism, the process of discrediting claims about a universal human nature has been strongly motivated. Anthropologists, by each new

claim of discovered variability, felt they were expanding the boundaries of their discipline (and, as they thought, of human possibility itself) and liberating the social sciences from biologically deterministic accounts of how we are inflexibly constrained to live as we do. This has elevated particularism and the celebration of variability to central values inside of anthropology, strongly asserted and fiercely defended.

The most scientifically damaging aspect of this dynamic has not been the consequent rhetorical emphasis most anthropologists have placed on the unusual (Bloch, 1977; Goldschmidt, 1960; Symons, 1979; see, especially, D. E. Brown, 1991). As Bloch (1977, p. 285) says, it is the “professional malpractice of anthropologists to exaggerate the exotic character of other cultures.” Nor is the most damaging aspect of this dynamic the professionally cultivated credulousness about claims of wonders in remote parts of the world, which has led anthropologists routinely to embrace, perpetuate, and defend not only gross errors (see Freeman, 1983, on Mead and Samoa; Suggs, 1971, on Linton and the Marquesas) but also obvious hoaxes (e.g., Casteneda’s UCLA dissertation on Don Juan; or the gentle “Tasaday,” which were manufactured by officials of the Marcos regime).

The most scientifically damaging aspect of this value system has been that it leads anthropologists to actively reject conceptual frameworks that identify meaningful dimensions of cross-cultural uniformity in favor of alternative vantage points from which cultures appear maximally differentiated. Distinctions can easily be found and endlessly multiplied, and it is an easy task to work backward from some particular difference to find a framework from which the difference matters (e.g., while “mothers” may exist both there and here, motherhood here is completely different from motherhood there because mothers there are not even conceptualized as being blood kin, but rather as the wife of one’s father, etc., etc.). The failure to view such variation as always profoundly differentiating is taken to imply the lack of a sophisticated and professional appreciation of the rich details of ethnographic reality.

But whether something is variable or constant is not just “out in the world”; it is also a function of the system of categorization and description that is chosen and applied. The distance from Paris to Mars is complexly variable, so is the location of Paris “constant” and “inflexible” or is it “variable?” In geography, as in the social sciences, one can get whichever answer one wants simply by choosing one frame of reference over another. The order that has been uncovered in physics, for example, depends on the careful selection of those particular systems of description and measure that allow invariances to appear. These regularities would all disappear if physicists used contingently relative definitions and measures, such as their own heartbeat to count units of time (the speed of light would slow down every time the measurer got excited—“relativity” indeed).

Other sciences select frameworks by how much regularity these frameworks allow them to uncover. In contrast, most anthropologists are disposed to select their frameworks so as to bring out the maximum in particularity, contingency, and variability (e.g., how are the people they study unique?). Certainly one of the most rewarded of talents inside anthropology is the literary ability to express the humanly familiar and intelligible as the exotic (see, e.g., Geertz’s description of a raid by the authorities on a cock fight in Bali; Geertz, 1973; see D. E. Brown, 1991, for a lucid dissection of the role of universals in this example, and Barkow, 1989, on how Balinese cock fighting illustrates the conventional psychology of prestige). Anthropologists’ attraction to

frameworks that highlight particularistic distinctions and relationships has nearly precluded the accumulation of genuine knowledge about our universal design and renders anthropologists' "empirically" grounded dismissal of the role of biology a matter of convention and conjuring rather than a matter of fact.

### ***Beneath Variable Behavior Lie Universal Mechanisms***

The social science tradition of categorizing everything that varies as "nonbiological" fails to identify much that is "biological." This is because anthropologists have chosen ill-suited frames of reference (such as those based on surface "behavior" or reflective "meaning") that accentuate variability and obscure the underlying level of universal evolved architecture. There may be good reasons to doubt that the "behavior" of marriage is a cross-cultural universal or that the articulated "meaning" of gender is the same across all cultures, but there is every reason to think that every human (of a given sex) comes equipped with the same basic evolved design (Tooby & Cosmides, 1990a). The critical question is not, for example, whether every human male in every culture engages in jealous behaviors or whether mental representations attached to situations of extra-pair mating are the same in every culture; instead, the most illuminating question is whether every human male comes endowed with developmental programs that are designed to assemble (either conditionally or regardless of normal environmental variation) evolutionarily designed sexual jealousy mechanisms that are then present to be activated by appropriate cues. To discern and rescue this underlying universal design out of the booming, buzzing confusion of observable human phenomena requires selecting appropriate analytical tools and frames of reference.

Genetics, for example, had enormous difficulty making progress as a science until geneticists developed the distinction between genotype and phenotype—between the inherited basis of a trait and its observable expression. We believe a similar distinction will prove necessary to the development of an integrated social science. We will refer to this as the distinction between the *evolved* (as in evolved mechanisms, evolved psychology, evolved architecture, etc.) and the *manifest* (as in manifest psychology, manifest behavior, etc.). One observes variable manifest psychologies or behaviors between individuals and across cultures and views them as the product of a common, underlying evolved psychology, operating under different circumstances. The mapping between the evolved architecture and manifest behavior operates according to principles of expression that are specified in the evolved developmental mechanisms and the psychological mechanisms they reliably construct; manifest expressions may differ between individuals when different environmental inputs are operated on by the same procedures to produce different manifest outputs (Cosmides & Tooby, 1987; Tooby & Cosmides, 1989b).

For example, some individuals speak English while others do not, yet everyone passes through a life stage when the same species-typical language acquisition device is activated (Pinker & Bloom, this volume). In fact, if an individual survives a childhood of aberrant social isolation she may never acquire a language and may be incapable of speaking; yet, she will have had the same species-typical language acquisition device as everyone else. So what at the behavioral level appears variable ("speaks English," "speaks Kikuyu"; or, even, "speaks a language," "does not speak any language") fractionates into variable environmental inputs and a uniform underlying design, interacting to produce the observed patterns of manifest variation. The fog

enveloping most social science debates would blow away if all hypotheses were completely spelled out, through analyzing each situation into environmental conditions, evolved architecture, and how their interaction produces the manifest outcome.

Standard Model partisans have confidently rested their empirical case on what now appears to be uncertain ground: that manifest universality across cultures is the observation that evolutionary hypotheses about human nature require and that, on the other hand, cross-cultural variability establishes that the behavior in question is uncontaminated by “biology” and is, instead, solely the product of “culture” or “social processes.” The recognition that a universal evolved psychology will produce variable manifest behavior given different environmental conditions exposes this argument as a complete non sequitur. From a perspective that describes the whole integrated system of causation, the distinction between the biologically determined and the nonbiologically determined can be seen to be a nondistinction.

In its place, the relevant distinction can be drawn between what Mayr (among others) called open and closed behavior programs (Mayr, 1976). This terminology distinguishes mechanisms that are open to factors that commonly vary in the organism’s natural environment and, hence, commonly vary in their manifest expression from those that are closed to the influence of such factors and are, consequently, uniform in their manifest expression. The human language acquisition device is an open behavior program whose constructed product, adult competency in the local language, varies depending on the language community in which the individual is raised. Certain facial emotional displays that manifest themselves uniformly cross-culturally (Ekman, 1973) may be examples of closed behavior programs. The Standard Social Science Model’s method of sorting behavior by its cross-cultural uniformity or variability of expression into “biologically determined” and “socially determined” categories in reality sorts behaviors into those generated by closed behavior programs, and those generated by open behavior programs. In neither case can the analysis of the “determination” of behavior be made independent of “biology,” that is, independent of understanding the participation of the evolved architecture. For this reason, the whole incoherent opposition between socially determined (or culturally determined) phenomena and biologically determined (or genetically determined) phenomena should be consigned to the dustbin of history, along with the search for a biology-free social science.

### ***The Search for the Artificer***

If psychology studies the content-independent laws of mind and anthropology studies the content-supplying inheritances of particular cultures, one still needs to find the content-determining processes that manufacture individual cultures and social systems. The Standard Social Science Model breaks the social sciences into schools (materialist, structural-functionalist, symbolic, Marxist, postmodernist, etc.) that are largely distinguished by how each attempts to affirmatively characterize the artificer, which they generally agree is an emergent group-level process of some kind. It is far beyond the scope of this chapter to review and critique these attempts to discover somewhere in the social system what is in effect a generative computational system. Nevertheless, it is important to recognize that the net effect of the central logic of the Standard Social Science Model has been to direct the quest for the ultimate cause or generator of significant mental and social organization outward away from the rich computational architecture of the human mind. It is there where sufficiently powerful ordering pro-

cesses—ones capable of explaining the phenomena—are primarily to be found. As will be discussed later, it is there where the actual generators of organization are principally (though not exclusively) located and could be productively investigated. And understanding this architecture is an indispensable ingredient in modeling or understanding whatever super-individual processes exist.

This is not to say that there aren't many important phenomena and processes operating at the population level, which, for example, modify the nature and distribution of representations (for non-SSSM analyses, see, e.g., Sperber, 1985, 1990, on epidemiological approaches to cultural transmission; see also Boyd & Richerson, 1985; Campbell, 1965, 1975; Durham, 1991; and others, who examine analogs to natural selection operating at the cultural level). But because the traditional SSSM efforts to characterize these generative processes make them entirely external to "the individual" as well as independent of species-typical psychology, these accounts tend to share a certain ineradicable indefiniteness of location and substance. The SSSM attempt to abstract social processes away from the matrix of interacting psychological architectures necessarily fails because the detailed structure of psychological mechanisms is inextricably bound up in how these social processes operate. One might say that what mostly remains, once you have removed from the human world everything internal to individuals, is the air between them. This vagueness of ontology and causal mechanism makes it difficult to situate these hypothetical generative processes with respect to our knowledge of the rest of the natural world (Sperber, 1986). Moreover, attempting to locate in these population-level processes the primary generator of significant organization has caused these processes to be fundamentally misunderstood, mystified, and imbued with such unwarranted properties as autonomy, teleology, functionality, organism-like integration, intelligence, intentionality, emotions, need-responsiveness, and even consciousness (see, e.g., Durkheim, 1895/1962; Harris, 1979; Kroeber, 1915; Marx, 1867/1909; Merton, 1949; Parsons, 1949; Radcliffe-Brown, 1952; see Harris, 1968, for review and discussion).

Of course, the social system is not like a person or an organism or a mind, self-ordering due to its own functionally integrated mechanisms. It is more like an ecosystem or an economy whose relationships are structured by feedback processes driven by the dynamic properties of its component parts. In this case, the component parts of the population are individual humans, so any social dynamics must be anchored in models of the human psychological architecture. In contrast, the customary insistence on the autonomy (or analytic separability) of the superorganic level is why there have been so few successful or convincing causal models of population-level social processes, including models of culture and social organization (apart from those originating in microeconomics or in analogies drawn from population biology, which do not usually take SSSM-style approaches; see, e.g., Boyd & Richerson, 1985; Schelling, 1978).

Rejecting the design of individuals as central to the dynamics is fatal to these models, because superorganic (that is, population-level) processes are not just "out there," external to the individual. Instead, human superindividual interactions depend intimately on the representations and other regulatory elements present in the head of every individual involved and, therefore, on the systems of computation inside each head. These govern what is selected from "out there," how this is represented, what procedures act on the representations, and what behaviors result that others can then observe and interact with in a population dynamic fashion (Sperber, 1985, 1986, 1990;

Tooby & Cosmides, 1989a). These psychological mechanisms are primarily where there is sufficient anti-entropic computational power to explain the rich patterning of human life. The design of the human psychological architecture structures the nature of the social interactions humans can enter into, as well as the selectively contagious transmission of representations between individuals. Only after the description of the evolved human psychological architecture has been restored as the centerpiece of social theory can the secondary anti-entropic effects of population-level social dynamics be fully assessed and confidently analyzed. Hence, the study of population-level social and cultural dynamics requires a sophisticated model of human psychology to undergird it (see Barkow, 1989, this volume; Cosmides & Tooby, 1989, this volume; Daly, 1982; Sperber, 1985, 1990; Tooby & Cosmides, 1989a).

### ***The Division of Labor: The Social Sciences versus the Natural Sciences***

The single most far-reaching consequence of the Standard Social Science Model has been to intellectually divorce the social sciences from the natural sciences, with the result that they cannot speak to each other about much of substance. Where this divorce has been achieved can be precisely located within the model. Because biology and evolved psychology are internal to the individual and because culture—the author of social and mental organization—is seen as external to the individual, the causal arrow from outside to inside logically insulates the social sciences from the rest of the natural sciences, making them autonomous and the natural sciences substantively irrelevant. This set of propositions is the locus of the primary break between the social and the natural sciences. Although there has been a causal flow across four billion years of evolutionary time, its ability to causally shape the human present is impermeably dammed at the boundaries of the individual—in fact, well within the individual, for evolution is thought to provide nothing beyond an account of the origins of the drives, if any, and of the general-purpose, content-free learning or computational equipment that together comprise the SSSM's minimalist model of human nature.

Thus, whatever their empirical success may be, the claims made by (to pick some obvious examples) ethologists, sociobiologists, behavioral ecologists, and evolutionary psychologists about the evolutionary patterning of human behavior can be simply dismissed out of hand as wrong, without requiring specific examination, because causality does not flow outward from the individual or from psychology, but inward from the social world (Sahlins, 1976a). Or, as Durkheim put it nearly a century before, “every time that a social phenomenon is directly explained by a psychological phenomenon, we may be sure that the explanation is false” (Durkheim, 1895/1962, p. 103). Organic evolution manufactured the biological substratum, the human capacity for culture—“the breadth and indeterminateness of [man's] inherent capacities” (Geertz, 1973, p. 45)—but otherwise reaches a dead end in its causal flow and its power to explain.

Finally, it would be a mistake to think that the Standard Social Science Model reflects the views solely of social scientists and is usually resisted by biologists and other natural scientists. It is instead considered the common sense and common decency of our age. More particularly, it is a very useful doctrine for biologists themselves to hold. Many of them vigorously defend its orthodoxies, adding their professional imprimatur to the social scientists' brief for the primacy of culture or social forces over “biology” (see, e.g., Gould, 1977a, 1977b; Lewontin, Rose & Kamin, 1984). This does not happen simply because some are drawn to the formidable moral authority of the Standard

Model and the mantle it confers. Even for those of a genuinely scientific temperament, fascinated with biological phenomena for their own sake, such a doctrine is a godsend. The Standard Model guarantees them, *a priori*, that their work cannot have implications that violate socially sanctified beliefs about human affairs because the Standard Model assures them that biology is intrinsically disconnected from the human social order. The Standard Model therefore frees those in the biological sciences to pursue their research in peace, without having to fear that they might accidentally stumble into or run afoul of highly charged social or political issues. It offers them safe conduct across the politicized minefield of modern academic life. This division of labor is, therefore, popular: Natural scientists deal with the nonhuman world and the “physical” side of human life, while social scientists are the custodians of human minds, human behavior, and, indeed, the entire human mental, moral, political, social, and cultural world. Thus, both social scientists and natural scientists have been enlisted in what has become a common enterprise: the resurrection of a barely disguised and archaic physical/mental, matter/spirit, nature/human dualism, in place of an integrated scientific monism.

## THE EVOLUTIONARY CONTRIBUTION TO INTEGRATED EXPLANATION

### Rediscovering the Relevance of Evolutionary Biology

If the adoption of the Standard Social Science Model has not led to a great deal of natural science-like progress, that is surely not a good argument against it. Its convenience has no bearing on whether it is true. What, then, are the reasons for believing it is false? There are a number of major problems that independently lead to the rejection of the SSSM—some emerging from evolutionary biology, some from cognitive science, and some from their integration. We will discuss three of these problems, arguing that (1) the Standard Social Science Model’s analysis of developmental or “nature-nurture” issues is erroneous; (2) the general-purpose, content-free psychology central to the SSSM could not have been produced by the evolutionary process and, therefore, is not a viable candidate model of human psychology; and (3) a psychology of this kind cannot explain how people solve a whole array of tasks they are known to routinely perform.

For advocates of the Standard Social Science Model, evolution is ignored because it is irrelevant: The explanatory power of evolution ends with the emergence of the content-free computational equipment that purportedly constitutes human nature. This equipment does not impose any form on the social world, but instead acquires all of its content from the social world. The supposed erasure of content-sensitive and content-imparting structure from hominid psychological architecture during our evolution is what justifies the wall of separation between the natural and the social sciences. If this view were correct, then evolution would indeed be effectively irrelevant to the social sciences and the phenomena they study.

In contrast, proponents of the Integrated Causal Model accept that, in addition to whatever content-independent mechanisms our psychological architecture may contain, it also contains content-specific devices, including those computationally responsible for the generation and regulation of human cultural and social phenomena. These content-specific mechanisms are adaptations (as are content-independent mechanisms), and evolved to solve long-enduring adaptive problems characteristic of

our hunter-gatherer past. Because of their design, their operation continually imparts evolutionarily patterned content to modern human life. If this view is correct, then the specifics of evolutionary biology have a central significance for understanding human thought and action. Evolutionary processes are the “architect” that assembled, detail by detail, our evolved psychological and physiological architecture. The distinctive characteristics of these processes are inscribed in the organizational specifics of these designs. Consequently, an understanding of the principles that govern evolution is an indispensable ally in the enterprise of understanding human nature and an invaluable tool in the discovery and mapping of the species-typical collection of information-processing mechanisms that together comprise the human mind. The complex designs of these mechanisms are the main causal channels through which the natural sciences connect to and shape the substance of the “social” sciences.

Thus, the relevance of evolutionary biology does not in the least depend on our being “just like” other species, which we obviously are not (Tooby & DeVore, 1987). Each species has its own distinctive properties stemming from its own unique evolutionary history. Evolutionary biology is fundamentally relevant to the study of human behavior and thought because our species is the product of naturalistic terrestrial processes—evolutionary processes—and not of divine creation or extraterrestrial intervention. However unusual our properties may be from a zoological point of view—and we have every reason to believe humans followed a unique evolutionary trajectory (Tooby & DeVore, 1987)—we need an account of how they were produced in the natural world of causation over evolutionary history (Boyd & Richerson, 1985). Such accounts are constructed from (1) the principles that govern the evolutionary process (such as natural selection and drift), (2) the designs of ancestral hominid species, and (3) the particular ancestral environments and contingent historical events hominids encountered during their evolutionary history.

### Reproduction, Feedback, and the Construction of Organic Design

[T]hese elaborately constructed forms, so different from each other, and dependent on each other in so complex a manner, have all been produced by laws acting around us. These laws, taken in the largest sense, being . . . Reproduction; Inheritance which is almost implied by reproduction; Variability . . . and as a consequence . . . Natural Selection. . . .

—CHARLES DARWIN,  
*The Origin of Species*

While physicists tend to start their causal history with the Big Bang, biologists usually select a different, later event: the emergence of the first living organism. Life (or the instances we have so far observed) is a phenomenon that originated on earth three to four billion years ago through the formation of the first living organism by contingent physical and chemical processes. What is life? What defining properties qualified some ancient physical system as the first living organism? From a Darwinian perspective, it is the reproduction by systems of new and similarly reproducing systems that is the defining property of life. An organism is a self-reproducing machine. All of the other properties of living organisms—cellular structure, ATP, polypeptides, the use of carbon’s ability to form indefinitely large chains, DNA as a regulatory element—are incidental rather than essential, and the logic of Darwinism would apply equally to self-reproducing robots, to self-reproducing plasma vortices in the sun, or to anything else that reproduces with the potential for inheritable change (mutation). From reproduc-

tion, the defining property of life, the entire elegant deductive structure of Darwinism follows (Dawkins, 1976; Tooby & Cosmides, 1990b; Williams, 1985).

Very simple proto-bacteria emerged early in terrestrial history, as chemical machines that constructed additional chemical machines like themselves. Because reproduction means the construction of offspring designs like the parent machines, one could imagine this leading to an endless chain of proliferating systems identical to the original parent. This is not what happened, of course, because mutations or random modifications are sometimes introduced into offspring designs by accident, with far-reaching consequences. Most random modifications introduce changes into the organism's organization that interfere with the complex sequence of actions necessary for self-reproduction. But a small proportion of random modifications happen to cause an enhancement in the average ability of the design to cause its own reproduction. In the short run, the frequency of those variants whose design promotes their own reproduction increases, and the frequency of those variants whose design causes them to produce fewer (or no) offspring decreases. Consequently, one of two outcomes usually ensues: (1) the frequency of a design will drop to zero—i.e., go extinct (a case of negative feedback); or (2) a design will outreproduce and thereby replace all alternative designs in the population (a case of positive feedback). After such an event, the population of reproducing machines is different from its ancestors because it is equipped with a new and more functionally organized design or architecture. Thus, the fact that alternative design features give rise to reproductive performance differences creates the system of positive and negative feedback called natural selection. Natural selection guides the incorporation of design modifications over generations according to their consequences on their own reproduction.

Over the long run, down chains of descent, this cycle of chance modification and reproductive feedback leads to the systematic accretion within architectures of design features that promote or formerly promoted their own propagation. Even more importantly, the reproductive fates of the inherited properties that coexist in the same organism are linked together: What propagates one design feature tends to propagate others (not perfectly, but sufficiently for a coherent design to emerge; see Cosmides & Tooby, 1981). This means that traits will be selected to work together to produce the same outcomes and to enhance each other's functionality. Frequently, then, these accumulating properties will sequentially fit themselves together into increasingly functionally elaborated machines for reproduction, composed of constituent mechanisms—called adaptations—that solve problems that are either necessary for reproduction or increase its likelihood (Darwin, 1859; Dawkins, 1986; R. Thornhill, 1991; Tooby & Cosmides, 1990b; Williams, 1966, 1985). As if by the handiwork of an invisible and nonforesightful engineer, element after element is added to a design over generations, making it a more functional system for propagation under the conditions prevailing at the time each new element was added. At present, there is no extant alternative theory for how organisms acquired complex functional organization over the course of their evolution (Dawkins, 1986).

What is most compelling about Darwin's approach is that the process of natural selection is an inevitable by-product of reproduction, inheritance, and mutation. Like water running downhill, over generations organisms tend to flow into new functional designs better organized for effective propagation in the environmental context in which they evolved. There is, however, another method, besides selection, by which mutations can become incorporated into species-typical design: chance. The sheer

impact of many random accidents may cumulatively propel a useless mutation upward in frequency until it crowds out all alternative design features from the population. Its presence in the architecture is not explained by the (nonexistent) functional consequences it has on reproduction, and so it will not be coordinated with the rest of the organism's architecture in a functional way.

But despite the fact that chance plays some role in evolution, organisms are not primarily chance agglomerations of stray properties. To the extent that a feature has a significant effect on reproduction, selection will act on it. For this reason, important and consequential aspects of organismic architectures are shaped by selection. By the same token, those modifications that are so minor that their consequences are negligible on reproduction are invisible to selection and, therefore, are not organized by it. Thus, chance properties drift through the standard designs of species in a random way, unable to account for complex organized design and, correspondingly, are usually peripheralized into those aspects that do not make a significant impact on the functional operation of the system (Tooby & Cosmides, 1990a, 1990b).

In short, evolution (or descent with modification, to use Darwin's phrase) takes place due to the action of both chance and natural selection, causing descendants to diverge in characteristics from their ancestors, down chains of descent. Over evolutionary time, this appears as a succession of designs, each a modification of the one preceding it. Generation by generation, step by step, the designs of all of the diverse organisms alive today—from redwoods and manta rays to humans and yeast—were permuted out of the original, very simple, single-celled ancestor through an immensely long sequence of successive modifications. Each modification spread through the species either because it caused its own propagation, or by accident. Through this analytic framework, living things in general and each species in particular can be located in the principled causal history of the universe. Moreover, the specific design features of a species' architecture can also be causally located in this history: they exist either because of chance incorporation or because they contributed to the functional operation of the architecture. The theory of evolution by natural selection vastly expanded the range of things that could be accounted for, so that not only physical phenomena such as stars, mountain ranges, impact crater's, and alluvial fans could be causally located and explained but also things like whales, eyes, leaves, nervous systems, emotional expressions, and the language faculty.

The modern Darwinian theory of evolution consists of the logically derivable set of causal principles that necessarily govern the dynamics of reproducing systems, accounting for the kinds of properties that they cumulatively acquire over successive generations. The explicit identification of this core logic has allowed the biological community to develop an increasingly comprehensive set of principles about what kinds of modifications can and do become incorporated into the designs of reproducing systems down their chains of descent, and what kinds of modifications do not (Dawkins, 1976, 1982, 1986; Hamilton, 1964, 1972; Maynard Smith, 1964, 1982; Williams, 1966). This set of principles has been tested, validated, and enriched by a comprehensive engagement with the empirical reality of the biological world, from functional and comparative anatomy, to biogeography, to genetics, to immunology, to embryology, to behavioral ecology, and so on. Just as the fields of electrical and mechanical engineering summarize our knowledge of principles that govern the design of human-built machines, the field of evolutionary biology summarizes our knowledge of the engineering principles that govern the design of organisms, which can be

thought of as machines built by the evolutionary process (for good summaries, see Daly & Wilson 1984a; Dawkins, 1976, 1982, 1986; Krebs & Davies, 1987). Modern evolutionary biology constitutes, in effect, an “organism design theory.” Its principles can be used both to evaluate the plausibility of the psychology posited by the Standard Social Science Model and to guide the construction of a better successor psychology.

### **The Peculiar Nature of Biological Functionality**

In certain narrowly delimited ways, then, the spontaneous process of evolution parallels the intentional construction of functional machines by human action. But, whereas machines built by human engineers are designed to serve a diverse array of ends, the causal process of natural selection builds organic machines that are “designed” to serve only one very specialized end: the propagation into subsequent generations of the inherited design features that comprise the organic machine itself.

Because design features are embodied in organisms, they can, generally speaking, propagate themselves in only two ways: (1) by solving problems that will increase the probability that the organism they are situated in will produce offspring, or (2) by solving problems that will increase the probability that the organism’s kin will produce offspring (Hamilton, 1964; Williams & Williams, 1957). An individual’s relatives, by virtue of having descended from a common ancestor, have an increased likelihood of having the same design feature as compared to other conspecifics, so their increased reproduction will tend to increase the frequency of the design feature. Accordingly, design features that promote both direct reproduction and kin reproduction, and that make efficient trade-offs between the two, will replace those that do not. To put this in standard biological terminology, design features are selected for to the extent that they promote their inclusive fitness (Hamilton, 1964). For clarity, we will tend to call this propagation or design-propagation.

Selection, then, is the only known account for the natural occurrence of complexly organized functionality in the inherited design of undomesticated organisms. Moreover, selection can only account for functionality of a very narrow kind: approximately, design features organized to promote the reproduction of an individual and his or her relatives (Dawkins, 1986; Williams, 1966). Fortunately for the modern theory of evolution, the only naturally occurring complex functionality that has ever been documented in plants, animals, or other organisms is functionality of just this kind, along with its derivatives and by-products. Mammals evolved adaptations to produce milk to feed their own young, infectious micro-organisms mimic human biochemistry to escape immune surveillance so they can survive and reproduce, and plants produce oxygen as a waste product of feeding themselves through photosynthesis, and not for the pleasure of watching humans breathe or forests burn. Of course, human breeders artificially intervene, and one could easily imagine, as an alternative to a Darwinian world, a benevolent deity or extraterrestrial being creating the properties of living things in order to serve human convenience rather than the organisms’ own reproduction. Wild horses could be born with saddle-shaped humps, luggage racks, and a spontaneous willingness to be ridden; chronic bacterial infections could jolt humans with caffeine every morning 45 seconds before they need to get up. Similarly, the non-living world could be full of intricate functional arrangements not created by humans, such as mountains that naturally mimic hotels down to the details of closet hangers, electric wiring, and television sets. But this is not the world we live in. We live in a

world of biological functionality and its derivatives, traceable originally to the operation of natural selection on reproducing systems (Darwin, 1859; Dawkins, 1976, 1986). To be able to understand the world of biological phenomena, one must be able to recognize this peculiar functional organization and distinguish it from the products of chance.

Of course, the fact that living things are machines organized to reproduce themselves and their kin does not mean that evolutionary functional analysis focuses narrowly on such issues as copulation or pregnancy (things intuitively associated with reproduction) over, say, taste preferences, vision, emotional expression, social categorization, coalition formation, or object recognition. A life history of successfully achieved reproduction (including kin reproduction) requires accomplishing the entire tributary network of preconditions for and facilitations of reproduction in complex ecological and social environments. Of course, this includes all of the information-gathering, inference, and decision-making that these tasks entail. For this reason, humans display a diverse range of adaptations designed to perform a wide and structured variety of subsidiary tasks, from solicitation of assistance from one's parents, to language acquisition, to modeling the spatial distribution of local objects, to reading the body language of an antagonist.

Finally, the behavior of individual organisms is caused by the structure of their adaptations and the environmental input to them; it is not independently governed by the principle of individual fitness maximization. Individual organisms are best thought of as adaptation-executors rather than as fitness-maximizers. Natural selection cannot directly "see" an individual organism in a specific situation and cause behavior to be adaptively tailored to the functional requirements imposed by that situation. To understand the role of selection in behavior, one must follow out all steps in the chain: Selection acting over evolutionary time has constructed the mechanisms we have inherited in the present, and it is this set of mechanisms that regulates our behavior—not natural selection directly. These mechanisms situated in particular individuals frequently—but by no means always—bring about a functional coordination between the adaptive demands of particular situations and associated behavioral responses.

Thus, the biological concept of functionality differs from the folk notion of functionality as goal-seeking behavior. Although some of our evolved psychological mechanisms probably operate through goal-seeking, surely none of them has fitness-maximization as a mentally represented goal (see Symons, this volume). Those goal-seeking mechanisms that do exist most likely embody proximate goals, such as "stay warm" or "protect your infant," rather than ultimate goals, such as "maximize your fitness" or "have as many offspring as possible." Indeed, goals of the latter kind are probably impossible to instantiate in any computational system (Symons, 1987, 1989, this volume; see also Barkow, 1989; Cosmides & Tooby, 1987, 1992; Daly & Wilson, 1988; Irons, 1983, p. 200; Tooby & Cosmides, 1990b. For somewhat contrary views, see, e.g., Alexander, 1979, 1987 and Turke, 1990).

For this reason, an adaptationist approach does not properly involve explaining or interpreting *individual* behavior in specific situations as "attempts" to increase fitness (Symons, 1989, this volume; Tooby & Cosmides, 1990b). To make the distinction between these alternative views of evolutionary explanation clear—humans as fitness-maximizers (fitness-teleology) versus humans as adaptation-executors (adaptationism)—a brief example will serve. Fitness teleologists may observe a situation and ask

something like, “How is Susan increasing her fitness by salting her eggs?” An adaptationist would ask, instead, “What is the nature of the evolved human salt preference mechanisms—if any—that are generating the observed behavior and how did the structure of these mechanisms mesh with the physiological requirements for salt and the opportunities to procure salt in the Pleistocene?” So, in viewing cases of behavior, the adaptationist question is not, “How does this or that action contribute to this particular individual’s reproduction?” Instead, the adaptationist questions are, “What is the underlying panhuman psychological architecture that leads to this behavior in certain specified circumstances?” and “What are the design features of this architecture—if any—that regulate the relevant behavior in such a way that it would have constituted functional solutions to the adaptive problems that regularly occurred in the Pleistocene?”

### ***What Adaptations Look Like***

For the reasons outlined above, the species-typical organization of the psychology and physiology of modern humans necessarily has an evolutionary explanation and an evolutionarily patterned architecture. This is not a vague speculation or an overreaching attempt to subsume one discipline inside another, but constitutes as solid a fact as any in modern science. In fact, this conclusion should be a welcome one because it is the doorway through which a very rich body of additional knowledge—evolutionary biology—can be brought to bear on the study of psychological architecture. At its core, the discovery of the design of human psychology and physiology is a problem in reverse engineering: We have working exemplars of the design in front of us, but we need to organize our sea of observations about these exemplars into a map of the causal structure that accounts for the behavior of the system. Psychology has never been limited by a lack of observations. Fortunately, the knowledge that humans are the product of evolution supplies us with a powerful set of tools—the concepts of evolutionary functional analysis—for organizing these observations into useful categories so that the underlying systems of order can be discerned.

The most illuminating level of description for organizing observations about living species is usually in terms of their adaptations (and associated evolutionary categories). This system of description has some warrant on being considered a privileged frame of reference because the complex functional organization that exists in the design of organisms was injected into them through the construction of adaptations by natural selection. Adaptations are the accumulated output of selection, and selection is the single significant anti-entropic or ordering force orchestrating functional organic design (Dawkins, 1986). So if one is interested in uncovering intelligible organization in our species-typical psychological architecture, discovering and describing its adaptations is the place to begin.

To understand what complex adaptations “look like,” it will help to begin concretely with a standard example, the vertebrate eye and its associated neural circuitry. (For its role in understanding adaptations, see Pinker & Bloom, this volume; for a discussion of color vision, see Shepard, this volume.) The eye consists of an exquisitely organized arrangement of cells, structures, and processes, such as (1) a transparent protective outer coating, the cornea; (2) an opening, the pupil, through which light enters; (3) an iris, which is a muscle that surrounds the pupil and constricts or dilates the aperture, regulating the amount of light entering the eye; (4) a lens, which is both transparent and flexible, and whose curvature and thickness can be adjusted to bring objects