

EXPLORING Intelligence

A Search in the Human, Animal, Machine and Extraterrestrial Domains

INTRODUCTION

6 Intelligence Considered

by Philip Yam, issue editor

Most people can identify intelligent signals, be they from a person, animal or machine. But can brainpower be measured, quantified and changed? Is human reasoning similar to how an animal might obtain a hidden treat or how a machine decides to trade a rook for a bishop? A definition is trickier than it might appear.

Twin savants
page 32



Scientific American Presents (ISSN 1048-0943), Volume 9, Number 4, Winter 1998, published quarterly by Scientific American, Inc., 415 Madison Avenue, New York, NY 10017-1111. Copyright © 1998 by Scientific American, Inc. All rights reserved. No part of this issue may be reproduced by any mechanical, photographic or electronic process, or in the form of a phonographic recording, nor may it be stored in a retrieval system, transmitted or otherwise copied for public or private use without written permission of the publisher. Periodicals Publication Rate. Postage paid at New York, N.Y., and at additional mailing offices. Canadian BN No. 127387652RT; QST No. Q1015332537. Subscription rates: one year \$19.80 (outside U.S. \$23.80). To purchase additional quantities: 1 to 9 copies: U.S. \$5.95 each plus \$2.00 per copy for postage and handling (outside U.S. \$5.00 P & H); 10 to 49 copies: \$5.35 each, postpaid; 50 copies or more: \$4.75 each, postpaid. Send payment to Scientific American, Dept. SAQ, 415 Madison Avenue, New York, NY 10017-1111. Postmaster: Send address changes to Scientific American Presents, Box 5063, Harlan, IA 51593. Subscription inquiries: U.S. and Canada (800) 333-1199; other (515) 247-7631.

HUMAN INTELLIGENCE

12 How Intelligent Is Intelligence Testing?

by Robert J. Sternberg

SATs and IQ tests don't tell everything about a person's chances of success in college or at a job, the author claims. Creativity and practical intelligence ("street smarts") are critical components as well, and tests can be devised that accurately assess these abilities. Unfortunately, they are overlooked in the big business of standardized testing.

18 A Multiplicity of Intelligences

by Howard Gardner

According to the theory of multiple intelligences, there are eight, possibly nine, different kinds of intelligence, including musical, athletic and personal. The originator of the theory discusses these ideas and argues that they are just as important as the intelligence measured by paper-and-pencil tests.

24 The General Intelligence Factor

by Linda S. Gottfredson

Also known as *g*, the general intelligence factor is what IQ tests are all about. Despite the political controversy surrounding it, the test scores and their differences, the author argues, are meaningful indicators not only of academic performance but also of future life outcomes, such as employment, divorce and poverty.

30 For Whom Did the Bell Curve Toll?

by Tim Beardsley, staff writer

The most controversial book on intelligence in the past decade created much political and media upheaval. But its conclusions as they relate to social policy are poorly grounded, and little has actually come in the way of policy changes.

32 Uncommon Talents: Gifted Children, Prodigies and Savants

by Ellen Winner

Often assumed to be well adjusted and easy to teach, gifted children and prodigies are generally out of step with their peers and can develop feelings of isolation that prevent them from achieving as adults. Most extreme are savants, who have a phenomenal capacity for calculation or memory despite being autistic.



38 Seeking “Smart” Drugs

by Marguerite Holloway, staff writer

Research on stemming the ravages of Alzheimer’s disease and other dementia conditions is paving the way for drugs that might enhance the memory capacity of healthy individuals. Pharmaceutical firms are racing to develop these cognitive enhancers, but the most effective smart drugs may already be in your kitchen.

44 The Emergence of Intelligence

by William H. Calvin

From evolution’s perspective, why did intelligence arise? The ability to anticipate and plan may have come about as a result of the need to organize ballistic movements, such as throwing, and language may have enabled humans to develop an ability to conceptualize.

ANIMAL INTELLIGENCE

52 Reasoning in Animals

by James L. Gould and Carol Grant Gould

Mounting evidence indicates that many species can infer concepts, formulate plans and employ simple logic to solve problems. Much of what they learn, however, is dictated by instinct and limited by an inability to learn from observation.



60 Talking with Alex: Logic and Speech in Parrots

by Irene M. Pepperberg

Mimicry is the mainstay of a parrot’s speech, but Alex the Grey parrot seems to understand what he says. He can count, identify the odd-man-out from a group and determine what’s the same and what’s different. The author, who has worked with Alex for more than 20 years, describes the teaching approach that permits the exploration of Alex’s cognitive abilities.

Animal Self-Awareness: A Debate

66 Can Animals Empathize?

Yes. Animals that learn to recognize themselves in mirrors—chimpanzees, orangutans and humans—are self-aware and therefore can infer the states of mind and emotions of other individuals.

by Gordon Gallup, Jr.

Maybe not. Chimps will beg for food from a blind-folded person as often as from a sighted one. Such tests suggest they cannot conceive of others’—and perhaps even their own—mental states.

by Daniel J. Povinelli

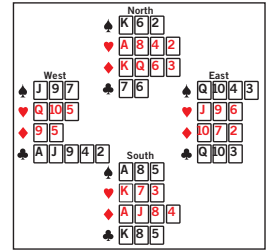
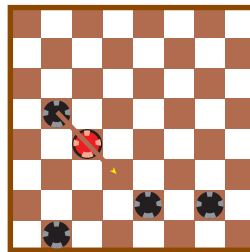
MACHINE INTELLIGENCE

78 On Computational Wings: Rethinking the Goals of Artificial Intelligence

by Kenneth M. Ford and Patrick J. Hayes

The “gold standard” of traditional artificial intelligence—passing the so-called Turing test and thereby appearing to be human—has led expectations about AI astray. Drawing an analogy to flying—modern aircraft do it quite well without mimicking birds—the authors argue that AI has made substantial achievements and, in fact, pervades everyday life.

84



Computers, Games and the Real World

by Matthew L. Ginsberg

Deep Blue may have deep-sixed the world chess champion last year, and machines are tops in checkers and Othello, but games such as bridge, Go and poker still elude competent computer play. The issue, though, isn’t simply pitting humans against machines. Games enable programmers to explore the algorithms and to decide which are best for particular problems.

90 Wearable Intelligence

by Alex P. Pentland

Soon you may no longer fumble through your memory for dates, figures or the location of your favorite restaurant. Researchers are miniaturizing computer machinery so that the devices can be worn unobtrusively as clothing, eyeglasses and shoes. They can provide travel directions, Internet access, electric power and foreign-language translation.

THE SEARCH FOR EXTRATERRESTRIAL INTELLIGENCE

96 Is There Intelligent Life Out There?

by Guillermo A. Lemarchand

The odds say we aren’t alone, but radio telescopes have yet to pick up a definite intelligent signal beyond Earth. Improving the chance of first contact may depend on searches around supernovae and even sending out our own greetings to likely candidate star systems.

100 Table of Major SETI Projects