

(admittedly brilliant) hackers, Brand accentuates their creativity and enthusiasm. Part of the Media Laboratory's heritage (its origins are in the School of Architecture) is a startling receptivity to the arts, especially music and the visual arts, and Brand repeatedly returns to this subject. Even here, intellectualism reigns: It is symptomatic that the lab members' interest in literature seems to be limited to science fiction. This lopsidedness echoes Turkle's complaint that hackers ignore the texture (emotion) of music in favor of its structure (intellect).

Not an engineer himself, Brand is not always in a position to critically evaluate what he saw; I was reminded of persons who, on seeing ELIZA, concluded that computerized psychotherapy was just around the corner. As Brand points out, the Media Lab replaces the publish-or-perish imperative with demo or die, and anyone who has produced a demo knows something about practical mendacity. Brand also tends to give short shrift to the perverse ways in which market forces can sabotage visionary ideas and to the disturbing potential of these technologies, for example, as part of government spying efforts on citizens and in widening and solidifying class differences; reducing the quality of free speech by overwhelming us with quantity; and, of course, facilitating aggression. Finally, there was no attempt to balance the boosterism of the lab's enthusiasts (such as the director, Nicholas Negroponte, whom he describes as a world-class salesman) with the critical assessments of the value of their work. The author is on the side of the visionaries, not the skeptics.

Brand manages to describe a fair number of research projects in this medium-length, popular survey and to be lucid and inspiring about most of them, although the low level of technical detail might leave many sophisticated readers unsatisfied. After briefly sketching Nicholas Negroponte's biography and philosophy in the first chapter, Brand lists the 11 project groups (circa 1986) that the book discusses: (1) electronic publishing (Walter Bender on NewsPeek, an electronic newspaper that adapts to the user's preferences, and Andy Lippman on interactivity), (2) speech (Chris Schmandt on a speech-understanding voice message system), (3) an advanced television

research program (William Schreiber on high-density TV [HDTV] and Steve Benton on an advanced beam-mixing television display), (4) movies of the future (putting feature-length movies on laser disks, thereby ushering in paperback movies), (5) the visible language workshop (Muriel Cooper in collaboration with professional designers to better exploit computer graphics), (6) spatial imaging (Stephen Benton on printed and projected holography), (7) computers and entertainment (Alan Kay on the Vivarium, a detailed computer model of an ecosystem using sophisticated graphics and robotics), (8) animation and computer graphics (David Zeltzer on the modeling of biological motion and Carl Feynmann on the physics of clothing), (9) computer music (Barry Vercoe on his robotic piano accompanist and Tod Machover on interactive and improvisational music programs), (10) the school of the future (Seymour Papert on his LOGO project), and (11) the human-machine interface (psychologist Richard Bolt on his research on using eye movements as input). Woven into the discussions of Media Lab research are brief sketches of related work that did not originate in the Media Lab but that is just as fascinating.

Members of the AI community will probably already be familiar with the ideas of Marvin Minsky, Seymour Papert, and Daniel Hillis from these scientists' own publications or from scuttlebutt. The material on HDTV, antialiasing, user interfaces, holography, and computer music will be familiar to fewer AI people but nonetheless absorbing. The chapters that are most likely to be new and fascinating concern the long-range, global implications of rapidly developing communication and computing technologies. Although much of the discussion along these lines is either conventional wisdom or wildly speculative, the views of professional trend-watchers Peter Schwartz and Jay Ogilvy are enlightening and persuasive, although they are unfortunately presented as transcripts of conversations.

In summary, *The Media Lab* is an attractive, entertaining, well-written, light technical book for general audiences. It has a useful bibliography but a somewhat larger index than a book of this type really needs. For workers in computers and communications, it can serve as a pleasant, if shallow,

introduction to new and provocative ideas as well as a pointer to additional information. Like Richard Feynman's two books of memoirs and Gleick's *Chaos*, this book will be passed among workers in computer and engineering departments as a good read.

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Representation and Reality

Lee A. Gladwin

In *Representation and Reality* (MIT Press, Cambridge, Mass., 1988, 134 pp., \$19.95, ISBN 0-262-16108-7), Hilary Putnam, the father of functionalism, turns on his mind child, declaring that "functionalism, construed as the thesis that propositional attitudes are just computational states of the brain, cannot be correct." After years of reflection, he now argues that the mind-machine analogy fails to answer the question, What is the nature of mental states? He describes functionalism as a reaction to the "idea that our matter is more important than our function, that our what is more important than our how"; that is, a machine or human brain could all "work much the same way when described at the relevant level of abstraction," and it is wrong to think that the essence of our minds is our hardware.

Although still retaining this view, Putnam states that his previous arguments "to show that a simpleminded identification of mental states with physical-chemical states cannot be right can be generalized and extended to show that a straight-forward identification of mental states with functional states, i.e., with computationally characterized states, also cannot be right."

Putnam takes issue with the attempt to unify belief-desire psychology with a computational model of the mind by identifying beliefs and desires as functional states. He proceeds to reject Jerry Fodor's notion of innate universally held concepts that can be decomposed

into semantic representations. Finally, he rejects the idea that concepts are "scientifically describable ('psychologically real') entities in the mind or brain." In sum, he now believes that mental states are not to be identified with either physical-chemical states or computational states and that there is a need "for a different way of looking at problems about 'mental states'."

For Putnam, meaning is a mutable entity that has "an identity through time [but] no essence." He notes that the term momentum had one meaning for Newton and another for Einstein. Meaning is also socioculturally determined through interaction with environment; for example, the word bonnet refers to a cap in the United States and to the hood of a car in the United Kingdom. Additionally, "two different representations may have the same reference (denotation)," such as rational animal and featherless biped. The relevance of meaning to time and sociocultural interaction with the environment poses complex problems for answering questions about the interpretation of sameness of meaning and reference. Botanists in the twentieth century refer to the same plants as their counterparts in the eighteenth century, but the two generations hold different beliefs about the presence of chlorophyll, the occurrence of photosynthesis, and so on. Putnam concludes "that what is preserved in translation isn't just 'mental representations'" and that mental representations don't suffice to fix reference.

Putnam concludes that "computational models of the brain/mind will not suffice for cognitive psychology," noting that "concepts and beliefs [cannot be individuated] without reference to the environment; i.e., our meanings are not simply 'in the head'." Propositional attitudes "are not 'states' of the human brain and nervous system considered in isolation from the social and non-human environment." They cannot, then, be viewed as functional states.

Putnam's emphasis on the evolution of meaning relative to time and environment and experiential learning is somewhat reminiscent of arguments found in Hubert L. Dreyfus and Stuart E. Dreyfus's *Mind over Machine: The Power of Human Intuition and Expertise in the Era of the Computer* (Free Press, New York, 1988), in which expert intuition in solving

problems is traced to the acquisition of situation prototypes through extensive experience. In fact, Putnam's discussion of the testing of scientific theory could almost have been written by the Dreyfus brothers. Scientific theory cannot be tested sentence by sentence, he writes. "Rather, it involves very intangible things, such as estimating simplicity...and weighing simplicity against our desire for successful prediction and also against our desire to preserve a certain amount of past doctrine. It involves having a nose for the 'right' trade-off between such values."

Those interested in other challenges to the mind-machine analogy will want to read John Heil's *Perception and Cognition* (University of California Press, 1983) for his views on the individual nature of perception and belief construction as well as his challenge to the thesis of internal representation. Heil finds it possible to speak of "representational states in explanations of cognitive phenomena without...dragging in some notion of internal systems of representation or, on the other hand, falling back on one or another species of reductionism." Perception can be viewed as the production of certain belieflike cognitive states in us without embracing "the view that such states must be understood as interior computational or syntactic configurations."

Interested readers will also want to read Jerry Fodor's *Psychosemantics: The Problem of Meaning in the Philosophy of Mind* (MIT Press, Cambridge, Mass., 1987) for the views that sparked many of the comments made by Putnam and Heil.

Given these ringing endorsements of experiential learning and the individualization of meaning, it is a wonder that there is any meaning left to share, but, of course, there is. Experience as individual interaction with the environment is not the only

way to derive meaning. To quote Benjamin Franklin, "Experience keeps a dear school, but a fool will learn in no other." If experience were the sole way to teach, say through labs and the discovery method, education would have ground to a halt long ago. Fortunately, a direct method of providing for an engineered sequence of learning experiences exists: It's called a curriculum.

Suppose, then, we hold an Inter-galactic Summer Symposium on Shared Meaning. Jerry Fodor comes from Earth 1 where an ordinary feline is gray, sleeps before the fireplace, disembowels small rodents, acts out of beliefs and desires, and is called a cat. From Earth 2 comes Hilary Putnam, who has an identical feline except that it has traces of catnip in its blood and would send out for pizza before eating a mouse. It is called a furniture terminator, which means cat. Initially, both men use the word cat when they refer to different items and hold different prototypes of cat. By the end of the symposium, however, both have revised their prototypes to include other types of felines and are careful to specify that they are referring to cat1 or cat2. In time, their conceptual frameworks will no longer resemble what was gained from their shared experience in the symposium, but perhaps they will return for a refresher course.

Anyone interested in the debate over the mind-machine analogy, the limits of AI, and the problems of modeling the mind, for example, intelligent tutoring system design and development, will find *Representation and Reality* must reading.

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