Review of General Psychology
2003, Vol. 7, No. 2, 150–182

1089-2680/03/$12.00 DOI: 10.1037/1089-2680.7.2.150

The Tree of Knowledge System and the Theoretical Unification of Psychology

Gregg Henriques
University of Pennsylvania

The outline for theoretically unified psychology is offered. A new epistemological system is used to provide a unique vantage point to examine how psychological science exists in relationship to the other sciences. This new view suggests that psychology can be thought of as existing between the central insights of B. F. Skinner and Sigmund Freud. Specifically, Skinner's fundamental insight is merged with cognitive neuroscience to understand how mind emerges out of life. This conception is then joined with Freud's fundamental insight to understand the evolutionary changes in mind that gave rise to human culture. By linking life to mind from the bottom and mind to culture from the top, psychology is effectively boxed in between biology and the social sciences.

> We have a surfeit of facts. What we do not have, and most of us in the quiet of our nights know it, is an overarching conception of context in which we can put these facts and, having done so, the truth then stands a chance of emerging. (S. B. Sarason, 1989, p. 279)

It is well known that there currently is no unified theory of psychology. There is so much ambiguity and so many theoretical schisms that students are taught to be skeptical of any unified approaches. In his popular book *How to Think Straight About Psychology,* Keith Stanovich (2001) characterized the difficulty in theoretically uniting the field as follows:

> The diversity of psychology guarantees that the task of theoretical unification will be immensely difficult. Indeed, many in psychology would argue that such a unification is impossible. Others, however, are searching for greater unification within the field . . . . *No matter what their position on the issue, all psychologists agree that theoretical unification will be extremely difficult and that such a unification will occur years in the future, if it is to occur at all* [italics added]. (p. 3)

Stanovich further commented that many who first learn the subject matter are disappointed to discover the absence of a unifying perspective. However, he ultimately minimized the problems associated with disunity and suggested that the diversity of approaches in psychology is a strength.

Although I applaud Stanovich's pluralistic approach from a political perspective, I take a different view on the issue of theoretical disunity. My view is similar to the one held by Arthur Staats (1983), who has articulated the problems associated with disunity as clearly as anyone. He observed:

> Psychology has so many unrelated elements of knowledge with so much mutual discreditation, inconsistency, redundancy, and controversy that abstracting general meaning is a great problem. There is a crisis, moreover, because the disunification feeds on itself and, left unchanged, will continue to grow. (Staats, 1991, p. 899)

Others have expressed similar concerns. Paul Meehl (1978/1992) noted:

> It is simply a sad fact that in soft psychology theories rise and decline, come and go, more as a function of baffled boredom than anything else; and the enterprise shows a disturbing absence of that *cumulative* character that is so impressive in disciplines like astronomy, molecular biology and genetics. (p. 524)

As suggested by Meehl's quote, the value of a unified perspective is seen clearly in our sister discipline, biology. In the 1940s, the modern synthesis was forged when evolutionary theory

I would like to thank Kenneth Ford, David Geary, Paul Grant, Joe Moldover, and Russell Ramsey for their helpful comments on earlier versions of this article. I would also like to thank those individuals who contributed to the fruitful exchange on philosophical issues pertaining to cognitive and behavioral science on the Society for Science and Clinical Psychology Listserv.

Correspondence concerning this article should be addressed to Gregg Henriques, Department of Psychiatry, University of Pennsylvania, 2029 Science Center, 3535 Market Street, Philadelphia, Pennsylvania 19104. E-mail: henri@landru.cpr.upenn.edu

merged with the science of genetics (Mayr & Provine, 1998). Biologists from a wide variety of subspecialties such as evolutionary biology, biochemistry, population genetics, cytology, botany, and ecology came together and agreed that the science of life could be theoretically united. Natural selection operating on genetic combinations through time became the central organizing principle that provided the causal explanatory framework for observed biological complexity. This unification had a tremendous impact on the capacity of the field to organize itself. A shared mission, a shared language, and a shared conceptual foundation have allowed for much greater consistency, novelty of discovery, and accumulation of knowledge. The central role biological theory played in these developments is captured by Theodosius Dobzhansky's (1973) famous quote, "Nothing in biology makes sense except in the light of evolution." A twist on this quote might capture the current state of affairs in psychology: "Nothing in psychology makes sense."

Recent Proposals on Unification

But is the theoretical unification of psychology a genuine possibility? Despite the daunting nature of the task, there has recently been a small but growing interest in unified approaches to the field (e.g., Gilgen, 1987; Magnusson, 2000; Newell, 1990). Gregory Kimble (1996) offered an approach to unification in the neobehaviorist tradition called "functional behaviorism" in which he outlined five Newtonian-like principles that he argued provide the framework for unifying psychology. Norman Anderson (1996) offered a functional theory of cognition called information integration theory that attempts to account for the phenomenology of everyday experience. Positing that thought and action must be understood in terms of goal directedness, Anderson developed a functional theory of measurement to map human "cognitive algebra" and applied this framework to many diverse areas in psychology such as psychophysics, person perception, judgment and decision making, emotional reactions, and ego defenses. In contrast to both Kimble and Anderson, who emphasize unifications from behavioral and cognitive perspectives, respectively, Sternberg and Grigorenko (2001) offered a "unified psychology," which they defined as "the multiparadigmatic, multidisciplinary, and integrated study of psychological phenomena through converging operations" (p. 1069). These authors argued that the field should be organized around psychological phenomena (e.g., learning or prejudice), as opposed to specific disciplines (i.e., social), particular schools of thought (i.e., cognitivist), or single methodologies.

Staats (1963, 1996) has articulated perhaps the most ambitious approach to unification. Called psychological behaviorism, Staats's approach explicitly attempts to build bridges both within the various fields in behavioral science and between behaviorism and traditional psychology (e.g., social and personality). Staats described his work as an interlevel, interfield theory that cuts across the various disciplines in the field and uses simpler phenomena to explain more complex phenomena. Staats (1996) anchored his model to an evolutionary biological account of emotions and articulated how animals build "basic behavioral repertoires" throughout their development by learning to approach positive emotional stimuli and avoid negative emotional stimuli. Staats used this model as a building block for more complex models of human cognitive phenomena, such as language, and thus linked behavioral theory with higher cognitive processes. Like Anderson, he has applied his framework to many diverse areas.

A Problem of Epistemology

These frameworks seek to provide a solution to psychology's increasing problem of disunity and should be applauded as such. However, despite the laudable ambitions, I believe that the current approaches are not sufficient because they fail to provide a broad, clear epistemological framework that sets the stage for defining the discipline and coherently unifying the major paradigms in the field. When one asks *basic* questions of these proposals such as "How are life, mind, culture, and behavior defined?" or "How is psychology specifically differentiated from biology from below and the social sciences from above?" or "How are the key insights from neuroscience, psychodynamic theory, evolutionary theory and genetics, behavioral science, cognitive science, systems theory, and social constructivist perspectives retained and integrated into a coherent whole?" answers are not readily forthcoming. Instead, these perspectives either struggle with or remain silent on these big questions.

According to this analysis, then, current unified approaches have failed not because they have been too general but because they have not been general enough. What is needed is a metatheoretical framework that crisply defines the subject matter of psychology, demonstrates how psychology exists in relationship to the other sciences, and allows one to systematically integrate the key insights from the major perspectives in a manner that results in cumulative knowledge. Metaphorically, each "key insight" can be viewed as a piece of the larger puzzle. And, as with completing a puzzle, the more pieces that are filled in, the clearer the overall picture. Furthermore, as the puzzle is completed, it will become increasingly clear as to which theoretical pieces do not fit into the overarching scheme.

In fitting the pieces together, what have traditionally been "either–or" epistemological splits become "both-and-neither" answers. The argument here is that the schisms between cognitive and behavioral science perspectives, distal/nature and proximal/nurture perspectives, psychodynamic and behavioral therapeutic perspectives, and constructivist and empiricist epistemological perspectives are the consequences of incomplete, partially correct knowledge systems being defined against one another in a manner that is more political than scientific. These fragmented, politically antagonistic mini-epistemologies create a buzzing, confusing mass of information that prevents cumulative understanding. Some basic epistemological agreement about the phenomena under examination is needed prior to healthy scientific disagreement about particular issues. Without such prior agreements, opponents cannot agree on the questions to ask, which greatly limits the value of answers offered by the empirical process. In fact, several have argued that psychology is a "would be" science because, unlike the "true" sciences of physics and biology, it has been unable to generate a consensually agreed upon conceptual framework that guides its scientific endeavors (Staats, 1999).

One needs to look no farther than the ideas of B. F. Skinner and Sigmund Freud, perhaps the two greatest figures in psychology, to see that markedly contrasting views have been taken. Each proposed a grand theory that has had a tremendous impact on the field. Yet, the two perspectives appear to be wholly incompatible. Skinner pejoratively dismissed "mentalistic" approaches and placed the focus on the causal role of the environment in the selection of behavioral responses. He also took an extreme fact-based approach to science and even questioned the need for deep theoretical constructs in psychology. The foundational database for his behavioral selection paradigm was the behavior of animals in the laboratory. Conversely, Freud's psychoanalytic paradigm was unabashedly mentalistic in nature. Stemming from observations of troubled humans free-associating on a couch, Freud wove together powerful insights with wild speculations and formulated an elaborate but ultimately unfalsifiable grand theory of the human mind. Of course, both Freud and Skinner are much maligned in opposing circles, and the vast majority of psychologists view each of their respective paradigms as incomplete and at least partially incorrect. Yet, both Skinner and Freud remain pillars of the field, and there is not currently a way to blend the insights of the two together in a coherent fashion.

According to this analysis and in direct contrast to those who argue that unification is impossible (e.g., Koch, 1993; Messer & Winokur, 1980), a unified approach can coherently unite the ideas of Skinner and Freud using the same overarching system, one that clearly spells out the errors and inconsistencies in each paradigm while retaining the key theoretical insights from both perspectives. Of course, students of psychology are not offered such a system. Instead, as highlighted by the quotation from Stanovich offered earlier, students are simply taught about the diversity of ideas and left to their own devices to sort out the issues. The current proposal seeks to change this status quo. The outline of a system is offered that I propose aligns the central insights of Skinner and Freud both with one another and with science at large. More specifically, I show how the science of psychology can be thought of as existing between the central insights of Skinner and Freud. In putting these pieces of the puzzle together, I offer a way to clearly define the field and provide a metatheoretical framework that can incorporate the major theoretical perspectives into a coherent whole.

The Tree of Knowledge System: A Proposal for a Universally Agreed Upon Representation of Scientific Knowledge

The advertisement that one could coherently unite the ideas of Skinner and Freud in a manner that provides a unified approach must be acknowledged to be a particularly audacious claim. The proposition is based on a new system of knowledge called the Tree of Knowledge (ToK) System. The ToK System is formally presented in Figure 1.

In his seminal work *Consilience: The Unity of Knowledge*, Edward O. Wilson (1998) presented a grand vision of how all knowledge, from quantum mechanics to culture, might be organized into a single overarching framework. The ToK System is constructed in the tradition of consilience, and, by offering a visuospatial representation of the entire system, it considerably advances Wilson's formulation. The tremendous advantage of the visuospatial Gestalt is that it simultaneous defines extremely broad concepts (e.g., life and mind) and defines how they exist in relationship to one another in a single, coherent knowledge system. The system of interlocking definitions ultimately provides the potential framework for a universally shared conceptual foundation and definitional system from which scientists from all disciplines could work. To more fully understand the message the ToK System communicates, it is useful to briefly review the evolution of complexity as told by modern science.

The Evolution of Complexity From Big Bang to Present

In accordance with modern cosmology, the ToK System assumes that the universe began as an energy singularity (Gribbin, 1998). Approximately 15 billion years ago, there was a chain reaction in the energy singularity called the "Big Bang," in which the pure energy quanta began to freeze into chunks of matter, called fermions (Ferris, 1997). Fermions are the fundamental units of matter that come in two types, quarks and leptons, and ultimately interact to form all of the matter in the universe (Greene, 1999). The Big Bang also generated the continuums of space and time (Hawking, 1998). As the universe expanded and cooled, subatomic particles formed into atomic systems. Large collections of gases condensed and formed into stars and galaxies. A wide variety of energy–matter environments emerged, which in turn resulted in the formation of a variety of different types of atoms.

In particular environments that are neither too hot nor too cold, atoms link up through the process of covalent bonding and create increasingly complex chemical systems. The chemical systems on the Earth's surface 4 billion years ago exhibited a wide variety of algorithmically complex behaviors (Maden, 1995), and one particular class of these behaviors was self-replication (Lifson, 1997). Through the process of replication, variation, and selection, these self-replicating chemical systems became increasingly complex and eventually formed into huge strands of ribonucleic acid (Maynard-Smith & Szathmary, 1999). Over the next several hundred million years, these self-replicating chemical machines transformed into prokaryotes (primitive cells that lack a nucleus), then eukaryotes (cells with a nucleus), and finally into large-scale, multicellular organisms (Dennett, 1995). This period from 4 billion years to 700 million years ago saw the evolution of life through natural selection operating on genetic systems.

Between approximately 640 and 550 million years ago, a new type of multicellular creature emerged, called animals (Gould, 1989). Animals are unique in that they are multicellular organisms that move around their environment (Boakes, 1984). The capacity for movement resulted in the evolution of a computational control center that measures the animal's relationship to its environment and moves the animal toward beneficial environments and away from harmful environments (Hoyle, 1964). This computational control center is, of course, the nervous system. The nervous system represents a fundamental shift in complexity because the behavior of animals is not fully restricted to the unfolding of the genetic program encoded in the deoxyribonucleic structure. Instead, animals generate new behavioral outputs in response to novel environmental stimuli. The period from 640 million years ago to 5 million years ago saw the evolution of the animal mind.

The period from 5 million years ago through today saw the emergence of culture, which occurred for one particular animal, the human

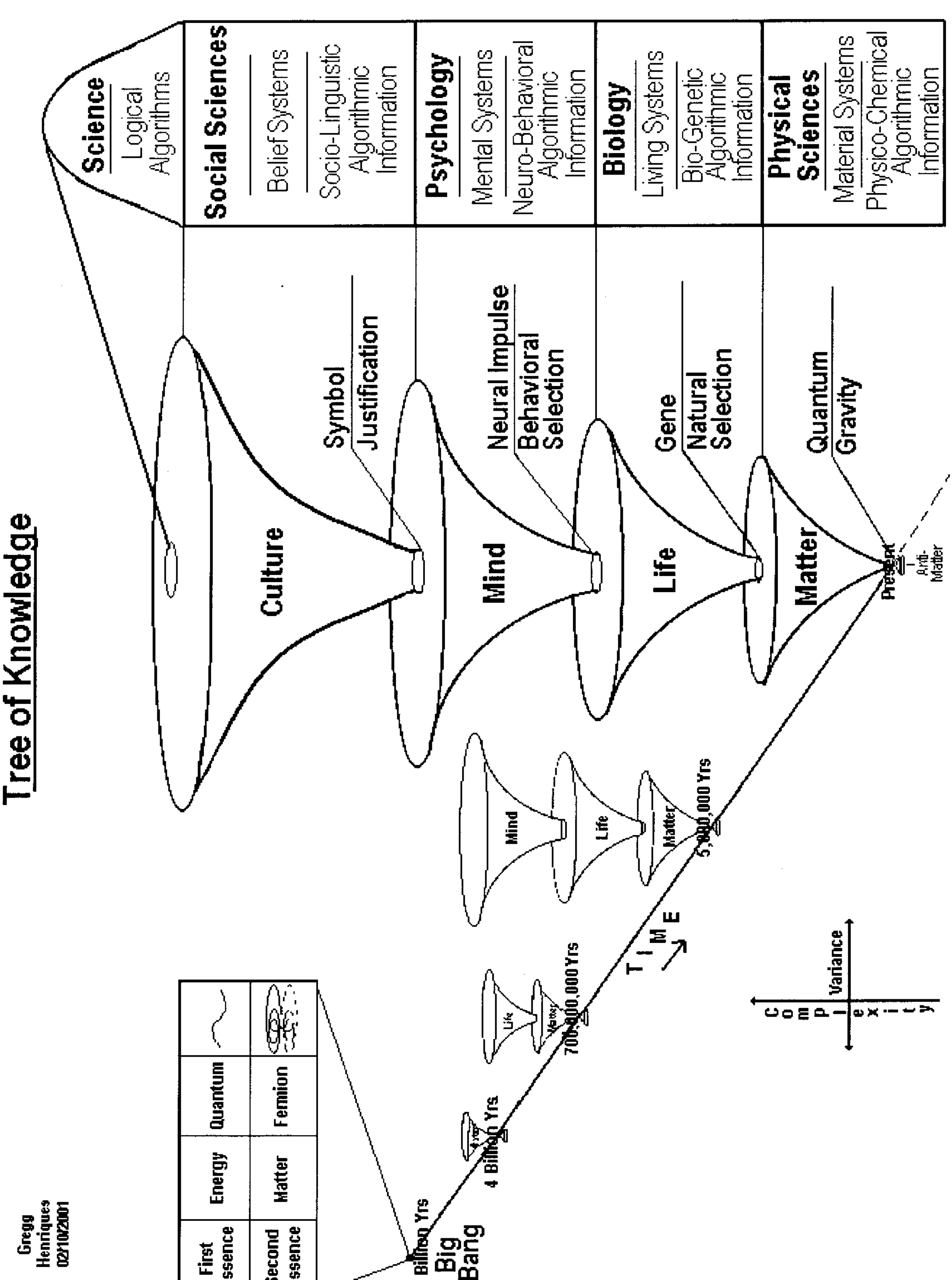

Figure 1. The Tree of Knowledge system.

animal.[1] Bipedalism had clearly emerged by 3.5 million years ago (Leaky & Lewin, 1992), and by 1.4 million years ago *Homo erectus*, one of our hominid ancestors, was making complicated hand axes (Mithen, 1996). The evolution of human language is generally thought to have occurred anywhere between 2 million and 50,000 years ago (Bickerton, 1995; Lieberman, 1998; Pinker, 1994). This period is associated with substantial growth of the cortical structures, as well as changes in throat structures associated with language. This time period is also associated with the emergence of modern humans.

Between 60,000 and 40,000 years ago, there was an explosion of cultural artifacts, such as carved statues, artwork in caves, and burials with ornamentation (Bahn, 1996). Modern humans began to appear in landscapes all over the world (Stringer & McKie, 1997). And the pace of change only accelerated. Agriculture appeared approximately 12,000 years ago, setting the stage for large-scale civilizations (Bronowski, 1974). Systems of belief emerged that coordinated the behaviors of huge populations of people. These belief systems branched into different domains such as religion, law, mathematics, and philosophy. Such systems of belief can be considered justification systems, in that they provide a framework for which actions are legitimate and which actions are not. The ToK System suggests that science is a particular branch in the evolution of justification systems built on the value of accuracy. The right side of the ToK System depicts how science emerged out of culture and functions to mathematically map complexity and change (Hawking, 1998; Wilson, 1998).

Presenting the Familiar in an Unfamiliar Way

The ToK System is essentially a picture of the evolution of complexity, as presently mapped out by science. The metaphor of the tree is used to illustrate how various branches of complexity emerged from more basic beginnings. The ToK System is unique in that it shows how scientific models of emergent complexity exist in relationship to one another in an incredibly parsimonious way. Returning to the puzzle metaphor, the ToK System provides a way to frame the puzzle of scientific knowledge and observe how scientific theories exist in relationship to one another on the dimensions of time and complexity. This new and extraordinarily broad view sets the stage for new insights.

The most significant aspect of the ToK System is that it presents a four-stage model in the hierarchical evolution of complexity. Each stage corresponds to a new dimension of algorithmic information sparked by a complexity-building feedback loop. The first stage is the evolution of material complexity or Matter, which was sparked by the Big Bang and resulted in the Energy-to-Matter transformation and the beginning of time. The second stage is the evolution of biological complexity or Life, which was sparked by natural selection operating on self-replicating chemical systems. The third stage is the evolution of neuronal complexity or Mind, which I argue was sparked by the capacity for behavioral selection emerging out of the interaction of neuronal patterns. The fourth stage is the evolution of symbolic complexity or Culture, which I argue was sparked by the capacity for justification emerging out of human communication patterns.

The four-stage model of emergent complexity allows for a much clearer vision of the correspondence between stages in the evolution of complexity and fundamental divisions in science. As depicted and is generally well known, the physical sciences correspond to the material layer of complexity and the biological sciences correspond to the genetic layer of complexity. However, the ToK System also corresponds the psychological sciences to the neuronal layer of complexity and the social sciences to the symbolic layer of complexity. This basic correspondence goes a long way toward clarifying confusing issues. As mentioned earlier, a unified theory of psychology must provide clear conceptual definitions of large concepts. Table 1 offers a four-category conception of the universe of scientific knowledge that consists of four fundamental levels of complexity, existence, and computation and four fundamental

[1] Several authors have suggested that other animals possess culture (e.g., Bonner, 1980; Wrangham & McGrew, 1994). Culture is defined here in terms of shared justification systems based on symbolic language (discussed in more detail later). Using this definition, it is argued that only humans have culture.

Table 1
Category Grid

Level of complexity	Class of science	Level of existence	Class of objects	Level of computation	Class of behavior
Culture	Social	Self-aware	Human	Symbolic	Sociolinguistic
Mind	Psychological	Mental	Animal	Neuronal	Neuropsychological
Life	Biological	Animate	Living	Genetic	Biogenetic
Matter	Physical	Inanimate	Material	Quantum	Physicochemical

classes of science, objects, and behavior. When combined with the ToK System, Table 1 provides a framework for the conceptual definitions proposed here.

The ToK System further suggests that the four fundamental levels of complexity are each associated with a theoretical joint point. A theoretical joint point can be defined as a causal explanatory framework that accounts for the emergence of one of the four fundamental levels of complexity. Thus, according to the ToK System, the Big Bang is the first joint point, because it provides the conceptual framework for Matter emerging out of Energy. Natural selection operating on genetic combinations across the generations is the second theoretical joint point and provides the framework for Life emerging out of Matter. Both of these theories are well known and well established in their respective scientific disciplines. It should be stated that the ToK System is dependent on the validity of these two grand theories and would be invalidated in the unlikely event that either one of these theories were demonstrated to be inaccurate. Some may question whether it makes sense to offer a theory of psychology that is ultimately dependent on ideas that, at first glance, appear so remote from the subject matter at hand (particularly the Big Bang). The reason is that the ToK System functions as a *system*, and it derives much of its heuristic utility and overall explanatory power from the symmetry and parallelism in its depiction. If that symmetry and parallelism is shown to be wrong, the definitional system (or at least very key elements of it) on which it is built collapses.

If the Big Bang and the modern synthesis represent the first two joint points, what about the third and fourth theoretical joint points? There is not currently a well-demarcated Life-to-Mind joint point. Even less clear is the theoretical joint point separating Mind and Culture. It is here that the ToK System brings conceptual clarity to previously confusing issues. To jump ahead to the conclusion, I argue that the ToK System shows why Skinner's ideas, when combined with cognitive neuroscience, provide the framework for the Life-to-Mind joint point and why Freud's ideas, when anchored to a coherent model of the nonverbal mind, provide the framework for the Mind-to-Culture joint point. Together, these two theoretical joint points "box in" psychology and provide a unified theoretical framework for the field. I turn first to Skinnerian psychology.

Critique of Skinnerian Psychology

Skinner's behavioral selection or operant paradigm is one of the most misunderstood sets of ideas in psychology (Catania & Harnard, 1988). This is particularly unfortunate because Skinner's ideas offer a wonderfully elegant way to understand the evolution of behavioral complexity through an animal's lifetime. In addition, Skinner's ideas are, contrary to the opinion of many, quite consistent with evolutionary theory, ethology, neurophysiology, and genetics. And there is nothing about the concept of behavioral selection per se that prevents it from being integrated with a cognitive neuroscience perspective. Yet, integration has not been achieved. Why?

Ironically, and despite his brilliance, Skinner himself is as much to blame as anyone. First, Skinner incorrectly equated his behavioral selection paradigm with a fatally flawed epistemological system that mistakenly construed the nature of the scientific enterprise. Observationally based description and control formed the cornerstone of his philosophy of science, and all else was deemed extraneous (Skinner, 1950). Yet, the ultimate goal of pure science is not to control behavior, as Skinner incorrectly argued.

Instead, the fundamental task of pure science is to develop mathematical models of complexity and change (Hawking, 1998; Wilson, 1998).

A second reason Skinner is to blame is that he never provided legitimate justification for his refusal to accept a neuro-information-processing view of the nervous system. Skinner certainly never explained why the nervous system could not be an information-processing system, nor did he ever explain why such a system could not have evolved. Instead, Skinner's primary argument was that it was unnecessary and thus unhelpful to view the nervous system as an information-processing system. But given the success of cognitive science, Skinner's claims were more likely a function of the fact that cognitive science challenged his radical behavioral epistemology rather than being unhelpful in any objective sense.

The third and most important problem with Skinner's system is that he never effectively defined either mind or behavior. Although he eschewed the mental versus physical distinction, Skinner repeatedly insisted that "private events" such as a "toothache" could be the subject of scientific inquiry. In *Verbal Behavior* (1957), he equated "thinking" with "behaving." But experiencing a "toothache" and "thinking" are clearly different kinds of behavior than scratching one's nose, and simply defining them all as "physical behavior" sidesteps this obviously complicated issue. It is fairly easy to understand how the biomechanical contractions of various muscle sequences result in observable arm movements. Yet, it is not so easy to understand how the behavior of neurons gives rise to thinking and feeling. The difference is not merely in the vantage point of the behaviorist, as Skinner's "overt" versus "covert" distinction of behavior might lead one to believe. Instead, the question of specifically how the behavior of the brain results in thoughts and feelings is ignored by Skinner's epistemological system. Contrasting Skinner's avoidance of this issue, the question of how the behavior of the brain gives rise to thoughts and feelings is one of the central questions of cognitive neuroscience (Crick, 1994; Gazzaniga, 1995).

Skinner also failed to effectively define the term *behavior*. He readily acknowledged that behavior is not easily defined, commenting that "there is no essence of behavior" (Skinner, 1988b, p. 469), although this was not a significant concern for him. A problem arises, however, because the term *behavior* is used inconsistently. Sometimes the term is used in a general sense, such as "movements that generate measurable effects." Other times it is used in a specific sense, such as "change that can be understood as the function of the operant." This variation in usage is problematic, because it results in *behavior* being used in mutually exclusive ways. For example, sometimes the term is used to connect what psychologists study to what other "real" scientists study, as in "unlike those Freudian folks, we are a real science because we study and measure behavior." Yet, sometimes the term is used in *precisely the opposite manner*. That is, the term is used to differentiate what psychologists study from what other scientists study, as in "psychology is the science of behavior," which is supposedly different from what biologists study. Thus, the same term, *behavior*, is used to justify connection with other sciences in some circumstances and used to justify differentiation from other sciences in other instances. If the same term can be used for two mutually exclusive purposes, there is a problem with it.

A bottom-up perspective clarifies the issues further. The most general definition of behavior is change in an object–field relationship, which can be algorithmically represented as $(X)(Xo)t1 - (X)(Xo)t2$, where X is the object, Xo is the field (not X) and t is time. This is important because it highlights that all sciences are sciences of behavior. Physics is the science of the behavior of objects in general. Particle physicists study the behavior of very small objects (e.g., fermions) using quantum theory, and cosmologists study the behavior of very large objects (e.g., galaxies) using the theory of relativity (Greene, 1999). If it is agreed that physicists study the behavior of objects in general, then it logically follows that other scientists study the behavior of certain objects in particular. Chemists study the behavior of molecular objects; biologists study the behavior of living objects. This analysis highlights that there are obviously significant problems with defining psychology as "*the* science of behavior." It is not the fact that animals behave that makes them unique; it is that they behave so differently from other objects. The key then becomes defining the subset of behaviors that psychologists study.

Behavioral Investment Theory as the Life-to-Mind Joint Point

Specifying the types of behaviors that psychologists study and why these are legitimately defined variables is an immensely important but obviously confusing issue. Much of this confusion stems from complicated epistemological issues and the schism between cognitive and behavioral science. I submit here that the concept of behavioral investment provides the framework for uniting cognitive and behavioral science. As such, behavioral investments and the processes by which animals make them provide a reasonable conception for the subject matter of psychological science. To understand why the subset of behavioral investments of animals provides the appropriate demarcation between psychology and biology, it is useful to more closely analyze the joint point between biology and chemistry.

The Modern Synthesis as the Matter-to-Life Joint Point

The modern synthesis resulted from the merger of the selection science of evolution with the information science of genetics and provided the framework to differentiate biology from chemistry (e.g., Maynard-Smith & Szathmary, 1999). George Williams (1966) summed up the issues as follows:

> The acceptance of this account of the origin of life implies an acceptance of the key position of the concept of adaptation as at least an abstract criterion whereby life may be defined and recognized. We are dealing with life when we are forced to invoke natural selection to achieve a complete explanation of an observed system. In this sense the principles of chemistry and physics are not enough. At the least one additional postulate of natural selection and its consequence, adaptation, are needed. (p. 5)

Richard Dawkins (1999) similarly described how "living matter introduces a *whole new set of rungs to the ladder of complexity*" [italics added] (p. 113) through natural selection operating on genetic combinations across the generations. Although genes are coordinated populations of molecules, individual molecules are not "small" genes. Genes are irreducible points of complexity and can be conceptualized as digits of biochemical information. In this light, biology can be thought of as the study of genetic language generated by the complexity-building feedback loop of natural selection. Utilizing the parallelism suggested by the ToK System, the question arises that if Life can be conceptualized as a fundamentally irreducible layer of emergent complexity generated by a feedback loop of variation, selection, and retention, can we consider Mind similarly? I argue yes. Indeed, this is very nearly the way B. F. Skinner conceptualized it.

Mind and the Behavior of the Animal-as-a-Whole

Although Skinner never effectively defined behavior, he did offer a unique and powerful way to conceptualize it. Skinner frequently used the phrase "the behavior of the organism-as-a-whole" (e.g., Skinner, 1990) to define the subject matter of his operant paradigm. Given the importance of precise definitions, it is important to note that Skinner's phrase "behavior of the organism-as-a-whole" is slightly unfortunate because it is overinclusive. Plants are organisms and one could argue that, in some respects, trees behave "as-a-whole," but the behavior of trees is not of much interest to a psychologist. It is the behavior of animals with a nervous system that is of interest.

What Skinner's analyses (along with many others) demonstrated is that animals behave as a whole in a manner that produces a functional effect on the animal–environment relationship. Moreover, Skinner meticulously documented how the behavior of the animal-as-a-whole was influenced depending on the functional effects or consequences the behavior produced. Skinner termed these functional environmental effects that influence the likelihood of future behaviors *operants*, and he most eloquently articulated how animal behaviors that produce certain effects are selected for (i.e., are reinforced), whereas behaviors that failed to produce certain effects are selected against (i.e., are extinguished).

Skinner's brilliance was that he realized that the ontogenetic evolution of behavioral complexity could be conceptually modeled in precisely the manner in which Darwin explained the evolution of biological complexity (Skinner, 1966, 1981). Variation and selection by consequences provided the theoretical framework (Donahoe, Burgos, & Palmer, 1993). Thus, Skinner had discovered psychology's theory of evolution.[2] Unfortunately, as Darwin lacked knowledge of genetics, Skinner never appreciated that an information-processing view of the nervous system provided a proximal explanation for his observations.[3]

Given the preceding discussion that it is not behavior in general that psychologists are attempting to define, but a specific subset of behavior, it is useful to suggest that the important element in Skinner's oft-used phrase is not "behavior" but the specifier "animal-as-a-whole." Focusing on this element of the expression allows one to more clearly see the problem of animal behavior and what differentiates the behavior of animals from that of other organisms. Animals behave as units that produce specific, predictable effects on the animal–environment relationship. With this clarification, it can readily be argued that the expression "as a whole" is too banal to capture the unique element of animal behavior. Instead, I would suggest that *coordinated singularity* is preferred, as it better captures the fact that it is because animals behave as coordinated singularities that their behavior is so unique and mysterious. It also highlights that this is the subset of behaviors, rather than behaviors in general, that psychologists should be trying to explain. Of course, it is the nervous system that allows animals to behave as coordinated singularities. Thus, according to this analysis, and in direct contrast to Skinner's (1950) antitheoretical stance regarding the conceptual nervous system, psychologists need the structure of the nervous system and the informational concept of the neural impulse to explain how animals behave, in much the same manner that biologists need the structure of DNA and the informational concept of the gene to explain the behavior of organisms in general.

With these clarifications, we can now ask how one might connect Skinner's behavioral selection paradigm with cognitive[4] science. There is a familiar saying in the cognitive science community that the mind is what the brain does. If the mind is what the brain does, we should then ask, What does the brain do? The usual answer from the cognitive scientist is that the brain processes information. Traditionally, this is where the radical behaviorist objects and the break in understanding occurs. However, an evolutionary perspective provides an intriguing and obvious but also different answer to the question of what the brain does. The nervous system evolved to coordinate the movement of the animal-as-a-whole (e.g., Adrian, 1935; Hoyle, 1964). The key defining elements that differentiate multicellular animals from other organisms are the capacity for free movement and the presence of the nervous system. Thus, the information-processing component highlighted by cognitive scientists is actually a means to an end. Coordinated movement of the animal as a whole is why we have nervous system complexity, or mind.

The phylogenetic functional base then provides the framework for unification between the cognitive and behavioral positions. If cognitive scientists study the mind and the mind is what the brain does and what the brain does is coordinate the behavior of the animal-as-a-whole and Skinner's operant paradigm is the study of the behavior of the animal-as-a-whole, then what has been an irresolvable schism becomes two sides of the same coin. Behavioral science can now be conceptualized as a *third-person perspective* that views animal behavior as information and attempts to systematically describe

---

[2] It would be legitimate to challenge this implication because the behavioral selection paradigm was in place well before Skinner. For example, Edward L. Thorndike clearly adopted a behavioral selectionist paradigm (Donahoe, 1999). The argument here is that Skinner deepened and promoted our understanding of behavioral selection more than anyone else.

[3] Of course, one could rightly point out that an important difference here is that Darwin did not know about genetics, whereas Skinner had exposure to the neuro-information-processing models of the brain; he simply disagreed with them.

[4] The term *cognitive* is a confusing term with many different connotations. Sometimes the term is used in the broad sense to refer to general neural information processing (e.g., Neisser, 1967; Reed, 1996), and sometimes it is used in a narrow sense, as in "cognition is different from motivation and emotion." I am using the term here in its broad sense, which includes concepts such as perception, motivation, and affect. Such processes are clearly present in animals as well as humans (Roth & Wulliman, 2001). Adding to the overall confusion here is the fact that the substantial majority of cognitive psychologists study human cognition, which is, as discussed later, different in important ways from animal cognition, the most notable difference being symbolic information processing (e.g., Deacon, 1997). Thus, there is much in the cognitive versus behavioral debate that is obscured by the fact that cognitive psychologists generally focus on humans, whereas behaviorists study and think in terms of animal behavior.

the functional relationships in the changes between the animal and its environment. Cognitive neuroscience can be conceptualized as a complementary *first-person perspective* that views the brain as an information processor and attempts to systematically map the changes within the nervous system that correspond to the changes between the animal and its environment. Causal preeminence is granted neither to changes within the nervous system nor to changes outside the animal. Instead, both sets of changes are conceptualized as sets of effects generated by an unfolding wave of causality synonymous with time.

Given this analysis, mind equals the behavior of the animal-as-a-whole in the sense that what makes the behavior of animal objects unique is that they behave as coordinated singularities that produce a systematic, functional effect on the animal–environment relationship. Cognitive neuroscience and cybernetics provide the framework for how the nervous system coordinates the behavioral expenditures of the animal-as-a-whole through the hierarchical arrangement of neuro-information-processing structures (e.g., Geary, 1998; Powers, 1973; Pribram, 1986). Thus, just as the science of life was united by the selection science of evolution with the information science of genetics, the science of mind is, according to the ToK System, united by the selection science of behaviorism with the information science of cognitive neuroscience.

Behavioral Investment Theory

Behavioral investment theory (BIT) is a theory of the conceptual nervous system and a formal proposal for the Life-to-Mind theoretical joint point. It can also be thought of as the outline of a unified theory of animal behavior. BIT posits that the nervous system evolved as an increasingly flexible computational system that computes and coordinates the behavioral expenditure of energy of the animal-as-a-whole. Expenditure of behavioral energy is computed on an investment value system built phylogenetically through natural selection operating on genetic combinations and ontogenetically through behavioral selection operating on neural combinations (see Johnston, 1999, for computer simulations of precisely such formulations). As such, the current behavioral investments of the organism are conceptualized as the product of the two vectors of phylogeny and ontogeny. Figure 2 offers a graphic representation of these two vectors and uses the two vectors to identify the focus of various disciplines. In such a formulation, BIT links distal causation with proximal causation under the same concept of behavioral investment. With these clarifications, the four fundamental postulates of BIT can be stated as follows:

1. The nervous system evolved as a computational control center that coordinates the behavior of the animal-as-a-whole (e.g., Hoyle, 1964).

2. Genes that tended to build neurobehavioral selectors that expended behavioral energy in a manner that positively covaried with inclusive fitness were selected for, and genes that failed to do so were selected against. Thus, inherited tendencies toward the behavioral expenditure of energy are a function of ancestral inclusive fitness (e.g., Hamilton, 1964).

3. In ontogeny, behavioral investments that effectively move the animal toward animal–environment relationships that positively covaried with ancestral inclusive fitness are selected for (i.e., are reinforced), whereas behavioral investments that fail to do so are extinguished (e.g., Thorndike, 1905).

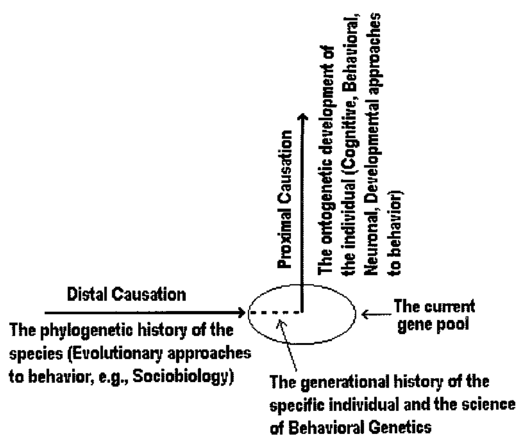

Figure 2. Behavioral investments as a function of the two vectors of phylogeny and ontogeny.

4. The current behavioral investments of an animal can be understood as a function of the two vectors of phylogeny and ontogeny (Skinner, 1966; Figure 2).

As discussed earlier, unified approaches to psychology must provide a framework for conceptual agreement, such that the key insights from various perspectives can be integrated into a more coherent whole. As illustrated in Figure 3, BIT is a proposed amalgamation of five broad domains of thought: evolutionary theory and genetics, behavioral science, cognitive science, cybernetics/control theory, and neuroscience. BIT claims to be deeply consistent with each of these domains of thought and builds bridges between them. For example, those familiar with ethological or behavioral ecological approaches will likely point out that BIT closely parallels their conception of animal behavior (e.g., Eibl-Eibesfeldt, 1989; J. R. Krebs & Davies, 1997; Tinbergen, 1951). Parental investment theory (Trivers, 1971) and optimal foraging theory (e.g., Stephens & Krebs, 1986) are two powerful ideas that are outgrowths of a very similar conception of nervous system complexity. Dawkins (1999) spelled out a "neuro-economic" model of behavioral investment that is very similar, if not identical, to the one offered by BIT. In describing how genes might build neuronal learning mechanisms, he wrote:

> One way for genes to solve the problem of making predictions in rather unpredictable environments is to build in the capacity for learning. Here the program may take the form of the following instructions to the survival machine: "Here is a list of things defined as rewarding: sweet taste in the mouth, orgasm, mild temperature, smiling child. And here is a list of nasty things: various sorts of pain, nausea, empty stomach, screaming child. If you should happen to do something that is followed by one of the nasty things, don't do it again, but on the other hand, repeat anything that is followed by the nice things." The advantage of this sort of programming is that it greatly cuts down the number of detailed rules that have to be built into the original program; and it is also capable of coping with changes in the environment that could not have been predicted in detail. (Dawkins, 1989, p. 57)

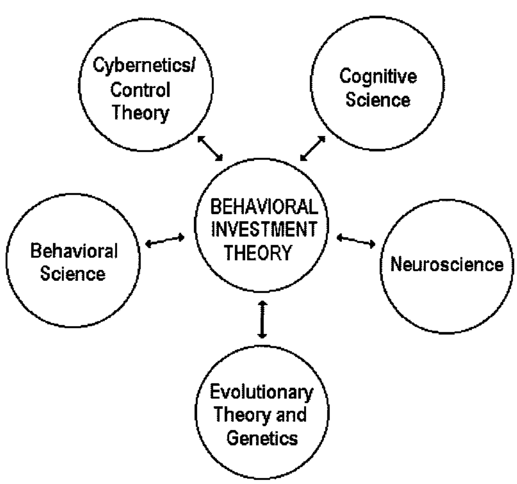

Figure 3. Behavioral investment theory and the five major brain–behavior paradigms.

But evolutionary theorists are not the only ones who have this conception of the nervous system. Skinner was also deeply concerned with the evolution of behavior, and those familiar with Skinner's work on the evolution of operant conditioning will see that BIT has a familiar ring to it (e.g., Skinner, 1984). Although Skinner might have objected to some of Dawkins's "vernacular," he would have surely agreed with the general principle. Indeed, he voiced precisely such a conception on several occasions. For example, Skinner (1974, p. 38) argued that "contingencies of survival cannot produce useful behavior if the environment changes substantially from generation to generation, but certain mechanisms have evolved by virtue of which the individual acquires behavior appropriate to a novel environment during its life time." Unfortunately, prominent sociobiologists and evolutionary psychologists have tended either to ignore Skinner completely or paint him in an unfavorable light (e.g., Pinker, 1997; Tooby & Cosmides, 1992; Wilson, 1975), and opportunities for merging evolutionary psychology with Skinner's evolutionary behaviorism have been missed. Skinner was "anti-cognitive," but he was surely not "anti-biological." As he put it, "All behavior is due to genes, some more or less directly, the rest through the role of genes in producing structures which are modified during the lifetime of the individual" (Skinner, 1988a, p. 430). In short, Skinner's behavioral selection paradigm has BIT as an implicit, if not explicit, understanding.

Those in cognitive neuroscience (e.g., Damasio, 1998; Gazzaniga, 1992), cognitive psychology (e.g., Broadbent, 1958), and cognitive psychotherapy (e.g., Beck, 1999) have all voiced a very similar conception of the nervous system suggested by BIT. For example, Aaron

T. Beck argued that personality is a collection of evolved behavioral strategies that facilitate the solving of adaptive problems. He has further pointed out that much of psychopathology can be effectively conceptualized as a mismatch between individuals' inherited behavioral strategies and their current environmental niche (Beck, 1999). Thus, the phylogenetic by ontogenetic conception of computed behavioral investment is highly consistent with the various cognitive approaches to psychology.

A control theory or cybernetic model is also directly consistent with BIT (Miller, Galanter, & Pribram, 1960). Perceptual control theory (Powers, 1973) provides a particularly powerful model that explicitly builds conceptual bridges between behavioral and cognitive approaches (Cziko, 2000). In this negative feedback loop model, animals work to reduce discrepancies between current states and computationally referenced goal states. A particularly fascinating element of the model is that it is explicitly both a neurocomputational model and a selectionist model. The nervous system is proposed to select perceived consequences that move the animal toward neuronally represented goal states. Also, in contrast to the strict environmental causation model imbedded in radical behavioral epistemology, the control theory view effectively allows for an animal-centered point of view. The legitimacy of taking an animal-centered point of view can be demonstrated with a question: "If the environment can 'select' behavioral responses, why can't the animal?"

BIT is also consistent with developments in behavioral neuroscience and more recent developments in behavioral economics (see Staddon, 2001). A behavioral neuroscience perspective begins with the phylogenic functional conception of the nervous system held by BIT. As Lord Adrian (1935), one of the founding fathers of neurophysiology, wrote, "The chief function of the nervous system is to send messages which will make the body move effectively as a whole" (cited in Cotman & McGaugh, 1980). One of the central features emerging from the behavioral neurosciences is the presence of two broad biobehavioral systems, one of activation–approach and one of inhibition–avoidance (e.g., Carver & White, 1994; Fowles, 1994). These two systems are directly consistent with BIT's neuro-economic conception of the selection of behavior. The behavioral activation system mobilizes the animal to approach animal–environment relationships that positively covaried with past phylogenetic–ontogenetic success, and the behavioral inhibition system mobilizes the animal to avoid those animal–environment relationships that negatively covaried with phylogenetic–ontogenetic success (see Davidson & Tomarken, 1989; Gray, 1987). Importantly, recent theoretical work has linked these two broad biobehavioral systems to extraversion and neuroticism, two of the Big Five personality factors (e.g., Watson, Wiese, Vaidya, & Tellegen, 1999), resulting in a link between the two previously disparate disciplines of factor-analytic personality theory and behavioral neuroscience.

Neural Darwinist (Edelman, 1989, 1992) models of brain development also are consistent with the variation, selection, and retention model offered by BIT. In these models, neural nets that are used become increasingly strengthened and interconnected, whereas neural nets that are not die out. Likewise, recent work on selectionist approaches to adaptive neural networks has provided promising avenues that link behavioral science with cognitive science and neuroscience (e.g., Donahoe et al., 1993; Tryon, 1993). A further advantage of BIT is that it is consilient with the physical sciences. As illustrated by the ToK System, energy is the most fundamental substance in the universe and can be thought of as the ultimate common denominator. Physicists define energy as the capacity to do work (e.g., Gribbin, 1998). In accordance with the second law of thermodynamics, animals are viewed as behavioral investors that must work to maintain animal–environment relationships conducive to survival and reproductive success. The focus of BIT on efficient energy expenditure links psychology with chemistry and physics, as well as biology.

What is new about BIT is that it finds a core of agreement and builds bridges between extant theoretical perspectives. In so doing, a conceptual framework is provided that demonstrates that the splits and schisms between cognitive–behavioral and proximal–distal approaches are mirages resulting from faulty epistemological systems and are more the consequence of defining paradigms against one another than genuine irreconcilability. In this new light, psychology becomes a cognitive–behavioral neuroscience (or the science of mind, brain, and behavior of the animal-as-a-whole) built on an evolutionary foundation. Animal behavioral investments and the neurocognitive processes associated with them become the central dependent variables for psychological science. And with the ToK System, BIT provides an explicit way of understanding the Life-to-Mind joint point. Just as Life is the product of Darwinian evolution operating on genetic combinations through the generations, Mind is the product of Skinnerian evolution operating on neural combinations through ontogeny.

Human Behavior Is Not Fully Explained by Behavioral Investment Theory

I propose that most in cognitive neuroscience, behavioral science, behavioral genetics, ethology, and sociobiology would agree with the broad conception offered by BIT. Certainly, there will be points of disagreement and calls for clarification. However, the more one says, the more there is to disagree with, and I have intentionally used broad strokes in the picture I have painted to facilitate the identification of points of agreement in the move toward greater unification.

Nonetheless, there are likely many in psychology who would fundamentally disagree with the picture I have painted, at least in the sense that the picture is not complete. Personality and social psychologists, cultural psychologists, developmental psychologists, and psychodynamic psychologists (to name a few) would all likely have serious reservations about the adequacy of BIT as a unifying theory of psychology. If my hypothesis about those in psychology who would disagree with me at this juncture is correct, an important point is raised. It would be primarily those who study human behavior who would argue that BIT is an incomplete explanatory framework. Perhaps they would grant that BIT does provide a framework for understanding the behavior of nonhuman animals. However, it is an observational fact that the behavior of humans is different from and in many ways discontinuous with the behavior of other animals. Thus, it is unrealistic to suppose that the same theory could be used to unify the behavior of animals and humans. This objection presents us with a conundrum, because humans are animals and any unified theory of animal behavior must be consistent with human behavior.

The ToK System again helps us make sense out of potentially confusing issues. The symmetry and parallelism that allowed us to use the Matter-to-Life joint point to make sense out of the Life-to-Mind joint point can now be used to understand the Mind-to-Culture theoretical joint point. Life was differentiated from Matter through a complexity-building feedback loop (Darwinian evolution) that generated genetic computational systems. Likewise, Mind was differentiated from Life through a complexity-building feedback loop (Skinnerian evolution) that generated neuronal computational systems. Thus, both biology and psychology were differentiated from the sciences beneath them by the emergence of new computational systems. The question can then be asked if there is a new computational system associated with the development of Culture. Thankfully, an obvious answer presents itself. Humans are capable of symbolic information processing in a manner that is fundamentally different than other animals (Deacon, 1997). As such, we can use the parallelism in the ToK figure to state that just as animals represent a subset of living objects that cannot be fully explained by biology, humans represent a subset of animal objects that cannot be fully explained by psychology.

The ToK System also suggests that to build a more complete causal explanatory framework for the behavior of human objects, we need a theory of the emergence of Culture. The capacity for symbolic information processing (i.e., language) is obviously a key element in the solution to the question of what differentiates humans from nonhuman animals. This has been suggested by many and is surely an important piece of the puzzle. However, it is not enough simply to say that humans are verbal and other animals are not. Instead, we need a more precise way of understanding the functional relationship between the verbal and the nonverbal mind if we are to understand that which links human behavior to and differentiates human behavior from the behavior of nonhuman animals. And to achieve this understanding, we need to turn to the Freudian paradigm.

Critique of Freudian Psychology

There is a large rift between Freudian and academic psychology. As with the philosophical schisms between cognitive–behavioral and proximal–distal approaches, the split between academic and Freudian psychology has had a detrimental impact on the field. Like Skinner, Freud is much to blame for the difficulties. He was dogmatic about his claims, and followers either pledged allegiance to the basic propositions of the psychoanalytic paradigm or became neo-Freudians. Compounding the problem of espousing an unchallengeable and unfalsifiable creed was the fact that Freud was wrong about many of his basic propositions. He claimed that there was a death instinct, and he was wrong. He argued that all drives were the derivatives of two motives, sex and aggression, and he was wrong. He argued that human females were biologically destined to be jealous of human males, and he was wrong. To be succinct, he was wrong in too many ways to count. But that he was often wrong does not mean that he was not also often correct (Westen, 1998). If we agree that Freud made significant contributions to our knowledge of human psychology, it must also be agreed that the fact that academic psychology pays so little attention to Freud is problematic. As is often the case in therapy, the task is to identify the dysfunctional split and to search for avenues that allow for a more functional integration.

To accomplish such an integration, it is essential to keep two key points in mind. First, to empathize more effectively with Freud's system of thought, it is necessary to remember both the method he used to acquire data for his theory and the cultural context in which both he and his patients were immersed. Emerging around the turn of the century in Victorian Europe, psychoanalysis is a pluralistic term that refers to a body of theory, the process of analyzing behaviors in terms of symbolic meanings and unconscious motives and conflicts, and a method of treatment centered on a long-term process of free association and interpretation (Aiken, 1993). The sociocultural backdrop and the contextual interrelationships among method, process, and structure in psychoanalysis are necessary to appropriately frame the issues and extract general meaning. The absence of such a frame can lead either to an early, blanket dismissal of Freudian thought as a collection of absurdities or to an unfortunate drowning in the metaphorical bottomless pit that characterizes much of psychoanalytic thinking.

Second, it is important to acknowledge that psychoanalysis proper is not a true scientific discipline and was constructed in a manner that prevented it from becoming one. The lack of objectively anchored definitions and concepts, the lack of falsifiability, the frequent pronouncements made with excessive certainty, and, perhaps most important, a conceptual framework anchored to blatantly incorrect and outmoded ideas regarding the nature of life and mind have all contributed to effectively render psychoanalytic theory proper closer to astrology than to astronomy, at least in terms of its scientific status. However, this dead horse has been beaten repeatedly, and it is unnecessary to engage in yet another flogging here. Taken together, these two elements mean that to repair the dysfunctional split between Freudian psychology and psychological science, we should return to Freud's observations and place them in the context of modern scientific understanding.

Updating Freud's Biology

The id was Freud's core biological component of the psyche. As he summarized it, "It contains everything that is inherited, that is present at birth" (Freud, 1940/1949, p. 14). Unfortunately, Freud was ignorant of information science and genetics, and his conception of evolution was as much Lamarckian as it was Darwinian (Rivto, 1990). As a consequence, Freud's conception of the id as an energy force seeking discharge was flawed. We should not blame Freud for this, as evolutionary theory was not well understood at the turn of the century. However, what should have been done is that psychoanalysis should have been updated on the basis of modern biology. Unfortunately, the lack of a scientific approach renders the formal psychoanalytic paradigm ineffective at self-correction.

There have been, of course, many neo-Freudians who have put forth conceptions of human motivation that are more consistent with evolutionary theory and genetics than classic Freudian drive theory (e.g., Adler, Horney, and Sullivan). John Bowlby's attachment theory is perhaps the most significant and successful bridge between psychoanalytic theory and ethology, and, more recently, several theorists have put forth eloquent presentations that explicitly attempt to align Freud's conception of the id with modern evolutionary theory. Bailey (1987) proposed a "sociobiological id." Slavin and Kriegman (1992) suggested that psychoanalytic theorists "take a gene's eye view" in understanding inherited motivational tendencies. Epstein (1994) proposed a cognitive–experiential model of mind that joins key elements of Freud's model with evolutionary theory and modern cognitive science.

In short, and as is well known, Freud's hydraulic model of a biological life force seeking to discharge energy is badly outdated. However, when one takes a more conciliatory approach, many of the parallels between Freud's id and BIT offered here become clear. Freud's id represents the biological component of the psyche, and BIT is anchored to a modern phylogenetic conception of distal motivation. Freud's id provides the energy that drives behavior. BIT is a proposal for a nonverbal behavioral system that guides and coordinates the expenditure of behavioral energy. Although there are important differences between BIT's conception of efficient energy expenditure and Freud's hydraulic energy release model, there are important parallels as well. Freud proposed that the id operates on the pleasure principle. It can readily be argued that BIT operates on the "pleasure–pain parallel fitness principle," where "fitness" is conceptualized in terms of phylogenetic by ontogenetic selection. This last parallel becomes crucial when one considers the nature of Freud's animal ego.

The Parallels

Although many have conceptualized the id as Freud's "animal mind" (a conception strongly reinforced by Freud's famous metaphor of horse and rider representing the id and ego, respectively), this is not a fully accurate characterization. As Freud (1940/1949, p. 18) put it, "the assumption of a distinction between ego and id [in higher animals] cannot be avoided." Thus, according to Freudian theory, animals have egos too. This intriguing point raises the question of how exactly Freud conceptualized the relationship between the ego and the id.

In drive theory, the id provides the impetus for all behavior. Of course, reality does not allow for immediate gratification, and if an animal were to act on every id impulse, it would quickly perish. Because of the need for self-preservation, the animal must be able to inhibit its impulses, and this is the fundamental task of the ego. Operating on the famous "reality principle," the ego functions by constructing defenses that block potentially dangerous id impulses and guides them to more reality-based expressions. The ego is initially part of the id. However, as experience impinges upon it, it evolves into an increasingly sophisticated problem-solving device that, in proper development, manages a more and more sophisticated relationship between the demands of the internal and external world (Greenspan, 1989). The many tricks by which the ego accomplishes the task of reigning in and redirecting the id impulses are labeled defense mechanisms. According to Freud, then, behavior results from the dialectical tension between drive and defense.

What is remarkable about characterizing Freudian theory this way is the degree to which this conception of the animal mind corresponds to BIT. One can readily draw strong parallels between Freud's drive and defense conception and the various perspectives discussed earlier regarding BIT. The behavioral activation and inhibition systems of the behavioral neurosciences, reinforcement and punishment from a behavioral perspective, approach and avoidance from a motivational perspective, and benefits and costs from a neuro-economic perspective all line up rather directly with Freud's drive–defense conception of behavior.

Psychodynamic theorist Drew Westen (1997, 1998) has recently built bridges between Freud's ideas and psychological science. What is particularly remarkable about Westen's (1997) conclusions regarding the nature of motivation is that they directly parallel BIT in terms of both content and process. In regard to content, he explicitly acknowledged that modern evolutionary theory provides the backdrop for understanding the supraordinate goals that guide human behavioral investments. In regard to process, he also offered a selectionist account of behavior. Noting that the two broad affective–motivational systems of pleasure–approach and pain–avoid can be readily conceptualized as behavioral guidance systems, Westen argued that animal behaviors that elicit positive affects tend to be selected for and behaviors that elicit negative affects tend to be selected against.[5] The parallels between his system and Skinner's did not escape Westen, although he seemed more puzzled by the correspondence than excited. He wrote:

> Emotions and sensory feeling states channel behaviour in adaptive directions in organisms whose behaviour is not rigidly controlled by relatively automatic instinctive processes (see Plutchik, 1980; Sandler, 1981, 1987, 1989; Tomkins, 1960, 1980). Affects are mechanisms for the selective retention of behavioural and mental responses: that is, of the behavioural and mental processes a person produces, those that minimize aversive states or maximize pleasurable feelings will be more likely to be used again in similar situations. Affect is thus a mechanism for the "natural selection" of responses; regulation of affect becomes a way of adaptively regulating behaviour . . . . In this view—and paradoxically echoing one of the least psychoanalytic thinkers in twentieth-century psychology, B.F. Skinner—where the natural selection of organisms leaves off, the natural selection of behaviour through learning begins. (Westen, 1997, pp. 529–530)

In short, recent psychodynamic formulations have argued for a conception of motivation and dynamic unconscious that is very similar to, if not identical with, the model offered by BIT. Given that the goal is conciliation and identification of points of agreement, the finding that BIT can be readily corresponded with a modern dynamic perspective is quite heartening. With the drive–defense dialectic of the id and animal ego captured by BIT, we can effectively turn our attention to Freud's most fundamental observation and begin to understand that which differentiates the human mind from the minds of other animals.

The Justification Hypothesis and the Mind-to-Culture Joint Point

The question of what differentiates humans from nonhuman animals has long occupied a central place in human discourse. According to the ToK System, human behavior reflects the fourth fundamental dimension in the evolution of complexity. In addition to the physicochemical, biogenetic, and neuropsychological processes that characterize the behavior of nonhuman animals, human behaviors are characterized by sociolinguistic processes.

As depicted in the ToK figure, the ToK System proposes that the process of justification provides the framework for linking the Mind and Culture levels of complexity, and I refer to the conceptual link between the two as the justification hypothesis (JH). The JH consists of three fundamental postulates, each of which is explored here in some detail. The first postulate is that Freud's fundamental observation was that there is a systematic relationship between conscious and unconscious processes. In particular, it is argued that Freud observed that conscious processes serve as a "justification filter" for unconscious motives. The second postulate is that the systematic relationship that Freud discovered suggests that the human self-awareness system exhibits a complex functional design that likely evolved through the process of natural selection. As such, I propose that the human ego evolved in response to the selection pressure created by the adaptive problem of justifying one's actions to others. The third postulate is that the first two postulates provide the framework for understanding the emergence of large-scale justification systems. In so doing, the JH provides the scientific foundation for a unified theory of culture. I turn now to the first postulate.

Freud's Fundamental Observation

To my knowledge, Freud never explicitly differentiated the human ego from the animal ego. Instead, he made the differentiation between conscious and unconscious processes.[6] The demarcation between conscious and unconscious processes parallels the demarcation between the animal and human ego because, for Freud, consciousness was intimately associated with symbolic language. As Freud (1923/1960, p. 10) stated, if we are to ask " 'How does a thing become conscious?' . . . the answer would be: 'Through becoming connected with the word-presentations corresponding to it'." He went on to state: "Thinking in pictures is, therefore, only a very incomplete form of becoming conscious . . . . It stands nearer to unconscious processes than does thinking in words, and it is

[5] Note that this formulation is very similar to Staats's (1996) three-function learning theory.

[6] As those familiar with psychodynamic theory will be aware, Freud differentiated between primary and secondary processes as well, also loosely paralleling the animal–human distinction (Epstein, 1994). Primary process is a more primitive mode of immediate responding to the environment and is differentiated from secondary processes, which are characterized by the more logical, realistic mode of reasoning of which humans are capable.

unquestionably older than the latter both ontogenetically and phylogenetically" (1923/1960, p. 11). Thus, consciousness in psychoanalytic theory is more closely related to self-awareness and access to information than it is to the concept of sentience (see Pinker, 1997, pp. 134–136), and the conscious aspects of the human ego are essentially equivalent to what is meant by "self" or "I" (McWilliams, 1994).[7]

With these clarifications about the conscious and unconscious aspects of the human ego made, we are now in a position to examine what I am claiming to be Freud's most fundamental observation. Freud observed that there are systematic reasons behind the reasons that people give for their behavior. In analytic language, Freud discovered the dynamic unconscious. Many others have similarly argued that this was Freud's most fundamental contribution (e.g., Jones, 1955; Westen, 1999). Freud was, of course, not the first to question the completeness of the conscious rationales people offered for their behavior. However, he was by far the most influential individual in articulating the systematic nature of the relationship between conscious and unconscious thought. Freud noted that because humans must contend with the sociolinguistic context and must determine what behaviors are legitimate to express and what behaviors are not, humans have a capacity that allows them to internalize the acceptable rules of conduct, which he called the superego. Freud merged this notion with the conception of the id and animal ego discussed earlier. In essence, then, Freud ultimately observed that the justifications that people offer for why they do what they do could be understood as arising from the inherent tension between biopsychological drives that guide behavior and the sociolinguistic system in which the individual is immersed.

In conjunction with determining those behavioral responses that are justifiable, the human ego is confronted with two tasks. First, it must inhibit behaviors that are not socially legitimate. The process of inhibiting socially unjustifiable impulses was the earliest focus of Freud's attention, and he considered repression, the unconscious process by which such impulses are inhibited, to be the cornerstone of the psychoanalytic paradigm (Eagle, 1998). As Anna Freud (1966) put it:

> The defensive situation with which we have been longest familiar in analysis and of which our knowledge is most thorough is that which forms the basis of neurosis in adults. The position here is that some instinctual wish seeks to enter consciousness and with the help of the ego to attain gratification. The latter would not be averse to admitting it, but the superego protests. The ego submits to the higher institution and obediently enters into a struggle against the instinctual impulse, with all the consequences which such a struggle entails. (pp. 54–55)

A second and related task the human ego must accomplish is that it must develop acceptable justifications for behaviors that are expressed. Simply put, one must generate a legitimate reason for why one does what one does. The importance and ubiquity of the process of developing such justifications is seen clearly in Nancy McWilliams's (1994) characterization of the ego defense mechanism known as rationalization:

> The defense of rationalization is so familiar that it hardly needs explication here. Not only has this term seeped into common usage with a connotation similar to the one used in psychoanalytic writing, it is also a phenomenon that most of us find naturally entertaining—at least in others. "So convenient a thing it is to be a *reasonable Creature*," Benjamin Franklin remarked, "since it enables one to find or make a Reason for everything one has in mind to do." [italics in original] (quoted in K. Silverman, 1986, p. 39) . . . .
>
> The more intelligent and creative a person is, the more likely it is that he or she is a good rationalizer. The defense operates benignly when it allows someone to make the best of a difficult situation with minimal resentment, but its drawback as a defensive strategy is that virtually anything can be—and has been—rationalized. People rarely admit to doing something just because it feels good; they prefer to surround their decisions with good reasons. Thus the parent who hits a child rationalizes the aggression by allegedly doing it for the youngster's "own good"; the therapist who insensitively raises a patient's fee rationalizes the

[7] If the conscious component of the human ego can be considered the self, the question arises as to how the unconscious portion of the human ego might be conceptualized. In connection with BIT, the unconscious portion of the human ego can awkwardly be characterized as the "human animal ego." The general nature of the human animal ego can be seen by taking a cross section of behavioral patterns exhibited by all of the great apes. The common denominators can provide a framework for understanding our "animal nature." In this light, the human animal ego can be thought of as the behavioral investment part of the mind that works through visuospatial information processing and motivational–affective behavioral guidance systems. It closely corresponds to what Epstein (1994) called the experiential system.

> greed by deciding that paying more will benefit the person's self-esteem; the serial dieter rationalizes vanity with an appeal to health. (pp. 124–125)

In summary, the processes of inhibiting unjustifiable impulses and generating acceptable rationales for those impulses that are expressed are some of the most basic elements of the Freudian paradigm.[8]

With the two central elements of the human ego conceptualized in terms of inhibition and justification, I can now state clearly the first postulate of the JH: Freud's fundamental observation was that the human ego or self-awareness system functions as a justification filter for underlying motives. We saw that Skinner's ideas became more readily integrated with other approaches when viewed from a modern phylogenetic functional perspective. The second postulate of the JH is that the systematic relationship between conscious and unconscious processes becomes much more readily understandable when one views the structural organization of the human self-awareness system as an evolved solution to the adaptive problem of justification.

The Evolution of the Human Ego and the Adaptive Problem of Justification

When confronted with complex functional designs in nature, it is useful to employ a reverse engineering perspective (Dennett, 1995; Pinker, 1997). A reverse engineering approach capitalizes on Darwin's fundamental insight that the complex functional design seen in organisms is a product of natural selection. Like a detective who matches a crime to a particular criminal, a reverse engineer matches organism design features to problems in the ancestral environment. This theoretical lock-and-key matching process is crucial because it serves as a guide to generating hypotheses about the evolved function of the characteristic in question (Mayr, 1983). As with a detective who must first determine that a crime has been committed, a reverse engineer must demonstrate that the characteristic in question exhibits a complex functional design. This is a crucial step in the process. Just as not all persons killed by gunshot are murder victims, not all biological characteristics are adaptations, a point eloquently elaborated on by sociobiological critics Gould and Lewontin (1979). As such, like a detective who can be too reckless and make unwarranted accusations or too cautious and fail to make reasonable ones, a reverse engineering theorist must navigate the dialectical tension between the Scylla of false positives and the Charybdis of false negatives.

If the presence of functional design is reasonably inferred, one then posits an adaptive problem that might account for the selection pressure that resulted in the present design. As with a detective who must establish motive, means, and opportunity for a suspect, a reverse engineer must effectively argue that the selection pressure was significant and that the design feature could have evolved given the phylogenic history. The explanation should be fundamentally consistent with available evidence, serve as a useful heuristic, offer a parsimonious account of the evidence available, and ultimately make falsifiable predictions.

Framed this way, the possibility arises that the human ego or self-awareness system evolved in response to some new selection pressure faced by our hominid ancestors. The second postulate of the JH is that the human ego or self-awareness system evolved because, for the first time in evolutionary history, our hominid ancestors had to justify their actions to others. In making the case, it is argued that the nature of human self-awareness is fundamentally different than that of other animals and that self-awareness is dependent on specific types of information-processing systems in the brain. It is also argued that the evolution of language must have created a fundamentally new adaptive problem for our human ancestors: the problem of justification. It is further proposed that

[8] There are, to be sure, many ego defense mechanisms other than repression and rationalization (e.g., Conte & Plutchik, 1995). However, I believe that viewing the human ego as a justification filter that must either inhibit or justify actions provides a framework for understanding many of the defense mechanisms. Denial, suppression, isolation, compartmentalization, and withdrawal, in addition to repression, represent a class of defenses that are characterized by the inhibition component. Rationalization, intellectualization, and moralization can all be readily understood as the development of justifications. Other human ego defenses, such as reaction formation and turning against the self (McWilliams, 1994), can be understood as combinations of inhibitions and justifications. For example, consider a reaction formation in a homophobic who clearly has homosexual fantasies. The function of the anti-homosexual belief system is to facilitate the repression of what the homophobic's superego perceives to be a deviant sexual urge.

the ability to effectively justify one's actions must have been directly related to the amount of social influence one achieved and, thus, was closely tied to reproductive success (see Robins, Norem, & Cheek, 1999, and Sedikides & Skowronski, 1997, for a discussion of related issues).

As with evidence such as fingerprints left at the scene by a perpetrator, this matching process leads to several implications. For example, this formulation clearly predicts that the human ego should be designed in such a way that it allows humans to effectively justify their actions to others in a manner that tends to maximize social influence. Some of the characteristics of the human ego, as elucidated by neuropsychology, social psychology, cognitive psychology, and developmental psychology, are reviewed to demonstrate that there is a large body of general human psychological research that is consistent with this proposition. It is concluded that the problem of justification is a prime suspect for a selection pressure that resulted in the evolution of the human ego. Stated differently, the argument will have been made that the human ego can be thought of as the mental organ of justification.

Evidence for a Human Self-Awareness System

A key element of the current proposal is that human self-awareness is fundamentally different than that of other animals. This is not a novel proposal. Many theorists and philosophers have suggested that it is the presence of the ego or self-awareness system that differentiates human consciousness from the consciousness of other animals. I have already discussed Freud's views. Dennett (1996) made the distinction between first-order and second-order intentional beings. A first-order intentional being has a mental life, consisting of beliefs and desires about many things, but not beliefs and desires about beliefs and desires. In short, first-order intentional creatures are aware, but not aware that they are aware. Second-order intentional beings, namely humans, have beliefs and desires about beliefs and desires; they are aware of their awareness. Likewise, Edelman (1989, 1992) distinguished between primary consciousness and higher order consciousness. He defined primary consciousness as the state of being mentally aware of things in the world, of having mental images of the present. Higher order consciousness is awareness of the self or the process of being conscious of being conscious. He argued that it is intimately tied to language and is only possessed by humans. Many others have made similar proposals[9] (e.g., Damasio, 1998; Dobzhansky, 1964; Duval & Wicklund, 1972; Epstein, 1994; Gould, 1993; James, 1890/1950; Kant, 1781/1996; Ornstein, 1972).

In addition to theoretical and philosophical arguments, there have been some empirical investigations of animal self-awareness. Such investigations are obviously difficult, but the ingenious technique of the mirror self-recognition (MSR) task developed by Gallup (1970) has yielded interesting results. Success at the MSR suggests at least a rudimentary cognitive capacity to become the focus of one's own attention. Success does not mean that the animal can introspect or be self-reflective (Mitchell, 1994). On the other hand, failure to succeed at the MSR task is a result that is much easier to interpret and is good evidence for the lack of any genuine capacity for self-awareness. What is remarkable, then, is that virtually all animals fail the MSR task. Only adult chimpanzees, bonobos, orangutans, and bottlenose dolphins seem to regularly pass the task. Even most adult gorillas fail to pass the test (Parker, Mitchell, & Boccia, 1994). Thus, the vast majority of organisms do not possess even the most basic cognitive capacities required for self-awareness. Humans generally pass the MSR task at approximately the age of 18 months. When one considers how adult humans explain their actions to others, worry about their death, develop myths to account for their existence, and plan their actions weeks, months, and even years in advance, the gulf in self-awareness between humans and even our nearest animal relatives is truly astounding.

Other empirical evidence comes from studies of individuals with brain injury. Neuropsy-

[9] As is often the case when discussing the nature of consciousness, there is potential for confusion here. Dennett's first-order intentionality and Edelman's primary consciousness loosely correspond to Freud's dynamic unconscious (primary processes), whereas the conscious portion of the human ego (secondary processes) in Freud's system corresponds to Dennett's second-order intentionality and Edelman's higher order consciousness.

chologists have demonstrated that there are linguistically based declarative memory systems in the brain that store information in a manner that allows the individual to consciously remember what happened (e.g., Schacter, 1993). In addition, brain damage can result in gross disturbances in self-awareness, a condition known as anosognosia (Schacter, 1990). Such individuals will often exhibit a remarkable, almost unbelievable, lack of self-awareness, often despite intact intellectual functioning as measured by intelligence tests. Examples include individuals who completely deny that half of their body is paralyzed or who report that they can walk despite being confined to a wheelchair (Barr, 1998). Many neuropsychologists explain these phenomena as disturbances in the self-awareness system (Amador & David, 1998). As discussed in more detail later, the language structures of the left hemisphere are intimately related to the human capacity for self-awareness. Anosognosia is the consequence of right hemisphere damage, and it has long been proposed that the damage results in the isolation of language structures in the left hemisphere that allow for self-reflection and self-reporting (Geschwind, 1965).

The enormous difference between human and animal self-awareness and the presence of neuro-information-processing systems that allow for self-awareness, in addition to the review of Freudian theory offered earlier, strongly suggests that the capacity to be aware of our perceptions, thoughts, and feelings is part of the complex functional design of the human brain. A reasonable inference from these observations is that the self-awareness system is a mental organ shaped by natural selection. However, the case is currently far from conclusive. It is still possible that the human ego is simply a byproduct of other evolved capacities. If a particular adaptive problem could be identified that has been present only in the hominid line and would require an elaborate self-awareness system, then the case that the human ego was the product of natural selection would be significantly strengthened.

Language and the Emergence of the Problem of Justification

Although there have been a few notable dissenters (e.g., Chomsky, 1972; Gould, 1987), most evolutionists and psycholinguists agree that human capacity for language evolved through the process of natural selection (e.g., Deacon, 1997; Pinker, 1994). These theorists note facts such as the following: Humans everywhere possess language; there is a developmental period in which children acquire language easily and rapidly; children learn to speak with remarkably little direct instruction; there are well-documented language processing centers in the brain; and the vocal chords of humans are elaborately constructed to allow for extremely complex sounds to be generated (Lieberman, 1998). Further, other animals (e.g., chimpanzees) can obtain only a crude approximation of human language despite immense training (Pinker & Bloom, 1992). Finally, groups of children raised in the absence of a native language have been known to develop a fully functioning language in as little as a single generation (Bickerton, 1995).

In addition to these elements, the capacity for language results in many advantages. It allows valuable information to be shared cheaply and effectively, which in turn allows for more synergistic and cooperative relationships (Pinker, 1997). Language also allows for the accumulation of information across the generations. Furthermore, the ability to symbolically represent perceptual objects and their transformations in the forms of nouns and verbs results in the capacity to elaborate, refine, connect, and remember a great number of new concepts (Deacon, 1997). Finally, the absence of useful alternative explanations makes the notion that the human capacity for language is a product of natural selection quite solid (Pinker, 1994).

Importantly for present considerations, language also provides a means to more directly access and assess the thoughts and intentions of others. Although chimpanzees can clearly send the message that they are angry or scared, without a symbolic language it is almost impossible for them to communicate the reasons why they feel that way. Humans are different. Unlike chimps, language allows humans to ask and be asked about the thought processes associated with their behaviors. Questions such as “Why did you do that?” “What gives you the right to behave that way?” and “Why should I trust you?” force the issue. Obtaining information about what others think, what they have done, what they plan to do is obviously important for navigating the social environment in modern times, and given that humans have always been an intensely social species, there is every reason to believe that it was equally essential in the ancestral past. As such, it is highly likely that as humans developed the cognitive–linguistic capacity to access another's thoughts, they did so with vigor (Barkow, 1992).

As a consequence of language, then, humans became the first organism that had to explain its thoughts and actions to others. To offer an explanation for one's behavior, one must have some degree of access to one's thoughts (Dennett, 1996). That is, to answer the question "Why did you do that?" one must be able to self-reflect and then translate those thoughts into a symbolic form that can be interpreted. This is the problem of justification.

Although we frequently offer reasons for why we do what we do, a moment's reflection reveals an important insight. The ability to generate such answers reflects an extraordinary computational capacity. Given that modern science cannot provide a coherent explanatory framework for human behavior in general, how is it possible that one could offer explanations for the behavior of a human in particular? If one cannot explain the general, explanations of the particular are hopeless. Indeed, from the standpoint of pure logic, until we have at least a generally agreed upon framework for understanding human behavior, we should technically answer "I do not know" to the question "Why did you do that?" (see Hofstadter & Dennett, 1981, for a philosophical discussion of similar issues). Of course, there are no human societies in which people, in the spirit of pure logic, never provide explanations for why they do what they do. Instead, humans everywhere construct elaborate linguistic systems of thought that attempt to provide a causal explanatory framework for their behavior and the behavior of the people around them.

Over the past two decades, there has been a dramatic increase in interest in how individuals form "folk" theories of their own mind and the minds of other people. Consistent with the view taken here, much of this research was sparked by considering the adaptive advantages associated with a skilled understanding of the social environment (Humphrey, 1976; Jolly, 1966). Furthermore, and consistent with the JH regarding the uniqueness of human capacities for understanding self and other, empirical research suggests that the "folk" psychological capacities of the other great apes pale in comparison with those of humans (Ponvinelli & Prince, 1998). The JH suggests that humans have such a strongly developed sense of folk psychology because they are the only species that has had to articulate what they think to others. Likewise, humans are the only animals that have had to evaluate the legitimacy of others' explanations.

However, accessing one's thoughts and feelings and generating an explanation of one's actions is only part of the problem generated by a sociolinguistic environment. Even if one were able to give a complete and accurate explanation for one's actions, it would not always be the best thing. The difficulty becomes readily apparent when one considers how different explanations given for behaviors result in different social reactions. If you strike a comrade with a stick, it matters whether you tell him it was done by accident or on purpose. If your mate finds you alone with an attractive member of the opposite sex, it matters how you explain the event. If you are bargaining with a stranger, you can get more resources if you emphasize that the resources you are trading are valuable, and so on. Different explanations result in different reactions because they communicate different things about the self to the listener. And, as everyone is likely to be aware, information about the self varies in the degree to which it is beneficial to be shared. Information that one is lazy, lying, ineffective, self-centered, or weak is often accurate but is obviously costly in terms of social influence. Communicating that one is in control, intelligent, moral, competent, fair, and honest is usually beneficial in terms of social influence.

An implication of this analysis, which has been offered by several evolutionary theorists (e.g., Alexander, 1979; Goleman, 1985; Trivers, 1985), is that people should be adept at some forms of self-deception. Furthermore, and consistent with the present formulation, there is a strong connection between psychodynamic theory and self-deception, and several theorists have noted the interrelationships between evolutionary analyses of self-deception and the psychodynamic models of conscious and unconscious processes (e.g., Nesse & Lloyd, 1992). Psychodynamic theorists Slavin and Greif (1995) put the issue as follows:

> Deception is a pervasive, universal intrinsic feature of all animal communication. In pursuit of their own inclusive fitness, organisms do not simply communicate to convey a truth about reality to others, but rather to convey a "presentation of self": to hide certain features and selectively accentuate others that they need or desire others to perceive. *The unique feature of human symbolic communication—its displacement from direct observation—greatly amplifies this power both to convey realities accurately and to hide them.* [italics added] (p. 149)

To summarize, effectively justifying one's actions almost certainly was a new, difficult, and extremely important problem for our ancestors to be able to solve, precisely the type of adaptive problem that would lead to strong selection pressures and rapid evolutionary change. Solving the problem of justification requires many new cognitive capacities such as self-representation, generating causal explanations for why one behaved in a certain way, and evaluating the legitimacy of others' actions. Furthermore, the problem of justification suggests that the evolutionary solution should involve a system of knowing that has more ready access to certain aspects of the self than other aspects of the self (i.e., access to information as to why the self behaved in a justifiable manner). Finally, several theorists have made connections between evolutionary analyses of self-deception and modern psychodynamic models of the human mind.

The Human Ego as the Mental Organ of Justification

The case has now been made that it is plausible that the human ego evolved to solve the problem of justification. The human self-awareness system exhibits a design indicative of natural selection and appears to be unique to the animal kingdom. It has also been shown that the problem of justifying one's actions to others is a problem unique to hominids and is ubiquitous in human affairs. As such, it is a plausible candidate for the selection pressure that gave rise to the human ego. As currently it stands, the JH is at the status of a good just-so story (Gould & Lewontin, 1979). To return to the detective metaphor, there appears to be good circumstantial evidence for the JH. We now need to examine the current scene and look for hard evidence. We can do this because the JH carries with it implications for how the human ego should be designed. If the human ego evolved because of the adaptive problem of justifying one's thoughts and actions to others, then the human self-awareness system should exhibit design features indicative of this. To be clear about the implications of the JH, it is useful to briefly compare and contrast the concept of justifications with pure explanations.

Justifications are the linguistic reasons we use to validate our actions or claims to others. If it is claimed that certain explanations validate certain actions, justifications inevitably involve claims about what ought to be. For example, justifications such as "I should be leader because I killed the most antelope," or "I hit him with a stick because he called me a liar," or "I am rewarding you because you received a good grade" involve claims about what ought to be. Because of this, justifications consist of both explanations and value-based claims. Accurate and inaccurate are not redundant with good and bad. For example, consider an abused wife who buys a gun and kills her husband. Everyone might agree on the facts of the case. However, some people will find her justification, "He controlled and beat me regularly," as legitimate and will believe that the woman should not be punished at all. Others will believe that this is not a good justification and think that she should be punished, perhaps even put to death. Conversely, in the case of pure explanations, accurate is defined as good and inaccurate as bad. Thus, justifications entail two separate dimensions (accuracy and value), whereas pure explanations are a special case of justifications in which the two dimensions are reduced to a single dimension (accuracy = value).

Comparisons between the ideological goals of the institutions of law and science help to make the differences between justifications and explanations clearer. The goal of law is to codify which behaviors are not justifiable, and the law functions as a system of interlocking justifications that formally define the rules of the society. On the other hand, the goal of science, at least in theory, is to factor out human values and to develop representations of reality that are as accurate as possible (Wilson, 1998). Of course, as many social constructivists have pointed out, explanations and justifications are not so neatly separated in the practice of science, or anywhere else for that matter. Nonetheless, the ideological goals of the two institutions help illustrate the conceptual distinction.

Because the law is a good example of a justification system, an analogy comparing the human ego with the role of defense attorney is helpful in clarifying the implications of the JH. If the adaptive problem created by language were simply the problem of self-explanation, we would expect the human ego to function similar to a court reporter. A court reporter simply translates the transactions of the trial into a symbolic record as accurately as possible. Likewise, if the primary function of the human ego is simply self-explanation, then individuals should work to convey information about the self as accurately as possible. Of course, the role of defense attorneys is quite different. They too must be concerned with the accuracy of their statements. However, they are also very goal oriented. They must explain their clients' actions in a manner that others will both believe and respond to favorably. Because the role of a defense attorney closely parallels the function of the human ego proposed by the JH, we can use the analogy to more clearly develop the predictions the JH makes for how knowledge about the self should be organized.

The interpreter function. Saying that you have no idea why your client did what he did is rarely a good defense. It is generally better to offer benign explanations so long as they make sense, and the JH proposes that the human self-awareness system functions to generate acceptable interpretations for one's behavior. An implication of this proposition is that people will generate reasons for their behavior even if the self-awareness system does not have access to necessary information. A unique circumstance in the field of neuropsychology actually allowed this implication to be explicitly examined.

Michael Gazzaniga (1992) found, through studying split-brain[10] patients, that the left hemisphere generates explanations about the behavior of the individual even when it does not have access to the necessary information. Gazzaniga found that if simple commands were flashed to the right hemisphere, such as "walk around" or "laugh," the patients would follow these commands (the right hemisphere does have rudimentary linguistic capacities). However, when asked to justify why they were performing these behaviors (walking or laughing), patients would confabulate a reason such as "I am going to get a drink" or "Because you guys are so funny." In other words, their ego justified their behavior in the absence of necessary information. That the human ego appears to be designed in such a way that it develops socially acceptable interpretations of the individual's behavior in the absence of complete information is a fundamental piece of evidence consistent with the JH. Gazzaniga (1992) characterized the system of cognitive processes that allows for these interpretations to occur as "the interpreter." He wrote:

> It is easy to imagine selection pressures promoting an interpreter mechanism in the human brain. A system that allows for thought about the implications of actions, generated by both others as well as the self, will grasp the social context and its meaning for personal survival . . . . Also, the interpreter function generates the possibility for human uniqueness . . . . I think that the built-in capacity of the interpreter gives each of us our local and personal color. (Gazzaniga, 1992, p. 134)

The self-serving bias. Defense attorneys are, by definition, biased in terms of how they explain their client's behavior, and they work to explain their client's behavior in a way that affords the most social influence. Thus, according to the JH, people should tend to explain their behavior and the things that happen to them in a manner that affords the most social influence. In an article titled "The Totalitarian Ego," Greenwald (1980) surveyed the vast social psychological literature on how information about the self is processed. He likened the human ego to a personal historian that is totalitarian and relentless in the manner in which it revises and fabricates history to make the individual seem more important, cognitively consistent, altruistic, and effective than the evidence would warrant. Taylor and her colleagues (Taylor & Brown, 1988, 1994; see also D. L. Krebs & Denton, 1997) concluded that most people (a) view themselves in unrealistically positive terms, (b) believe they have greater control over their environment than is actually the case, and (c) have a more rosy view of their future than the base rate data could justify. Interestingly, these researchers also demon-

[10] In split-brain patients, the left hemisphere can no longer communicate with the right hemisphere because the corpus callosum has been severed. Information flashed to the left visual field is only processed by the right hemisphere, and vice versa.

strated that such self-enhancing tendencies are positively related to mental health.

The tendency for people to evaluate themselves in an overly positive manner and to explain bad outcomes in terms of external causes and good outcomes in terms of internal causes has been confirmed in literally hundreds of psychological studies and can be considered one of the most robust findings in social psychology. Demonstrating the pervasiveness of this tendency, Friedrich (1996) found that after students were taught about the self-serving bias, they tended to see themselves as less self-serving than most, a phenomenon he humorously coined the "ultimate self-serving bias." As made clear by the defense attorney metaphor, because people will want relationships with more skillful, giving, powerful people, the more positive picture of oneself one can justifiably paint, the better.

Cognitive dissonance. According to the JH, and as is made clear by the defense attorney metaphor, individuals should experience anxiety if they hold two unjustifiable propositions simultaneously. The reason is that holding two inconsistent beliefs would mean that the advocated belief systems would be vulnerable to being shown to be inaccurate. This, in turn, would mean criticism from others.

Imagine the following: After completing an extremely boring task for a psychology experiment, the experimenter asks you to do her a favor. Her graduate assistant, who was supposed to inform the participant that the task is exciting and enjoyable, is not there and she needs someone to fill in. She then offers you either $1 or $20 to help her out. After you comply, she then asks you what you really felt about the task. As is now well known, if you received $1 you rate the task as more enjoyable and less boring than if you received $20.

Why would people alter their beliefs in this manner? If one extends the scenario, an obvious explanation presents itself. Imagine it is sometime later and you come across the participant you lied to. "Hey," he calls, "that task was boring as anything. Why did you lie to me and tell me it was exciting?" If the experimenter gave you $20, you have a reasonable justification and might respond "Sorry, but it was something they were going to tell you anyway and she gave me $20." If, however, you only received $1, it is much harder to justify that you lied. Yet, if you did not find the task to be so bad, you could defend yourself as follows: "The experimenter asked me to say that. And I didn't think the task was so bad." Literally hundreds of experiments have supported the finding that people doctor their belief systems so that their behavior is presented in as justifiable a manner as possible (Aronson, 1996).

It is particularly important to note that the process operates outside of self-awareness. That is, when asked about her or his thought processes, no one responds "I initially felt that the task was boring, but then when I found myself willing to lie about it for only a dollar, I realized that this made me vulnerable to attack and criticism for committing a fairly unjustifiable act. As such, I changed my belief in how boring the task was so that I would be in a better place to justify my actions." People are conscious of the result of the dissonance reduction process but are not conscious of the process itself. Likewise, children are not explicitly taught about dissonance or about how to adjust their beliefs accordingly. The findings associated with cognitive dissonance research are obviously directly consistent with the JH, and the implicit nature of cognitive dissonance lends further credence to the JH.

The capacity to reason. One only needs to read the lucid descriptions of great ape behavior offered by primatologists such as Franz de Waal (1982), Jane Goodall (1986), and Diane Fossey (1983) to realize that our nearest relatives live intricate and complicated social lives. At the same time, one only needs to confront our great ape relatives with tasks that require basic analytic reasoning to realize that the gulf between humans and other great apes in this domain is oceanic (Byrne, 1995). Why, according to the JH, would humans be good reasoners? For the same reason that we pay smart lawyers more than stupid ones. Determining logical inconsistencies in one's own and others' justification systems is obviously of crucial importance. The only way to identify such logical inconsistencies is through the process of analytic reasoning. Some evolutionary psychologists are fond of pointing out that there cannot be a domain-general learning device because of the frame problem and because there are no general adaptive problems that must be solved (Tooby & Cosmides, 1992). The JH challenges this assertion, at least in the sense that to solve the problem of what is and what is not justifiable requires the capacity for general, analytic reasoning.

The JH further suggests that the general reasoning capacity in humans emerged out of determining what is and what is not justifiable in the social context. This gives rise to another implication of the JH. If social reasoning gave rise to general reasoning, then humans should be particularly adept at social reasoning, at least in comparison with other forms of general reasoning. This is precisely the case. Cognitive psychologists have long noted that people reason more effectively about what they may, ought, or must not do in a given set of social circumstances than they do when reasoning generally. Cognitive psychologists refer to reasoning about socially justifiable acts as deontic reasoning. After noting how crucial deontic reasoning is across social situations, Cummins (1996a) summarized the findings in adults as follows:

> In contrast to their performance on statistical reasoning (e.g., Kahneman, Slovic, & Tversky, 1982), indicative reasoning (e.g., Wason & Johnson-Laird, 1972), and mathematical or scientific problem-solving tasks (e.g., Chi, Feltovich, & Glaser, 1981), adults typically perform consistently and well on tasks requiring deontic reasoning (e.g., Cheng & Holyoak, 1985, 1989; Griggs & Cox, 1983; Manktelow & Over, 1991, 1995). In fact, so robust and reliable is performance on deontic tasks that numerous proposals have been put forth to explain it. (p. 823)

Cummins (1996a) proceeded to demonstrate that 3- and 4-year-old children also show superiority in deontic reasoning. In a separate article arguing that the ability for deontic reasoning is a consequence of evolutionary pressures, Cummins (1996b) observed that deontic reasoning "emerges early in childhood, is observed regardless of the cultural background of the reasoner, and can be selectively disrupted at the neurological level" (p. 160). In short, and in direct accordance with the JH, there is an abundance of evidence that suggests that humans reason better about what is and what is not socially justifiable than they do when reasoning about abstract general truths.

I have reviewed data relevant to some of the more direct implications about self-knowledge that fall out of the JH. In accordance with the JH, there are recently evolved brain structures that allow humans to interpret their own behavior and to generate acceptable reasons for their behavior. Massive amounts of data indicate that humans tend to hold the most positive picture of themselves that can be reasonably justified. Massive amounts of data indicate that humans doctor their beliefs to maintain a socially justifiable image of themselves. And humans are far better general reasoners than the other great apes and far better social reasoners than analytic reasoners. These findings, when combined with Freud's fundamental observation regarding the nature of the human ego as a justification filter and the logical necessity that evolution of language generated the adaptive problem of justification, strongly suggest that we can consider the human ego the mental organ of justification.

The Foundation for a Unified Theory of Culture

The third postulate of the JH is that it provides a framework for building a conceptual bridge across the great rift that currently divides scientific thought. On the one hand, there are the natural and biological sciences. On the other hand, there are the social sciences, including the human psychologies (e.g., social and cultural), sociology, anthropology, economics, and political science, to name a few of the more prominent disciplines. The former disciplines are often characterized as the hard sciences and are generally seen as more empirical. The latter disciplines are associated with more constructivist epistemologies, and the science is more historically and contextually based.

In *Consilience*, Wilson (1998) characterized the rift between the natural and social sciences as one of the great remaining problems in science. He further suggested that the lack of a consilient framework that integrates the natural and social sciences prevents the science of human behavior from effectively progressing. He observed:

> We know that virtually all of human behavior is transmitted by culture. We also know that biology has an important effect on the origin of culture and its transmission. The question remaining is how biology and culture interact, and in particular how they interact across all societies to create the commonalities of human nature. What, in the final analysis, joins the deep, mostly genetic history of the species as a whole to the more recent cultural histories of far-flung societies? That, in my opinion, is the nub of the relationship between the two cultures. It can be stated as a problem to be solved, the central problem of the social

> sciences and the humanities, and simultaneously one of the great remaining problems of the natural sciences.
>
> At present time no one has a solution. But in the sense that no one in 1842 knew the true cause of evolution and in 1952 no one knew the nature of the genetic code, the way to solve the problem may lie within our grasp. (p. 126)

According to the representation provided by the ToK System, Wilson is arguing that the theoretical joint point that connects the science of culture to the rest of the sciences is currently missing. Importantly and also directly consistent with the ToK System, in his keynote address presented at the 2000 convention of the American Psychological Association, Wilson rightly proclaimed that the field of psychology existed between the natural and social sciences and thus would be instrumental in building the bridge between them. An implication of Wilson's claim is that a unified psychology would successfully join the two cultures and, in so doing, a consilient picture of all of the sciences would emerge.

Taken together, BIT, the JH, and the ToK System suggest the veracity of Wilson's consilient hypothesis. The essence of culture is the presence of large-scale belief systems that function to coordinate and legitimize human behavior. The fundamental point of a social science perspective is that human behavior must be understood in the context of the larger sociolinguistic system in which it is immersed (e.g., Gergen, 1985). The theoretical problem has been that there was no systematic way to understand how the evolution of the mind in general, and the human mind in particular, led to the emergence of these cultural justification systems. As such, social scientists have tended to focus simply on the systems themselves and not concern themselves with the origins of their emergence (e.g., Geertz, 1973). As an inevitable consequence of this starting point, the social science models that arose essentially lacked any systematic framework for integrating biopsychological causation and thus were obviously incomplete (Tooby & Cosmides, 1992). Unfortunately, the biopsychological models built by taking a bottom-up perspective have proven inadequate for providing a framework for understanding the emergence of the large-scale justification systems examined by cultural scientists. The absence of a large-scale meta-theoretical framework that could effectively incorporate physical, biological, psychological, and social causation in explaining human behavior has resulted in the rift between the two cultures. The ToK System, with its depiction of the correspondence between the four layers of complexity and the four domains of science, provides the meta-theoretical framework necessary for consilience between the natural and social sciences to be achieved.

Some Considerations in Applying the Unified Theory

The current focus on theory has stemmed from the argument that psychology's biggest problems are epistemological in nature. Of course, the ultimate value of the proposal will be in the degree to which it increases our understanding of psychological phenomena. Implicit in the current proposal is the notion that if psychologists adopt the unified theoretical approach, then a much more comprehensive view of specific psychological phenomena will emerge. The argument is similar to the one made by Sternberg and Grigorenko (2001), who stated that a multiparadigmatic perspective would result in a deeper understanding of psychological phenomena. A major omission in their approach, however, was the fact that adopting a multiparadigmatic approach is not easy because crucial epistemological differences render the various paradigms, as they are currently defined, incompatible. The approach offered here can be considered a metaparadigmatic approach, which agrees with Sternberg and Grigorenko's (2001) call for converging operations in the study of psychological phenomena but further suggests that what is needed is epistemological consistency and a shared conceptual framework.

The current analysis also suggests that the introduction of the two large concepts of behavioral investments and justifications will effectively organize much extant psychological research and provide a framework for understanding everyday psychological phenomena. A cursory glance reveals the concepts of behavioral investments and justifications to be almost omnipresent in human affairs. To provide just one of endless possible examples of how these concepts already implicitly influence everyday thinking, consider Sternberg and Grigorenko's (2001) analysis of how researchers may become unfortunately channeled into one particular avenue of investigation:

> Researchers may seek to maximize the return on their time investment and use what they have learned as much as possible. Even if they come to see the flaws of their preferred methodology, they may come to view the time invested as a sunken cost and seek to justify or even redeem the investment anyway. (p. 1072)

The two broad concepts also readily lend themselves to phenomena currently under scientific investigation. A broad number of psychological phenomena have already been surveyed, such as reinforcement and extinction, the self-awareness system, cognitive dissonance and attributional research, verbal versus nonverbal information processing and hemispheric specialization, and deontic reasoning, among others. Although these psychological concepts were used to bolster the theoretical arguments, the converse can readily be done; that is, the theories offered here can be used in empirical investigations of these phenomena.

There are many other areas to which the analysis can be extended. Consider, for example, the construct of depression. The mental health community still struggles monumentally with defining this concept (e.g., Maj & Sartorius, 1999). Is depression a normal human reaction? Is it a cognitive disorder? A behavioral disorder? Is it a biological disease? Of course, it depends in part on one's definitional system, which is why a broad, shared definitional system is so essential. BIT readily provides a clear functional understanding of depression. Animals should decrease their behavioral expenditure of energy if their behavioral investments consistently result in no functional effect on the animal–environment relationship. In this light, depression is a state of behavioral shutdown (Henriques, 2000), and research on animals strongly conforms to this conception (e.g., Seligman, 1975).

The metaparadigmatic perspective allows one to easily move among behavioral, cognitive, psychodynamic, and biopsychiatric perspectives when conceptualizing depression. From a behavioral perspective, consider what happens if the behavioral shutdown results in increasingly greater loss. If the shutdown creates greater loss, then a vicious cycle ensues in which the behavioral reaction results in the additional loss, resulting in greater shutdown and so on. The individual can also justify behavioral investments and events in a problematic fashion, and overly negative or pessimistic interpretations can result in vicious depressive cycles as well, which is essentially the cognitive formulation (e.g., Beck, 1976). Or, from a more psychodynamic perspective, consider how the self-criticisms so prominent in depressed individuals might sometimes function to justify submission and the inhibition of aggressive impulses. The unified approach allows one to consider depression from each of these perspectives under the same general framework of understanding.

The unified perspective also allows for a biopsychiatric conceptualization and clarifies the distinction between a disease and a behavioral disorder. As I have argued elsewhere (Henriques, 2002), the concept of "disease" can be thought of as an applied biological construct that can be defined as a harmful breakdown in the function of an evolved mechanism (see Wakefield, 1999). This construct can be conceptually differentiated from psychological disorders in which rigid, maladaptive behavioral patterns result from vicious behavioral cycles, as just described in the context of depression. Thus, severe depressive responses that occur in the absence of behavioral ineffectiveness or loss (e.g., Solomon, 1998) can be considered depressive diseases, because such occurrences reflect a breakdown in the functioning of the basic biopsychological architecture. Ultimately, the conceptual distinction between psychological disorders and diseases may have significant implications for the frequently strained relationship between clinical psychology and psychiatry.

Conclusion

A well-defined subject matter, a shared language, and conceptual agreements about the fundamentals are key elements that constitute a mature science. The physical and biological sciences have reached maturity. The psychological sciences have not. Instead, students of psychology are given choices to be or not to be radical behaviorists, cognitive psychologists, evolutionary psychologists, social constructivists, feminists, physiological psychologists, or psychodynamic psychologists, among others. The lack of a shared, general understanding has had unfortunate consequences. Paradigms are defined against one another, and epistemological differences justify the dismissal of insights gleaned from other approaches. The result has been a fragmented field and a gulf between the natural and social sciences.

This analysis suggests that the fragmentation that currently characterizes the field of psychology is unnecessary. Instead, through the use of the ToK System as a meta-theoretical framework, a coherent unified theory of psychology is possible. With it, the truth stands a genuine chance of emerging.

References

Adrian, E. D. (1935). *The mechanism of nervous action*. Philadelphia: University of Pennsylvania Press.

Aiken, L. R. (1993). *Personality: Theories, research and applications*. Englewood Cliffs, NJ: Prentice Hall.

Alexander, R. D. (1979). *Darwinism and human affairs*. Seattle: University of Washington Press.

Amador, X. F., & David, A. S. (1998). *Insight and psychosis.* New York: Oxford University Press.

Anderson, N. (1996). *A functional theory of cognition*. Mahwah, NJ: Erlbaum.

Aronson, E. (1996). Persuasion via self-justification: Large commitments for small rewards. In E. Aronson (Ed.), *The social animal* (7th ed., pp. 221–236). New York: Freeman.

Bahn, P. G. (1996). Ancient art. In S. Jones, R. Martin, & D. Pilbeam (Eds.), *The Cambridge encyclopedia of human evolution* (pp. 261–277). London: Oxford University Press.

Bailey, K. G. (1987). *Human paleopsychology: Applications to aggression and pathological processes.* Hillsdale, NJ: Erlbaum.

Barkow, J. H. (1992). Beneath new culture is old psychology: Gossip and social stratification. In J. Barkow, L. Cosmides, & J. Tooby (Eds.), *The adapted mind: Evolutionary psychology and the generation of culture* (pp. 627–638). New York: Oxford University Press.

Barr, W. B. (1998). Neurobehavioral disorders of awareness and their relevance to schizophrenia. In X. F. Amador & A. S. David (Eds.), *Insight and psychosis* (pp. 107–141). New York: Oxford University Press.

Beck, A. T. (1976). *Cognitive therapy and the emotional disorders.* New York: Meridian.

Beck, A. T. (1999). Cognitive aspects of personality disorders and their relation to syndromal disorders: A psychoevolutionary approach. In C. R. Cloninger (Ed.), *Personality and psychopathology* (pp. 411–429). Washington, DC: American Psychiatric Press.

Bickerton, D. (1995). *Language and human behavior*. Seattle: University of Washington Press.

Boakes, R. (1984). *From Darwinism to behaviourism: Psychology and the minds of animals.* New York: Cambridge University Press.

Bonner, J. T. (1980). *The evolution of culture in animals*. Princeton, NJ: Princeton University Press.

Broadbent, D. E. (1958). *Perception and communication*. New York: Pergamon Press.

Bronowski, J. (1974). *Ascent of man*. Boston: Little, Brown.

Byrne, R. (1995). *The thinking ape: Evolutionary origins of intelligence*. New York: Oxford University Press.

Carver, C. S., & White, T. L. (1994). Behavioral inhibition, behavioral activation, and affective responses to impending reward and punishment: The BIS/BAS Scales. *Journal of Personality and Social Psychology, 67,* 319–333.

Catania, A. C., & Harnard, S. (1988). *The selection of behavior: The operant behaviorism of B. F. Skinner: Comments and consequences*. New York: Cambridge University Press.

Chomsky, N. (1972). *Language and mind*. New York: Harcourt Brace Jovanovich.

Conte, H. R., & Plutchik, R. (1995). *Ego defenses: Theory and measurement*. New York: Wiley.

Cotman, C. W., & McGaugh, J. L. (1980). *Behavioral neuroscience*. New York: Academic Press.

Crick, F. (1994). *The astonishing hypothesis: The scientific search for the soul.* New York: Simon & Schuster.

Cummins, D. D. (1996a). Evidence of deontic reasoning in 3- and 4-year-old children. *Memory & Cognition, 24,* 823–829.

Cummins, D. D. (1996b). Evidence for innateness of deontic reasoning. *Mind and Language, 11,* 160–190.

Cziko, G. (2000). *The things we do: Using the lessons of Bernard and Darwin to understand the what, how, and why of our behavior*. Cambridge, MA: MIT Press.

Damasio, A. (1998). *The feeling of what happens: Body and emotion in the making of consciousness.* New York: Harcourt Brace Jovanovich.

Davidson, R. J., & Tomarken, A. J. (1989). Laterality and emotion: An electrophysiological approach. In F. Boller & J. Grafman (Eds.), *Handbook of neuropsychology* (pp. 419–441). Amsterdam: Elsevier.

Dawkins, R. (1989). *The selfish gene* (2nd ed.). Oxford, England: Oxford University Press.

Dawkins, R. (1999). *The extended phenotype: The long reach of the gene* (2nd ed.). New York: Oxford University Press.

Deacon, T. (1997). *The symbolic species.* New York: Norton.

Dennett, D. C. (1995). *Darwin's dangerous idea*. New York: Simon & Schuster.

Dennett, D. C. (1996). *Kinds of minds: Toward an understanding of consciousness.* New York: Basic Books.

de Waal, F. (1982). *Chimpanzee politics: Power and sex among apes.* New York: Harper & Row.

Dobzhansky, T. (1964). *Heredity and the nature of man*. New York: New American Library.

Dobzhansky, T. (1973). Nothing in biology makes sense except in the light of evolution. *American Biology Teacher, 35,* 125–129.

Donahoe, J. W. (1999). Edward L. Thorndike: The selectionist connectionist. *Journal of the Experimental Analysis of Behavior, 72,* 451–454.

Donahoe, J. W., Burgos, J. E., & Palmer, D. C. (1993). Selectionist approach to reinforcement. *Journal of the Experimental Analysis of Behavior, 58,* 17–40.

Duval, S., & Wicklund, R. (1972). *A theory of objective self-awareness*. New York: Academic Press.

Eagle, M. N. (1998). Freud's legacy: Defenses, somatic symptoms and neurophysiology. In G. Guttmann & I. Scholz-Strasser (Eds.), *Freud and the neurosciences: From brain research to the unconscious* (pp. 87–101). Vienna: American Psychological Association.

Edelman, G. (1989). *The remembered present: A biological theory of consciousness.* New York: Basic Books.

Edelman, G. (1992). *Bright air, brilliant fire: On the matter of the mind.* New York: Basic Books.

Eibl-Eibesfeldt, I. (1989). *Human ethology*. New York: Aldine de Gruyter.

Epstein, S. (1994). Integration of the cognitive and the psychodynamic unconscious. *American Psychologist, 49,* 709–724.

Ferris, T. (1997). *The whole shebang: A state-of-the-art universe(s) report*. New York: Simon & Schuster.

Fossey, D. (1983). *Gorillas in the mist*. Boston: Houghton Mifflin.

Fowles, D. C. (1994). A motivational theory of psychopathology. In W. Spaulding (Ed.), *Nebraska Symposium on Motivation: Integrated views of motivation, cognition and emotion* (Vol. 41, pp. 181–238). Lincoln: University of Nebraska Press.

Freud, A. (1966). *The ego and the mechanisms of defense*. New York: International Universities Press.

Freud, S. (1949). *Outline of psychoanalysis*. New York: Norton. (Original work published 1940)

Freud, S. (1960). *The ego and the id*. New York: Norton. (Original work published 1923)

Friedrich, J. (1996). On seeing oneself as less self-serving than others: The ultimate self-serving bias? *Teaching of Psychology, 23,* 107–109.

Gallup, G. G., Jr. (1970). Chimpanzees: Self-recognition. *Science, 167,* 86–87.

Gazzaniga, M. S. (1992). *Nature's mind: The biological roots of thinking, emotion, sexuality, language, and intelligence*. New York: Basic Books.

Gazzaniga, M. S. (1995). *The cognitive neurosciences*. Cambridge, MA: MIT Press.

Geary, D. (1998). *Male/female: The evolution of human sex differences*. Washington, DC: American Psychological Association.

Geertz, C. (1973). *The interpretation of cultures*. New York: Basic Books.

Gergen, K. (1985). The social constructionist movement in modern psychology. *American Psychologist, 40,* 266–275.

Geschwind, N. (1965). Disconnection syndromes in animals and man. *Brain, 88,* 237–294.

Gilgen, A. R. (1987). The psychological level of organization in nature and interdependencies among major psychological concepts. In A. W. Staats & L. P. Mos (Eds.), *Annals of theoretical psychology* (Vol. 5, pp. 179–209). New York: Plenum.

Goleman, D. (1985). *Vital lies, simple truths: The psychology of self-deception and shared illusions*. New York: Simon & Schuster.

Goodall, J. (1986). *The chimpanzees of Gombe: Patterns of behavior*. Cambridge, MA: Belknap.

Gould, S. J. (1987, November). *The limits of adaptation: Is language a spandrel of the human brain?* Paper presented at the Cognitive Science Seminar, Cambridge, MA.

Gould, S. J. (1989). *Wonderful life: The Burgess Shale and the nature of history*. New York: Norton.

Gould, S. J. (1993). *Eight little piggies*. New York: Norton.

Gould, S. J., & Lewontin, R. C. (1979). The spandrels of San Marco and the Panglossian program: A critique of the adaptionist programme. *Proceedings of the Royal Society of London, 205,* 281–288.

Gray, J. A. (1987). Perspectives on anxiety and impulsivity: A commentary. *Journal of Research in Personality, 21,* 493–509.

Greene, B. (1999). *The elegant universe: Superstrings, hidden dimensions, and the quest for the ultimate theory*. New York: Norton.

Greenspan, S. I. (1989). *The development of the ego*. Madison, CT: International Universities Press.

Greenwald, A. G. (1980). The totalitarian ego: Fabrication and revision of personal history. *American Psychologist, 35,* 603–618.

Gribbin, J. (1998). *Q is for quantum: An encyclopedia of particle physics*. New York: Touchstone.

Hamilton, W. D. (1964). The genetical evolution of social behavior (I and II). *Journal of Theoretical Biology, 7,* 1–52.

Hawking, S. (1998). *A brief history of time* (2nd ed.). New York: Bantam Books.

Henriques, G. R. (2000). Depression: Disease or behavioral shutdown mechanism? *Journal of Science and Health Policy, 1*, 152–165.

Henriques, G. R. (2002). The harmful dysfunction analysis and the differentiation between mental disorder and disease. *Scientific Review of Mental Health Practice, 1*, 157–173.

Hofstadter, D. R., & Dennett, D. C. (1981). *The mind's I: Fantasies and reflections on self and soul*. New York: Basic Books.

Hoyle, F. (1964). *Man in the universe.* New York: Columbia University Press.

Humphrey, N. (1976). The social function of intellect. In P. P. G. Bateson & R. A. Hinde (Eds.), *Growing points in ethology* (pp. 303–317). Cambridge, England: Cambridge University Press.

James, W. J. (1950). *The principles of psychology*. New York: Dover. (Original work published 1890)

Johnston, V. S. (1999). *Why we feel: The science of human emotions*. Reading, MA: Perseus Books.

Jolly, A. (1966). Lemur social intelligence and primate intelligence. *Science, 153*, 501–506.

Jones, E. (1955). *The life and work of Sigmund Freud* (Vol. 2). New York: Basic Books.

Kant, I. (1996). *Critique of pure reason*. Indianapolis, IN: Hackett. (Original work published 1781)

Kimble, G. (1996). *Psychology: The hope of a science*. Cambridge, MA: MIT Press.

Koch, S. (1993). "Psychology" or "the psychological studies"? *American Psychologist, 48,* 902–904.

Krebs, D. L., & Denton, K. (1997). Social-illusions and self-deception: The evolution of biases in person perception. In J. A. Simpson & D. T. Kenrick (Eds.), *Evolutionary social psychology* (pp. 21–48). Mahwah, NJ: Erlbaum.

Krebs, J. R., & Davies, N. B. (1997). *Behavioral ecology: An evolutionary approach* (4th ed.). Cambridge, MA: Blackwell Science.

Leaky, R., & Lewin, R. (1992). *Origins reconsidered: In search of what makes us human*. New York: Doubleday.

Lieberman, P. (1998). *Eve spoke: Human language and human evolution*. New York: Norton.

Lifson, S. (1997). On the crucial stages in the origin of animate matter. *Journal of Molecular Evolution, 44,* 1–8.

Maden, B. F. (1995). No soup for starters? Autotrophy and the origins of metabolism. *Trends in Biochemistry, 20,* 337–341.

Magnusson, D. (2000). The individual as the organizing principle in psychological inquiry: A holistic approach. In L. R. Bergman, R. B. Cairns, L. G. Nilsson, & L. Nystedt (Eds.), *Developmental science and the holistic approach* (pp. 33–47). Mahwah, NJ: Erlbaum.

Maj, M., & Sartorius, N. (1999). *Depressive disorders*. New York: Wiley.

Maynard-Smith, J., & Szathmary, E. (1999). *The origins of life: From the birth of life to the origin of language.* Oxford, England: Oxford University Press.

Mayr, E. (1983). How to carry out the adaptionist program. *American Naturalist, 121,* 324–334.

Mayr, E., & Provine, W. B. (1998). *The evolutionary synthesis: Perspectives on the unification of biology*. Cambridge, MA: Harvard University Press.

McWilliams, N. (1994). *Psychoanalytic diagnosis.* New York: Guilford Press.

Meehl, P. (1992). Theoretical risks and tabular asterisks: Sir Karl, Sir Ronald, and the soft progress of slow psychology. In R. B. Miller (Ed.), *The restoration of dialogue* (pp. 523–555). Washington, DC: American Psychological Association. (Original work published 1978)

Messer, S. B., & Winokur, M. (1980). Some limits to the integration of psychoanalytic and behavior therapy. *American Psychologist, 35,* 818–827.

Miller, G. A., Galanter, E., & Pribram, K. (1960). *Plans and the structure of behavior*. New York: Holt.

Mitchell, R. W. (1994). Multiplicities of self. In S. T. Parker, R. W. Mitchell, & M. L. Boccia (Eds.), *Self-awareness in animals and humans* (pp. 81–107). New York: Cambridge University Press.

Mithen, S. (1996). *The prehistory of the mind: A search for the origins of art, religion, and science.* London: Thames & Hudson.

Neisser, U. (1967). *Cognitive psychology*. New York: Appleton-Century-Crofts.

Nesse, R., & Lloyd, A. T. (1992). The evolution of psychodynamic defense mechanisms. In J. Barkow, L. Cosmides, & J. Tooby (Eds.), *The adapted mind: Evolutionary psychology and the generation of culture* (pp. 601–626). New York: Oxford University Press.

Newell, A. (1990). *Unified theories of cognition*. Cambridge, MA: Harvard University Press.

Ornstein, R. E. (1972). *The psychology of consciousness*. San Francisco: Freeman.

Parker, S. T., Mitchell, R. W., & Boccia, M. L. (1994). *Self-awareness in animals and humans*. New York: Cambridge University Press.

Pinker, S. (1994). *The language instinct.* New York: HarperCollins.

Pinker, S. (1997). *How the mind works.* New York: Norton.

Pinker, S., & Bloom, P. (1992). Natural language and natural selection. In J. Barkow, L. Cosmides, & J. Tooby (Eds.), *The adapted mind: Evolutionary psychology and the generation of culture* (pp. 451–494). New York: Oxford University Press.

Ponvinelli, D. J., & Prince, C. G. (1998). When self met other. In M. Ferrari & R. Sternberg (Eds.), *Self-awareness: Its nature and development* (pp. 37–107). New York: Guilford Press.

Powers, W. T. (1973). *Behavior: The control of perception*. Chicago: Aldine.

Pribram, K. (1986). The cognitive revolution and mind/brain issues. *American Psychologist, 41,* 507–520.

Reed, S. K. (1996). *Cognition: Theory and applications* (4th ed.). Pacific Grove, CA: Brooks/Cole.

Rivto, L. (1990). *Darwin's influence on Freud: A tale of two sciences.* New Haven, CT: Yale University Press.

Robins, R. W., Norem, J. K., & Cheek, J. M. (1999). Naturalizing the self. In L. A. Pervin & O. P. John (Eds.), *Handbook of personality: Theory and research* (2nd ed., pp. 443–477). New York: Guilford Press.

Roth, G., & Wulliman, M. F. (2001). *Brain evolution and cognition*. New York: Wiley.

Sarason, S. B. (1989). The lack of an overarching conception in psychology. *Journal of Mind and Behavior, 10,* 263–279.

Schacter, D. L. (1990). Toward a cognitive neuropsychology of awareness: Implicit knowledge and anosognosia. *Journal of Clinical and Experimental Neuropsychology, 12,* 155–178.

Schacter, D. L. (1993). Neuropsychological evidence for a consciousness system. In A. I. Goldman (Ed.), *Readings in philosophy and cognitive science* (pp. 415–444). Cambridge, England: Cambridge University Press.

Sedikides, C., & Skowronski, J. J. (1997). The symbolic self in evolutionary context. *Personality and Social Psychology Review, 1,* 80–102.

Seligman, M. E. P. (1975). *Helplessness: On depression, development and death.* San Francisco: Freeman.

Skinner, B. F. (1950). Are theories of learning necessary? *Psychological Review, 57,* 193–216.

Skinner, B. F. (1957). *Verbal behavior.* Englewood Cliffs, NJ: Prentice Hall.

Skinner, B. F. (1966). The phylogeny and ontogeny of behavior. *Science, 153,* 1205–1213.

Skinner, B. F. (1974). *About behaviorism*. New York: Alfred A. Knopf.

Skinner, B. F. (1981). Selection by consequences. *Science, 213,* 501–504.

Skinner, B. F. (1984). The evolution of behavior. *Journal of the Experimental Analysis of Behavior, 41,* 217–221.

Skinner, B. F. (1988a). Reply to Gottlieb. In A. C. Catania & S. Harnard (Eds.), *The selection of behavior: The operant behaviorism of B. F. Skinner: Comments and consequences* (p. 430). New York: Cambridge University Press.

Skinner, B. F. (1988b). What are the scopes and limits of radical behaviorist theory: Reply to Harnard. In A. C. Catania & S. Harnard (Eds.), *The selection of behavior: The operant behaviorism of B. F. Skinner: Comments and consequences* (pp. 465–473). New York: Cambridge University Press.

Skinner, B. F. (1990). Can psychology be a science of mind? *American Psychologist, 45,* 1206–1210.

Slavin, M. O., & Greif, D. (1995). The evolved function of repression and the adaptive design of the human psyche. In H. R. Conte & R. Plutchik (Eds.), *Ego defenses: Theory and measurement* (pp. 139–175). New York: Wiley.

Slavin, M. O., & Kriegman, D. (1992). *The adaptive design of the human psyche: Psychoanalysis, evolutionary biology and the therapeutic process.* New York: Guilford Press.

Solomon, A. (1998, January). Anatomy of melancholy. *The New Yorker*, pp. 47–61.

Staats, A. W. (1963). *Complex human behavior*. New York: Holt, Rinehart & Winston.

Staats, A. W. (1983). *Psychology's crisis of disunity: Philosophy and method for a unified science*. New York: Praeger.

Staats, A. W. (1991). Unified positivism and unification psychology: Fad or new field? *American Psychologist, 46,* 899–912.

Staats, A. W. (1996). *Behavior and personality: Psychological behaviorism*. New York: Springer.

Staats, A. W. (1999). Uniting psychology requires new infrastructure, theory, method, and a research agenda. *Review of General Psychology, 3,* 3–13.

Staddon, J. E. R. (2001). *Adaptive dynamics: The theoretical analysis of behavior*. Cambridge, MA: MIT Press.

Stanovich, K. (2001). *How to think straight about psychology* (6th ed.). Boston: Allyn & Bacon.

Stephens, D. W., & Krebs, J. R. (1986). Foraging theory. In J. R. Krebs & T. Clutton-Brock (Eds.), *Monographs in behavior and ecology* (pp. 354–375). Princeton, NJ: Princeton University Press.

Sternberg, R. J., & Grigorenko, E. L. (2001). Unified psychology. *American Psychologist, 56,* 1069–1079.

Stringer, C., & McKie, R. (1997). *African exodus: The origins of modern humanity*. New York: Holt.

Taylor, S. E., & Brown, J. D. (1988). Illusion and well-being: A social psychological perspective on mental health. *Psychological Bulletin, 103,* 193–210.

Taylor, S. E., & Brown, J. D. (1994). Positive illusions and well-being revisited: Separating fact from fiction. *Psychological Bulletin, 116,* 21–27.

Thorndike, E. L. (1905). *Elements of psychology*. New York: Seiler.

Tinbergen, N. (1951). *The study of instinct*. New York: Oxford University Press.

Tooby, J., & Cosmides, L. (1992). The psychological foundations of culture. In J. Barkow, L. Cosmides, & J. Tooby (Eds.), *The adapted mind: Evolutionary psychology and the generation of culture* (pp. 19–136). New York: Oxford University Press.

Trivers, R. (1971). Parental investment and sexual selection. In B. Campbell (Ed.), *Sexual selection and descent of man* (pp. 1871–1971). Chicago: Aldine.

Trivers, R. (1985). *Social evolution*. Menlo Park, NJ: Benjamin Cummings.

Tryon, W. W. (1993). Neural networks: I. Theoretical unification through connectionism. *Clinical Psychology Review, 13,* 341–352.

Wakefield, J. C. (1999). Evolutionary versus prototype analyses of the concept of disorder. *Journal of Abnormal Psychology, 108,* 374–399.

Watson, D., Wiese, D., Vaidya, J., & Tellegen, A. (1999). The two general systems of affect: Structural findings, evolutionary considerations, and psychobiological evidence. *Journal of Personality and Social Psychology, 76,* 820–838.

Westen, D. (1997). Towards a clinically and empirically sound theory of motivation. *International Journal of Psycho-Analysis, 78,* 521–548.

Westen, D. (1998). The scientific legacy of Sigmund Freud: Toward a psychodynamically informed psychological science. *Psychological Bulletin, 124,* 333–371.

Westen, D. (1999). The scientific status of unconscious processes: Is Freud really dead? *Journal of the American Psychoanalytic Association, 47,* 1061–1106.

Williams, G. C. (1966). *Adaptation and natural selection: A critique of some current evolutionary thought.* Princeton, NJ: Princeton University Press.

Wilson, E. O. (1975). *Sociobiology: The new synthesis.* Cambridge, MA: Harvard University Press.

Wilson, E. O. (1998). *Consilience: The unity of knowledge.* New York: Alfred A. Knopf.

Wrangham, R. W., & McGrew, W. C. (1994). *Chimpanzee cultures*. Cambridge, MA: Harvard University Press.

Received October 17, 2001
Revision received March 22, 2002
Accepted March 25, 2002 ■