Special Section

THE UNDISCOVERED MIND: How the Human Brain Defies Replication, Medication, and Explanation

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Abstract—*In* The End of Science, *I argued that particle physics, cosmology, evolutionary biology, and other fields of pure science have entered an era of diminishing returns (Horgan, 1997). Although scientists will continue refining and extending current theories and applying their knowledge in the realms of technology and medicine, they may never again achieve insights into nature as profound as quantum mechanics, relativity theory, the big bang theory, natural selection, and DNA-based genetics. One reasonable objection to the book was that mind-related research, of all current scientific enterprises, has the most revolutionary potential, and it deserves a more thorough treatment than it received in* The End of Science. *I responded to this objection by writing a book that focused on "mind-science" (Horgan, 1999).* The Undiscovered Mind *considered not only the debate over consciousness, which was the primary focus of* The End of Science; *it also reviewed the record of fields such as clinical psychology, psychiatry, behavioral genetics, evolutionary psychology, artificial intelligence, and neuroscience. I contended that there has been little progress in understanding the mind, replicating its properties, or treating its disorders—especially compared with the extravagant claims made by proponents of certain approaches. In this article, I summarize some of my book's main points.*

In *The End of Science* (Horgan, 1997), I coined the term "ironic science" to describe science that never gets a firm grip on reality and thus does not converge on the truth. Ironic science does not make the kind of literal, factual statements about the world that can be either confirmed or invalidated through empirical means; it is thus more akin to philosophy, literary criticism, or even literature than to true science. Ironic science crops up in the so-called hard sciences, such as physics (an obvious example of ironic science is a theory that postulates the existence of other universes in addition to our own). But ironic science is most pervasive in fields that address the human mind.

Theories of human nature never really die; they just go in and out of fashion. Often, old ideas are simply repackaged in more palatable forms. Phrenology is reincarnated as cognitive modularism. Sociobiology mutates into evolutionary psychology. Eugenics, stripped (for the most part) of its unsavory political tenets, evolves into behavioral genetics. Old treatments for mental illness linger, too. Shock treatments and lobotomies, although pushed to the sidelines of psychiatry in recent decades by Prozac and lithium, are still prescribed for severe mental illness (Sackheim, Devanand, & Nobler, 1995; Vertosick, 1997).

The variability and malleability of minds enormously complicate the search for general principles of human nature. The evolutionary biologist Ernst Mayr, of Harvard University, has pointed out that no field of biology can match the precision and power of physics, because unlike electrons or neutrons, all organisms are unique (Mayr, 1988). But the differences between two *E. coli* bacteria or two leafcutter ants are trivial compared with the differences between any two humans, even those who are genetically identical. Each individual mind may also change dramatically when its owner is spanked, learns the alphabet, reads *Thus Spoke Zarathustra*, takes LSD, falls in love, gets divorced, undergoes Jungian dream therapy, or suffers a stroke.

One striking symptom of mind-science's lack of progress is the persistence of psychoanalysis. Freud's legacy has sustained brutal attacks over the past decade (Crews, 1998). Nevertheless, millions of people still receive psychotherapy based—at least indirectly—on Freudian tenets. Moreover, many intellectuals—including not only French philosophers but also scientists who supposedly should know better—still profess admiration for psychoanalysis (Edelman, 1992; Fisher & Greenberg, 1996; Kandel, 1998). Even scientists who disavow Freudian concepts still employ them as benchmarks for evaluating newer ideas (LeDoux, 1996; Schacter, 1996).

Psychoanalysis has persisted not because it has been empirically validated—of course, it has not been—but because science has not yielded an obviously superior explanation of the mind and its disorders. Anti-Freudians argue, in effect, that psychoanalysis has no more scientific standing than phlogiston, the pseudosubstance that 18th-century physicists believed was released during combustion. But the reason physicists do not still debate the phlogiston hypothesis is that it was rendered utterly obsolete by the discovery of oxygen and other advances in chemistry and thermodynamics. A century's worth of research in psychology, psychiatry, genetics, neuroscience, and adjacent fields has not yielded a paradigm powerful enough to obviate Freud, once and for all. If psychoanalysis is the equivalent of phlogiston, as the anti-Freudians claim, so are all its would-be successors.

PSYCHOTHERAPY AND THE DODO HYPOTHESIS

After reading the first draft of this article, the editor of this journal objected that experimental psychology has produced an "extraordinarily detailed understanding" of vision, memory, and language. But as many observers have pointed out, the findings of psychology have not been drawn together into a coherent, compelling paradigm. The neuroscientists V.S. Ramachandran and J.J. Smythies complained recently that the history of psychology "has been characterized by an embarrassingly long sequence of 'theories,' each really nothing more than a passing fad that rarely outlived the person who proposed it" (Ramachandran & Smythies, 1997, p. 667).

Perhaps the major application of psychology is psychotherapy. One would hope that as psychology progresses, it would lead to refinements in psychotherapy that make it more effective. In fact, few psychotherapists practice classic Freudian psychoanalysis any more. It has yielded to other, supposedly more "modern" talk therapies, such

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as cognitive-behavioral therapy. There are more than 450 types of psychotherapy, according to one estimate (Karasu, 1986).

In one influential review of psychotherapy outcome studies, the psychologist Lester Luborsky and two colleagues reported that all psychotherapies were roughly as effective as each other (Luborsky, Singer, & Luborsky, 1975).[1] To dramatize this finding, the authors quoted the Dodo in *Alice's Adventures in Wonderland.* After observing a footrace, the Dodo declares, "*Everybody* has won, and all must have prizes!" Studies indicating the superiority of a particular approach, Luborsky has suggested, generally derive from an "allegiance effect"—the tendency of researchers to find evidence for the therapy that they favor (Luborsky et al., 1993).

Other investigators have corroborated the Dodo hypothesis, and they have discovered two important corollaries. First, there is no correlation between the time patients spend in therapy and the benefits they receive. Second, there is no correlation between the credentials or experience of therapists and their ability to help patients (Dawes, 1994; Smith & Glass, 1977).

In one trial, psychiatric patients were randomly assigned to two different groups of "therapists": One group consisted of professional psychologists, and the other consisted of professors who had never even taken a course in psychology. The patients responded as well to the pseudotherapists as to the real ones (Strup & Hadley, 1979). These findings have a disturbing implication: The major active ingredient of psychotherapy may be the placebo effect, the tendency for patients' hopes and beliefs to become self-fulfilling (Frank & Frank, 1993).

Clinical psychologists supposedly possess special knowledge and methods that enable them to discern a patient's past and predict his or her future more accurately than laypeople. But there is no evidence that Rorschach tests or similar techniques employed by clinical psychologists when they interview patients have any special diagnostic or predictive power. So-called actuarial methods have consistently proven to be superior to so-called clinical methods in predicting the future behavior of psychiatric patients and criminals (Dawes, 1994).

IS PROZAC A PLACEBO?

"If there is one intellectual reality at the end of the twentieth century," Edward Shorter declared in *A History of Psychiatry,* "it is that the biological approach to psychiatry—treating mental illness as a genetically influenced disorder of brain chemistry—has been a smashing success. Freud's ideas, which dominated the history of psychiatry for the past half century, are now vanishing like the last snows of winter" (Shorter, 1997, p. vii). Ironically, Shorter's own account demonstrated that biological psychiatry, far from being a smashing success, has produced some of the most horrific treatments in the history of modern medicine, including insulin coma therapy, the fever cure, and the lobotomy.

The ascent of biopsychiatry can be traced to the 1950s, when psychiatrists began using lithium, chlorpromazine, and other medications to treat mental illness. The psychopharmacology revolution peaked with the advent of selective serotonin-reuptake inhibitors, or SSRIs, in the late 1980s. Almost 40 million people worldwide now take the leading SSRI, Prozac, and millions more take rival SSRIs. Although there is no evidence that antidepressants benefit children, the fastest-growing segment of the SSRI market is children under the age of 12 (Sommers-Flanagan & Sommers-Flanagan, 1996; Strauch, 1997).

Prozac has been hailed as a "breakthrough drug" not just by the media but also by psychiatrists (Cowley, 1990). In *Listening to Prozac*, Peter Kramer pondered the metaphysical implications of a drug that can make us "better than well" (Kramer, 1993). But studies by Prozac's own manufacturer have shown that the drug is no more effective than older antidepressants, such as the tricyclics (G.E. Simon et al., 1996). Contrary to popular belief, Prozac's side effects are not significantly milder than those of tricyclics (Nelson, 1994). Prozac causes sexual dysfunction in as many as three out of four consumers (Segraves, 1995). In *Listening to Prozac*, Kramer relegated discussion of the sexual side effects to the fine print, literally, in his book's appendix.

Perhaps the greatest illusion promulgated by *Listening to Prozac* is that antidepressants represent a tremendous advance beyond psychotherapy alone in the treatment of depression. In fact, studies comparing psychotherapy with antidepressants reveal that they produce roughly comparable outcomes (Antonuccio, Danton, & DeNelsky, 1995). In other words, the Dodo's proclamation—"*Everybody* has won, and all must have prizes"—applies not only to psychotherapies but also to antidepressants.

In the National Institute of Mental Health (NIMH) Treatment of Depression Collaborative Research Program, 239 depressed patients were treated for 16 weeks with one of four different methods: cognitive-behavioral therapy; interpersonal therapy; the tricyclic imipramine plus clinical management, a brief weekly consultation that serves as a kind of placebo psychotherapy; and a placebo pill plus clinical management. All the treatments, including the placebo, produced similar outcomes. "Although there was significant improvement from pre- to posttreatment for all treatment conditions," stated Irene Elkin of the University of Chicago, who oversaw the NIMH project, "there were surprisingly few significant differences among the treatments at termination" (Elkin, 1994, p. 130).

The popular belief that drugs and psychotherapy work best when combined was undermined by a survey conducted in 1995 by *Consumer Reports.* The magazine asked readers treated for psychological disorders to rate their treatments. Respondents reported roughly the same degree of satisfaction with psychotherapy, medications, and combination therapy (Seligman, 1995). But Alcoholics Anonymous (AA) scored higher than any of the psychotherapies or medications. The religious aspects of AA may be the key to its success. A recent study showed that religious conviction is a better predictor of remission from depression than treatment with either psychotherapy, medication, or both (Koenig, George, & Peterson, 1998).

Seymour Fisher and Roger Greenberg have asserted that many ostensibly double-blind studies of antidepressants and other psychiatric drugs are actually biased in favor of showing positive effects (Fisher & Greenberg, 1997). Because all psychiatric drugs cause side effects, both patients and physicians can often determine who has received the medication, thus triggering an expectation of improvement that becomes self-fulfilling. Fisher and Greenberg concluded that the placebo effect might explain much, if not all, of the reported effectiveness of psychiatric drugs.

The psychiatrist Walter Brown proposed that placebo pills be prescribed as the initial treatment for mild to moderate cases of depression (Brown, 1994). Brown pointed out that many depressed patients respond as well to a placebo pill as they do to antidepressants or to psychotherapy. Placebos are less expensive—and require less training to dispense—than either active medications or psychotherapy. Incred-

1. Luborsky et al. credited Saul Rosenzweig with coining the phrase "Dodo hypothesis."

ibly, there is evidence that people will respond to a placebo pill even if they know it is inert (Park & Covi, 1965).

GENE-WHIZ SCIENCE

Biopsychiatry's ascent has gone hand in hand with the rise of behavioral genetics, which views genes rather than experience as the key to human personality and pathology. Researchers studying twins have reported that even culturally defined traits such as religiosity, political beliefs, job satisfaction, and proneness to divorce are substantially inherited (Bouchard, Lykken, McGue, Segal, & Tellegen, 1990). Although these claims have been challenged, one journalist recently proclaimed that behavioral genetics "has made a persuasive case that much of our identity is stamped on us from conception; to that extent our lives seem to be pre-chosen—all we have to do is live out the script that is written in our genes" (Wright, 1997, p. 143).

What separates modern behavioral genetics from the kind practiced by Francis Galton in the 19th century is that now science has the potential to pinpoint the specific genes underlying specific traits and disorders. Over the past decade, researchers have linked specific genes to manic depression, schizophrenia, autism, alcoholism, heroin addiction, high IQ, male homosexuality, sadness, extraversion, introversion, social skills, novelty seeking, impulsivity, attention deficit disorder, obsessive-compulsive disorder, violent aggression, anxiety, seasonal affective disorder, pathological gambling, and anorexia nervosa. Like the twins studies, these findings have been touted by the media. "Oedipus, Schmoedipus. The fault, dear Sigmund, may be in our genes," *Time* declared in its article on the neurosis gene (Collins, 1996).

Those who blame the media for exaggerating the achievements of behavioral genetics should read two recent books by prominent geneticists: *Remaking Eden,* by Lee Silver (1997), of Princeton, and *Living With Our Genes,* by Dean Hamer, of the National Cancer Institute (Hamer & Copeland, 1998). Silver and Hamer both predicted that genetic engineering will eliminate mental illness, substance abuse, dyslexia, and obesity and make us smarter, happier, more athletic, more creative—and possibly even immortal.

These forecasts represent an absurd extrapolation of scientific reality. So far, not a single claim linking specific genes to specific, complex behavioral traits and disorders has been confirmed. A recent report has challenged Hamer's own claim to fame, the so-called gay gene (Rice, Anderson, Risch, & Ebers, 1999). Genuine progress has been made in finding genes associated with single-mutation diseases such as Huntington's chorea, cystic fibrosis, and severe immune deficiency. Tests are now available for identifying persons who carry these genes and thus are likely or certain to come down with the associated disease. But none of the promises of gene therapy based on this knowledge have been fulfilled. More than 300 clinical trials have been carried out so far, and every one has failed (Anderson, 1998).

DARWIN TO THE RESCUE!

Another genetic paradigm that has generated egregious hype lately is evolutionary psychology, which depicts the human mind as a bundle of adaptations sculpted by natural selection during our primordial past (Barkow, Cosmides, & Tooby, 1992; Pinker, 1997). There have been previous attempts to explain human nature in evolutionary terms, notably sociobiology, but for both political and scientific reasons they never really caught on. Evolutionary psychologists such as David Buss claim that they have corrected many of the errors of their predecessors (Buss, 1995).

Darwinian theorists have certainly generated some interesting ideas. One of my favorites is the notion that human self-deception may be adaptive, because the most effective liars are those who believe their own lies (Trivers, 1985). This principle may explain some of the recent success of evolutionary psychologists. Many of their "discoveries" seem a bit stale. Is it really news that males tend to be less sexually choosy than females? Or that seemingly altruistic behavior often stems from hidden selfish motives? Or that the brain is not just an all-purpose learning and calculating machine but a bundle of modules dedicated to different tasks?

The effort of evolutionary psychologists to avoid political problems has also led them into some logical contradictions. Evolutionary psychologists often distance themselves from behavioral genetics; they emphasize that they are interested in traits that all humans share, whereas behavioral genetics focuses on traits that set us apart. Some leading evolutionary psychologists have even denied that genetic differences between individuals have significant behavioral consequences (L. Cosmides & J. Tooby, personal communication, June 22, 1995). Evolutionary psychologists are clearly trying to avoid being associated with *The Bell Curve* (Herrnstein & Murray, 1994) and other controversial products of behavioral genetics. But if genes can account for our commonalities, as the evolutionary psychologists insist, surely genes can also account for our differences. Moreover, without genetic variation among individuals, natural selection would lack the material necessary to work its magic; evolution could not occur (Lykken, 1998).[2]

Despite its faults, behavioral genetics at least has some hope of providing clinically useful information about schizophrenia and other disorders. Most popularizations of evolutionary psychology avoid discussing mental illness, perhaps wisely (Pinker, 1997). The Darwinian theorists Randolph Nesse and George Williams have speculated that schizophrenia, depression, panic attacks, and other disorders have persisted because they conferred some benefits on our ancestors. Schizophrenia, for example, might "increase creativity or sharpen a person's intuitions about what others are thinking" (Nesse & Williams, 1994, p. 225). Although I hate to agree with Stephen Jay Gould, I think he had a point when he derided evolutionary psychology as "pure guesswork in the cocktail party mode" (Gould, 1997, p. 51).

SEEKING ARTIFICIAL COMMON SENSE

Artificial intelligence (AI) has produced a few useful applications and metaphors, such as speech-recognition devices and neural networks. But these advances pale beside the grandiose fantasies of AI proponents. In 1958, Herbert Simon and Allen Newell prophesied that AI would "help man obey the ancient injunction: Know thyself. And knowing himself, he may learn to use advances of knowledge to benefit, rather than destroy, the human species" (H. Simon & Newell, 1958). More recently, AI enthusiasts have claimed that machines represent the next step in the evolution of intelligence and will soon leave us mere humans in their cognitive dust (Kurzweil, 1998; Moravec, 1998).

2. In this interview on the Edge Web site, Lykken, a psychologist and twin researcher at the University of Minnesota, pointed out the inconsistencies of evolutionary psychologists who disavow behavioral genetics.

These cyber-prophets invariably cite Garry Kasparov's loss to the IBM computer Deep Blue in 1997 as a portent of AI's impending triumph. Actually, the contest underscored the limitations of AI. Chess, with its straightforward rules and tiny, Cartesian playing field, is a game tailor-made for computers. Deep Blue, whose five human handlers included the best chess programmers in the world, is a prodigiously powerful machine, capable of examining hundreds of millions of positions each second. If this silicon monster must strain so mightily to beat a mere human at chess, what hope is there that AI engineers will ever create HAL, the lip-reading killer in *2001?*

In *HAL's Legacy*, a collection of essays by AI experts, David Kuck stated flatly, "Under any general definition . . . AI so far has been a failure" (Kuck, 1997, p. 49). Roger Schank declared that HAL "is an unrealistic conception of an intelligent machine" and "could never exist" (Schank, 1997, p. 189). The best that computer scientists can hope to do is to create machines "that will know a great deal about what they are supposed to know about and miserably little about anything else." Even Marvin Minsky, who had predicted in the mid-1960s that computers would be as smart as humans within 3 to 8 years, admitted that "we really haven't progressed too far toward a truly intelligent machine" (quoted in Stork, 1997, p. 27). Incidentally, Minsky once told me that his favorite theorist of the mind is Freud. Minsky's precise words were as follows: "Freud has the best theories so far, next to mine, of what it takes to make a mind" (M. Minsky, personal communication, May 25, 1993).

THE HUMPTY DUMPTY DILEMMA

The field best positioned to illuminate the mysteries of the mind is not psychology, psychiatry, behavioral genetics, evolutionary psychology, or AI, but neuroscience. Neuroscientists have acquired an astonishing ability to probe the brain with microelectrodes, magnetic resonance imaging, positron emission tomography, and other tools. Neuroscience is clearly advancing; it is getting somewhere. The question is, where?

Neuroscience has had virtually no payoff in terms of diagnosing and treating mental illness. It has failed to winnow out all the competing unified theories of human nature, whether psychoanalysis or behaviorism or connectionism or evolutionary psychology. Neuroscientists are "making fundamental discoveries of great importance," Jerome Kagan has remarked, "but the observable behavioral events to which these individual discoveries apply are often unclear" (Kagan, 1994, p. 274). Three psychologists recently reported in *American Scientist* that the enormous surge in neuroscience research has not been reflected in citations in four leading psychology journals. "Clearly neuroscience is rising in prominence but, according to our measures, not within mainstream psychology" (Robins, Gosling, & Craik, 1998, p. 312).

Arguably the most important discovery to emerge from neuroscience so far is that different regions of the brain are specialized for carrying out different functions. The visual cortex contains one set of neurons dedicated to orange-red colors, another to objects with high-contrast diagonal edges, and still another to objects moving rapidly from left to right. Neuroscientists have also shown that there are many different types of memory—working, long-term, episodic, procedural, implicit, explicit—each underpinned by separate neural regions and processes (Schacter, 1996).

The question is, how does the brain coordinate and integrate the workings of these highly specialized parts to create the apparent unity of perception and thought that constitutes the mind? This conundrum is sometimes called the binding problem. I would like to propose another term: the Humpty Dumpty dilemma. Like a precocious 8-year-old tinkering with a radio, neuroscientists excel at breaking the brain into pieces, but they are not very good at putting it back together again. The Humpty Dumpty dilemma plagues not only neuroscience, but also cognitive science, evolutionary psychology, and indeed all fields that divide the mind into a collection of relatively discrete "modules," "intelligences," "instincts," or "computational devices" (Fodor, 1998).

The plight of neuroscience today resembles that of particle physics in the 1950s. During that period, the number of particles detected in accelerators proliferated wildly, and theorists trying to make sense of it all were baffled. Order finally emerged from chaos after Murray Gell-Mann and George Zweig showed that all these different particles are made of a few more fundamental particles, now called quarks. But particle physics is a child's game compared with neuroscience. When it comes to the human brain, there may be no unifying insight that turns chaos into order.

The neuroscientist Joseph LeDoux, of New York University, once complained that any discussion of neuroscience's limits is grossly premature because the field is "infantile" (LeDoux, 1997). Actually, the roots of neuroscience run as deep as those of any other field of science. Luigi Galvani showed two centuries ago that nerves emit and respond to electric current, and around the same time Franz Gall proposed the first modular-mind theory, phrenology. William James wrote *Principles of Psychology* in 1890, while Camillo Golgi, Santiago Ramon y Cajal, and others were beginning to unravel the structure and function of neurons.

LeDoux's claim that neuroscience is still in its infancy is based not on his field's actual age but on its productivity. As LeDoux (1997) himself acknowledged: "We know very little. We have no idea how our brains make us who we are. There is as yet no neuroscience of personality . . . . The meltdown of mental life in psychosis is still a mystery." LeDoux and I agree on the current status of his field. The question, again, is how far will neuroscience and related fields go in the future, given how little progress there has been to date?

Optimists like LeDoux contend, essentially, that the lack of progress in mind science thus far means that great things lie ahead. In other words, past failure predicts future success. This is not an argument but an expression of faith. I am inclined to agree with another neuroscientist, Gunther Stent, who predicted 30 years ago that "the brain might not be capable, in the last analysis, of providing an explanation of itself" (Stent, 1969, p. 74).

Stent's views have been echoed by Howard Gardner. Psychology has not "added up to an integrated science," Gardner declared, "and it is unlikely ever to achieve that goal" (Gardner, 1992, p. 180). Gardner contended that neither psychology, neuroscience, nor any other field has provided much illumination of psychology's "core" topics: consciousness, the self, free will, and personality. These subjects "seem particularly resistant to decomposition, elementarism, or other forms of reductionism," Gardner said (p. 186). He contended that psychologists may advance by adopting a more "literary" style of investigation and discourse—the style exemplified by Freud.

WHAT'S THE UPSIDE?

When I first considered writing a book critiquing mind-related science, I discussed the idea with a literary agent. He told me that

the theme sounded interesting but somewhat negative. Did my message have an "upside," so that readers would not go away depressed? After giving the matter some thought, I came up with a couple of upsides. The first is that if we accept that the human mind is in certain respects irreducible, we may become less susceptible to pseudoscientific ideologies based on Freudianism, or Darwinism, or DNA, or Prozac, or computers. The second upside has more relevance for readers of this journal: The problems posed by the human mind are so important, both pragmatically and intellectually, that society will surely never stop funding efforts to solve them. The fact that these problems may also be intractable means that mind science may last forever. Inner space is science's final—and possibly eternal—frontier.

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