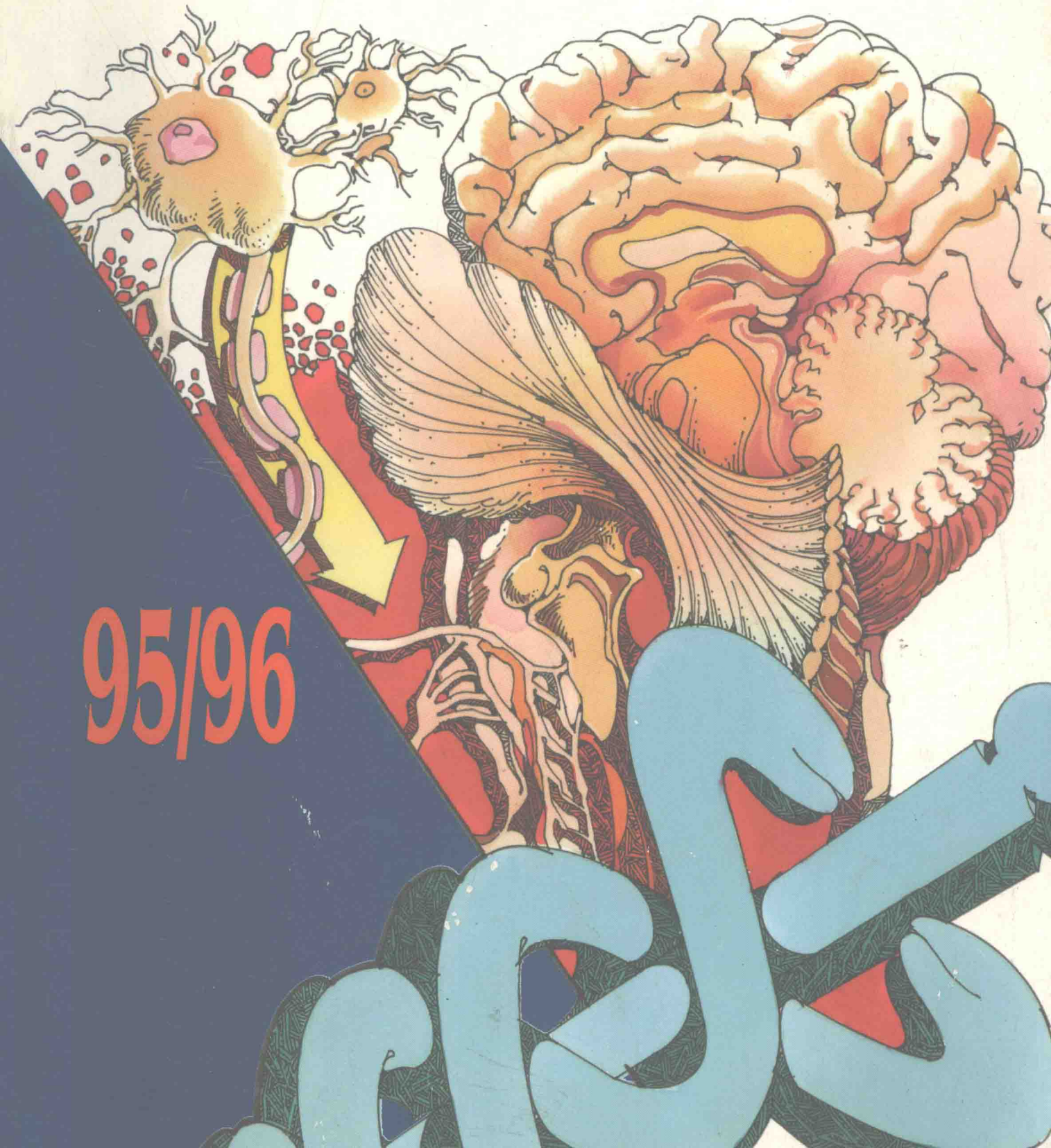
ANNUAL EDITIONS

BIOPSYCHOLOGY



95/96

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Editors/ Advisory Board

Members of the Advisory Board are instrumental in the final selection of articles for each edition of Annual Editions. Their review of articles for content, level, currentness, and appropriateness provides critical direction to the editor and staff. We think you'll find their careful consideration well reflected in this volume.

To the Reader

In publishing ANNUAL EDITIONS we recognize the enormous role played by the magazines, newspapers, and journals of the *public press* in providing current, first-rate educational information in a broad spectrum of interest areas. Within the articles, the best scientists, practitioners, researchers, and commentators draw issues into new perspective as accepted theories and viewpoints are called into account by new events, recent discoveries change old facts, and fresh debate breaks out over important controversies.

Many of the articles resulting from this enormous editorial effort are appropriate for students, researchers, and professionals seeking accurate, current material to help bridge the gap between principles and theories and the real world. These articles, however, become more useful for study when those of lasting value are carefully *collected, organized, indexed,* and *reproduced* in a *low-cost format*, which provides easy and permanent access when the material is needed. That is the role played by *Annual Editions*. Under the direction of each volume's *Editor*, who is an expert in the subject area, and with the guidance of an *Advisory Board*, we seek each year to provide in each *ANNUAL EDITION* a current, well-balanced, carefully selected collection of the best of the public press for your study and enjoyment. We think you'll find this volume useful, and we hope you'll take a moment to let us know what you think.

Congress has declared the 1990s as the "Decade of the Brain" and the World Congress of Neuroscience anticipates that the twenty-first century will be the "Century of the Brain." These announcements recognize the benefits of discoveries in the field of neuroscience to humanity. The study of the brain is not an easy task, so the field of neuroscience is divided into several disciplines. Some scientists study the brain's anatomy (neuroanatomy), cellular and regional functions (neurophysiology), or response to drugs (neuropharmacology). Biopsychology, on the other hand, integrates several biological mechanisms of the brain, as well as genetic and evolutionary factors, with the regulation of behavior. Biopsychology assumes a difficult but challenging role in revealing the biological attributes of psychological events.

Advances in molecular biology help us understand how the nervous system works. There is a clearer understanding of the processes involved in neurotransmitter synthesis, release, and actions at the synapse because of these advances. It is also possible to identify the genes associated with both normal and abnormal behaviors, using techniques in molecular biology. Information derived from these studies reveal the underlying cellular and molecular mechanisms of psychological processes.

Neuroimaging techniques make it possible to visualize events in the brain during the performance of cognitive tasks. These techniques produce pictorial representations of functional changes in various brain regions during cognitive tasks, such as reading, talking, and problem solving. Neuroimaging techniques are also invaluable in assessing neurological disorders.

In spite of the impressive achievements in biopsychology, attributions made of biological mechanisms to psychological phenomena must remain judicious. Human behavior is far too complex, sophisticated, and labile, and biological determinants are often insufficient in providing explanations. Even the most sophisticated computer models cannot sufficiently simulate the higher cognitive functions in man, such as concept formation and creativity.

Although biopsychology recognizes the important roles that biology exerts on behavior, it does not necessarily subscribe to the dogma of biological determinism, nor does it aim to reduce behavior into molecules and electrical potentials. Biopsychology is a perspective amongst many that has proven heuristic in understanding behavior. In order to get to the very nature of behavior, integration of ideas from different perspectives is needed. Ideas from psychoanalytic to behavioral perspectives, or from philosophy to physics, are usually helpful.

The goals of this first edition of *Annual Editions: Biopsychology* are threefold: to assist in the understanding of biopsychological mechanisms; to develop an appreciation of the contributions of biopsychology toward human welfare, and to encourage a synthetic approach in understanding behavior. This edition consists of 11 units that deal with major concepts in biopsychology. The anthology of articles within each unit represents seminal reports or recent significant discoveries in the field. Some articles represent current topics of public interest on the basis of frequent media coverage.

I hope that *Annual Editions: Biopsychology* fulfills its goals and provides many interesting readings. I also hope that this anthology does not exaggerate nor understate the field of biopsychology. Either way is an offense to the brilliant minds who have contributed significant ideas to the field and to those who are now working hard to continue the legacy.

This book is an anthology, and any anthology can be improved. You can influence the content of future editions by returning the article rating form at the end of the book with your comments and suggestions.

Boyce M. Jubilan
Editor

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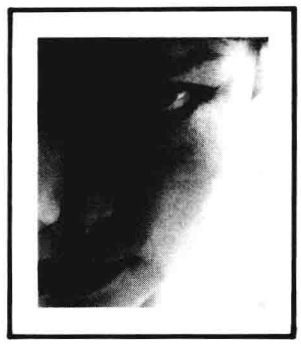

Unit 1

Methods in Biopsychology

The four articles in this section discuss brain analysis techniques used in assessing the mechanics of brain function.

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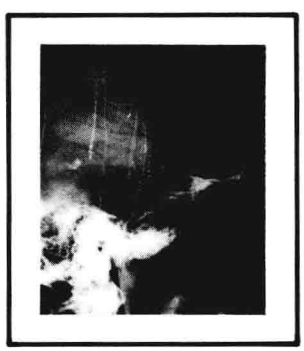
1. **Visualizing the Mind,** Marcus E. Raichle, *Scientific American,* April 1994. 6
   Brain analysis techniques, such as ***magnetic resonance imaging (MRI), X-ray computed tomography (X-ray CT), positron-emission tomography (PET),*** and ***magnetoencephalography (MEG),*** are described in this article. The significance of these ***techniques*** is discussed in relation to its (a) use in understanding brain functions and (b) applications in the ***clinical*** setting.
2. **Mapping the Mind,** June Kinoshita, *New York Times Magazine,* October 18, 1992. 14
   A husband and wife team of neuroscientists, Drs. Antonio and Hanna Damasio, uses neuroimaging techniques, such as ***magnetic resonance imaging (MRI),*** to observe brain activity in some cases of brain disorders. The technique can be used to understand how the brain evaluates, stores, and remembers information.
3. **Expression of C-Fos Protein in Brain: Metabolic Mapping at the Cellular Level,** S. M. Sagar, F. R. Sharp, and T. Curran, *Science,* June 3, 1988. 21
   Neurons can express the ***proto-oncogene c-fos*** when activated by a variety of stimuli. The ***c-fos protein (Fos)*** can be visualized using ***immunocytochemical techniques. Fos immunocytochemistry*** can be used to map functional pathways in the nervous system.
4. **Gateway to the Brain,** Ricki Lewis, *BioScience,* March 1994. 25
   The brain is protected from the infiltration of certain biological entities by a complex system known as the ***blood-brain barrier (BBB).*** Although protective in function, the ***BBB*** prevents some therapeutic agents from reaching the brain and in so doing hinders therapeutic efficiency. New ***techniques*** developed to penetrate the BBB are discussed in this article.



Unit 2

The Neuron and Regions of the Brain

The three articles in this section examine the function of neurotransmitters.

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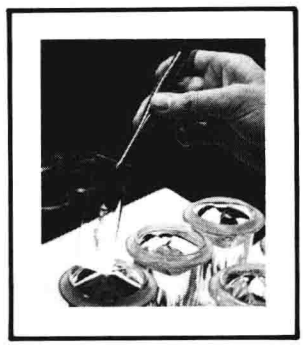
5. **Janus Faces of Nitric Oxide,** Solomon H. Snyder, *Nature,* August 12, 1993. 32
   Nitric oxide (NO), a gas under atmospheric conditions, behaves much like a ***neurotransmitter*** and plays a significant role in neurotransmission. A significant increase of ***NO*** in the nervous tissue can also be toxic to the cells.
6. **A New Job for the Thalamus,** Wolf Singer, *Nature,* June 9, 1994. 34
   The ***thalamus*** is traditionally considered to be the relay station in the brain because it sends incoming sensory information to target areas in the ***cerebral cortex.*** However, ***feedback*** connections from the ***cortex*** to the ***thalamus*** have also been reported. These connections may serve as neural pathways through which the ***thalamus*** can organize information for further cortical processing.
7. **The Return of Phineas Gage: Clues About the Brain from the Skull of a Famous Patient,** Hanna Damasio, Thomas Grabowski, Randall Frank, Albert M. Galaburda, and Antonio R. Damasio, *Science,* May 20, 1994. 36
   The classic case study of ***Phineas Gage*** has provided significant understanding of the role of the ***cerebral cortex*** in the regulation of behavior. Recent modern techniques of ***neuroimaging*** Gage's skull identified the specific areas of the cortex involved in this control.



Unit 3

Neural Development and Plasticity

Five articles examine how mental development is affected by psychoactive substances, diet, and other nutritional chemicals.

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8. **Building a Better Brain,** Daniel Golden, *Life,* July 1994. 42
   The remarkable plasticity of the adult brain is exemplified in a group of elderly nuns living in a convent in Minnesota. Of the 150 retired nuns, 25 are older than 90. The incidence of Alzheimer's disease among the nuns is lower than that of the general population. Their secret is exposing the mind to constant challenges with worthwhile cognitive tasks.
9. **Innocent Victims,** Anastasia Toufexis, *Time,* May 13, 1991. 47
   Abuse of ***psychoactive substances*** such as crack cocaine by pregnant women can eventually lead to children with certain physical, as well as psychological, deficiencies. The drugs can interfere with the normal ***development*** of the brain and, as a result, these children can experience poor cognitive abilities and control of ***emotions***.
10. **Nutrition and Mental Development,** Henry N. Ricciuti, *Current Directions in Psychological Science,* April 1993. 50
    Normal ***development*** of the body, including the brain, requires a proper ***diet.*** Some disorders of mental development, such as mental retardation, are associated with poor nutrition. This nutritional status interacts with the environmental surroundings of a child during the course of mental development.
11. **It's All in the Timing,** Julie Ann Miller, *BioScience,* February 1993. 54
    Developmental ***dysphasia*** and ***dyslexia*** in humans are associated with deficiencies in processing sensory information that is presented in rapid succession. This effect also holds true for auditory processing. An ***animal model*** has been developed to investigate the brain mechanism involved in processing sound stimuli presented in succession with the hope that it can provide a tool for understanding certain ***developmental disorders*** in humans.
12. **Neurotrophic Factors Enter the Clinic,** Marcia Barinaga, *Science,* May 6, 1994. 56
    A novel approach in the teatment of certain nervous tissue disorders is the use of ***neurotrophic factors. Neurotropic factors*** are proteins that allow neurons to live healthily. Several biotechnology companies are embarking on this project.

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Sensation and Movement

Five unit articles discuss the sensory systems of smell, taste, touch, and hearing and how hormones interact with behavior.

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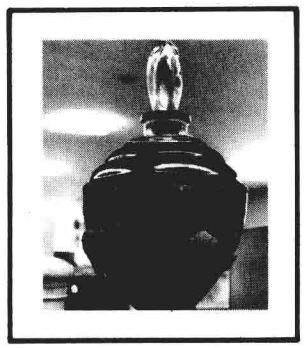
13. **In the Realm of the Chemical,** David H. Freedman, *Discover,* June 1993. 62
    Probably the oldest sensory systems existing among organisms, including humans, within the context of evolution, are the sensory systems that rely on chemicals as stimuli. These so-called chemical senses are the senses of ***smell*** and ***taste.*** The neural pathways for processing smell and taste stimuli are described in this article.
14. **The Sniff of Legend,** Karen Wright, *Discover,* April 1994. 68
    Pheromones are chemical signals that convey a variety of information relevant to reproduction, aggression, recognition, and other behaviors necessary for survival. Although pheromonal communication is well documented in nonhuman species, its relevance to human behavior is controversial.
15. **Touching the Phantom,** James Shreeve, *Discover,* June 1993. 73
    The ***sense of touch*** is mediated by specialized receptors found on the surface of the skin and processed by neurons in the ***sensory cortex*** of the brain. Some people who had limbs amputated report subjective sensory experience of touch coming from the lost parts, as if these parts were still intact. James Shreeve discusses this phenomenon.



Unit 5

Motivation: Hunger and Aggression

The six articles in this section examine how hunger and aggression can be motivated by chemicals, hormones, and neurotransmitters.

16. **Metabolic Sense,** Jill E. Schneider, *Hormones and Behavior,* March 1992. **79**

All animals, including humans, require an optimal amount of ***metabolic energy*** for survival. When the metabolic energy level is critically low (or high), the body makes physiological and behavioral adjustments to maintain ***homeostasis.*** These adjustments are believed to be mediated by a unique sensory system sensitive to fluctuations in metabolic energy levels.

17. **Brain Locates Source of a Sound with Temporal, Not Spatial, Clues,** Sandra Blakeslee, *New York Times,* May 10, 1994. **82**

Sound stimuli are processed by specialized neurons found in the ***auditory cortex*** of the brain. These neurons have the ability to encode the location of sound in the environment. Whether a ***spatial*** or ***temporal map*** exists in the ***auditory cortex*** is subject to speculation.

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18. **Hypothalamic Neuropeptide Y and the Regulation of Eating Behavior and Body Weight,** B. Glenn Stanley and Elizabeth R. Gillard, *Current Directions in Psychological Science,* February 1994. **86**

The ***hypothalamus*** is a key brain structure involved in the regulation of ***eating*** behavior. A peptide associated with the control of eating is called ***neuropeptide Y.*** Studies show that injection of neuropeptide Y into the hypothalamus stimulates eating.

19. **Can What You Eat Make You Smarter and Happier?** *Consumer Reports on Health,* May 1994. **93**

A person's ***diet may indeed affect their mood and improve their minds.*** Research is inconclusive at this point, but there are indications that different foods, individual nutrients, and eating habits can affect how clearly people think and how good they feel.

20. **Diet and Health: What Should We Eat?** Walter C. Willett, *Science,* April 22, 1994. **95**

The ***diet*** we eat significantly affects our ***health.*** The massive proliferation of information concerning ***diet*** and ***health*** sometimes leads to confusing conclusions. Walter Willett summarizes reliable information on the subject and includes the recommendations of the ***National Research Council (NRC).***

21. **The Biology of Violence,** Jane Ellen Stevens, *BioScience,* May 1994. **101**

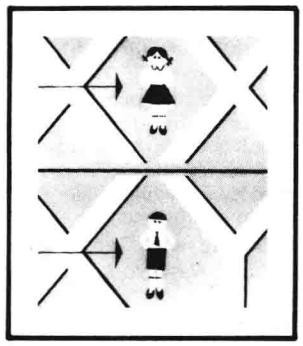
Violence is a leading cause of death in America. The ***National Research Council (NRC)*** describes the role of biology in the etiology of ***violence.*** Factors such as genetics, hormones, ***neurotransmitters,*** and ***brain damage*** may be involved in violent behaviors.

22. **A Violence in the Blood,** Sarah Richardson, *Discover,* October 1993. **105**

A significant finding was reported in a Dutch study concerning the biological basis of ***violent*** or ***aggressive*** behavior. A ***gene*** coding for an enzyme called ***monoamine oxidase A (MAOA)*** was found to be defective in certain individuals showing violent behavior. The defect appears to be heritable.

23. **Human Aggression While Under the Influence of Alcohol and Other Drugs: An Integrative Research Review,** Brad J. Bushman, *Current Directions in Psychological Science,* October 1993. **107**

Psychoactive substances such as ***stimulants*** and ***depressants*** have been known to affect behavior, quite often in harmful ways. The associations between ***psychoactive substances*** and ***aggression*** are examined in this article.



Unit 6

Reproductive Behavior

Four articles discuss the underlying mechanisms that control sexual drive.

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24. **The Mating Game,** *U.S. News & World Report,* July 19, 1993. 114

Evolutionary biologists, sociobiologists, and psychologists have speculated on what basis we choose our mates or partners in life. Possible criteria are one's ability to invest time and resources, fertility, and health status. Behavioral and physical signs are used to evaluate these characteristics.

25. **Is Homosexuality Biologically Influenced?** Simon LeVay, Dean H. Hamer, and William Byne, *Scientific American,* May 1994. 118

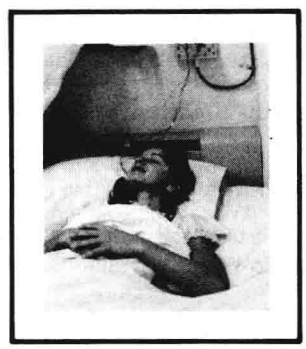
The search for the underlying mechanisms for ***sexual preference*** is laden with controversies. In part one of this two-part article, Simon LeVay and Dean Hamer review the current understanding of the biological mechanism underlying ***homosexuality*** in humans. In the second part, William Byne argues that current data lack substance.

26. **A Torrid Affair,** Bruce H. Dobkin, *Discover,* June 1992. 130

A report describes a woman whose ***sexual behavior*** was intensified after an auto accident caused ***brain damage.*** Some studies suggest that human ***sexual drives*** are controlled by certain brain regions and ***neurotransmitter*** systems.

27. **Male Hormone Molds Women, Too, in Mind and Body,** Natalie Angier, *New York Times,* May 3, 1994. 133

Males and females have both ***estrogen*** and ***testosterone*** circulating in their blood, but the amounts vary between sexes. Natalie Angier discusses the significance of these ***steroid hormones*** on physical and psychological development of males and females.



Unit 7

Sleep and Biological Rhythms

Three selections in this section discuss the physiological and environmental variables that influence the daily rhythms of sleep and wakefulness.

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28. **Alert at the Switch,** Martin Moore-Ede, *Technology Review,* October 1993. 138

It is assumed that people are alert when at work. ***Sleep*** and ***wakefulness*** are very important concerns for jobs that operate 24 hours a day. Physiological and environmental variables can significantly influence one's state of ***wakefulness.***

29. **Mystery of Sleep Yields as Studies Reveal Immune Tie,** Sandra Blakeslee, *New York Times,* August 31, 1993. 144

Sleep-deprived rats tend to die of bacterial infections of the blood, and sleep deprivation may have affected the animals' ***immune response*** to invading organisms. Studies on sleep-deprived humans also show significant alteration of the ***immune response.***

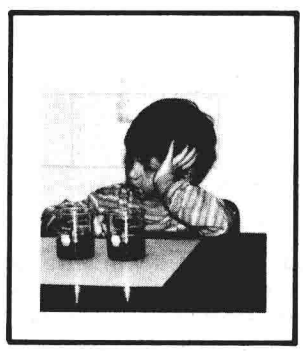
30. **Time *Is* the Essence: Molecular Analysis of the Biological Clock,** Terry L. Page, *Science,* March 18, 1994. 147

The body exhibits certain physiological and behavioral events in predictable rhythms. These rhythms are believed to be controlled by specialized cells serving as ***"biological clocks."*** Terry Page presents the molecular mechanisms of these biological clocks.

Unit 8

Emotions, Stress, and Health

Four unit articles examine how emotions and health can be impacted by one's cultural environment, physiology, and level of hostility.



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Learning and Memory

The five articles in this section review how cognitive abilities are developed.

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31. **Emotions Research: Some Promising Questions and Some Questionable Promises,** R. B. Zajonc and Daniel N. McIntosh, *Psychological Science,* January 1992. 152
The authors provide a current overview on the progress of research on ***emotions.*** A person's cultural environment, as well as internal physiological states, can significantly influence the experience of ***emotions.***

32. **Autonomic Nervous System Differences among Emotions,** Robert W. Levenson, *Psychological Science,* January 1992. 157
One of the enduring debates concerning the biological basis of ***emotions*** involves the relationship between physiological responses (specifically the ***autonomic nervous system*** response) and subjective ***emotions.*** Recent studies show distinctive responses between negative and positive ***emotions.***

33. **Stress, Emotion, and Human Immune Function,** Ann O'Leary, *Psychological Bulletin,* November 1990. 162
Ann O'Leary presents one of the most comprehensive reviews of the interactions among ***stress, emotion,*** and ***immune response*** in humans. An overview of the immune system and discussion of human illness such as ***cancer*** and ***AIDS*** are also included.

34. **How Dangerous to the Heart Is Anger? Perhaps Not Very,** Natalie Angier, *New York Times,* February 10, 1993. 176
Recent studies have found some correlations between the degree of ***hostility*** and incidence of ***coronary heart disease.*** The relationship between these two factors, however, could be influenced by the individual's gender and age.

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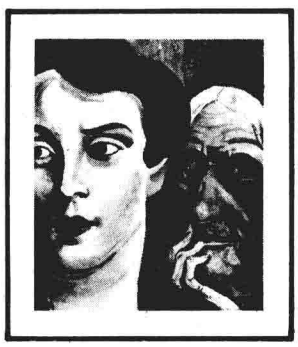
35. **Mental Decline in Aging Need Not Be Inevitable,** Daniel Goleman, *New York Times,* April 26, 1994. 180
It is a common notion that along with chronological aging comes a decline in mental abilities, such as the abilities to ***learn*** and ***remember*** information. Recent studies reveal that such an observation cannot be generalized to the whole sector of the older adult population. Conflicting reports on this issue may be due to the difficulty of developing tests of cognitive abilities appropriate for this population group.

36. **Learning by Diffusion: Nitric Oxide May Spread Memories,** Marcia Barinaga, *Science,* January 28, 1994. 182
The molecular basis for learning and memory is known as ***long-term potentiation (LTP). LTP*** can be observed in certain types of neurons and supposedly localized in a ***synapse.*** Recent studies suggest that LTP can spread to other synapses through the mediation of ***nitric oxide (NO),*** a soluble gas that has ***neurotransmitter***-like actions.

37. **Miscoding Is Seen as the Root of False Memories,** Daniel Goleman, *New York Times,* May 31, 1994. 183
False memory syndrome is one of the most controversial issues in recent times. Because of its significant social and legal implications, thorough scientific investigations are warranted. A neurological theory for the formation of false memories involves damage to the frontal lobe of the ***cerebral cortex.***



Unit 10

Disorders of Behavior and the Nervous System

Four unit articles examine behavioral disorders that include Alzheimer's disease, Huntington's disease, schizophrenia, and depression.

38. **Comprehending Those Who Can't Relate,** Tina Adler, *Science News,* April 16, 1994. **186**

In order to be socially competent, one needs to have the ability to ***learn*** and to remember significant information. Damage to the ***frontal lobe*** of the brain affects the decision-making processes in an individual, which can have an impact on the ability to interact with others. ***Autistic*** children tend to have problems interacting with others and this can be attributed to impaired working ***memory*** ability.

39. **Autism, Amnesia, Hippocampus, and Learning,** G. Robert DeLong, *Neuroscience & Biobehavioral Reviews,* Spring 1992. **188**

The ***hippocampus*** is essential for a developing child to learn ***language.*** Dysfunction of the ***hippocampus*** during the critical stages of ***development*** may underlie the cause of ***autism.***

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40. **The Brain-boosting Sex Hormone,** Sarah Richardson, *Discover,* April 1994. **200**

Statistics show that significantly more women are afflicted with ***Alzheimer's disease*** than men. Recent studies show that women receiving ***estrogen*** treatment for medical reasons not related to Alzheimer's disease have lower risks of developing the disease.

41. **Nancy Wexler,** Mary Murray, *New York Times Magazine,* February 13, 1994. **202**

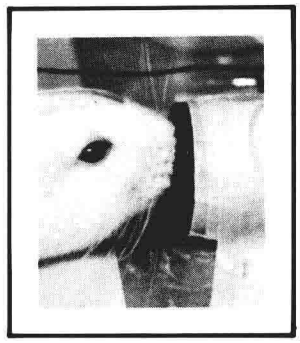
Nancy Wexler, an eminent scientist studying a fatal brain disorder known as ***Huntington's disease,*** contributed significantly toward the discovery of a ***gene*** that causes the disease. A child has a 50-50 chance of inheriting the gene from a parent that possesses it, and Nancy Wexler's mother died from ***Huntington's disease.*** She contemplates on the idea of getting tested for the presence of the gene.

42. **Schizophrenia Reviewed: Toward an Integrative Genetic Model** and **Searching for the Origins of Schizophrenia,** William G. Iacono, William M. Grove, and Rue L. Cromwell, *Psychological Science,* September 1993. **206**

William Iacono and William Grove review two recent comprehensive books on ***schizophrenia.*** Findings on the biological basis for the disorder are presented. The second part of the article is a commentary by Rue Cromwell on selected issues concerning the origins of schizophrenia.

43. **Thinking About Prozac,** Samuel H. Barondes, *Science,* February 25, 1994. **212**

The drug ***Prozac*** is one of the most talked-about drugs on the market today. The drug, originally intended to cure ***depression,*** is now used for a host of other conditions. Its effect on a person's personality is reported to be dramatic.



Unit 11

Ethical Issues

Five articles in this section consider the moral and ethical dynamics of clinical trials on humans, nervous tissue transplants, and animal use for scientific inquiry.

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44. Agency Faults a U.C.L.A. Study for Suffering of Mental Patients, Philip J. Hilts, *New York Times,* March 10, 1994. 216

Clinical trials of drugs using human subjects usually involve assigning subjects to different treatment conditions. The ethical implications of this procedure are questioned in a case involving a study on schizophrenic patients.

45. Neural Transplantation for Neurodegenerative Diseases: Past, Present, and Future, D. Eugene Redmond Jr. et al., from *Alzheimer's Disease,* Annals of the New York Academy of Science, 1993. 219

The brain is considered to be a sacred organ by many, and invasive procedures of this tissue are usually suspect. ***Nervous tissue transplant*** is one of the novel approaches in the treatment of nervous tissue disorders such as ***Parkinson's disease.*** An overview of this procedure is presented in this article.

46. Human Morality and Animal Research, Harold Herzog, *The American Scholar,* Summer 1993. 224

Harold Herzog addresses the ***moral*** and ***ethical issues*** concerning the use of ***animals for scientific inquiries.*** The rationale for the use of animals in biopsychological and biomedical research is discussed, and the use of animals for food or companionship is also covered.

47. Toxicity Tests Minus Animals? Anna Maria Gillis, *BioScience,* March 1993. 231

The use of ***animals in research*** has been a controversial issue within, as well as outside, the scientific community. A number of biopsychological researchers dealing with the evaluation of the safety of psychoactive substances utilize animals as subjects. Anna Gillis discusses the issue of ***alternative strategies*** to the use of animals in experiments.

48. Germ-Line Gene Modification and Disease Prevention: Some Medical and Ethical Perspectives, Nelson A. Wivel and LeRoy Walters, *Science,* October 22, 1993. 235

Certain nervous tissue disorders afflicting humans are determined by specific ***genes.*** With the help of modern technology, it is now possible to identify and modify particular genes. Although the medical benefits of this procedure abound, such approaches touch serious ethical grounds.

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BIOPSYCHOLOGY 95/96

Editor

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Topic Guide

This topic guide suggests how the selections in this book relate to topics of traditional concern to biopsychology students and professionals. It is useful for locating articles that relate to each other for reading and research. The guide is arranged alphabetically according to topic. Articles may, of course, treat topics that do not appear in the topic guide. In turn, entries in the topic guide do not necessarily constitute a comprehensive listing of all the contents of each selection.

TOPIC AREA	TREATED IN:
Aggression/ Violence	21. Biology of Violence 22. Violence in the Blood 23. Human Aggression While Under the Influence
Alzheimer's Disease	8. Building a Better Brain 12. Neurotrophic Factors Enter the Clinic 40. Brain-boosting Sex Hormone
Amnesia	39. Autism, Amnesia, Hippocampus, and Learning
Animal Research	11. It's All in the Timing 46. Human Morality and Animal Research 47. Toxicity Tests Minus Animals?
Antibodies	33. Stress, Emotion, and Human Immune Function
Autism	38. Comprehending Those Who Can't Relate 39. Autism, Amnesia, Hippocampus, and Learning
Autonomic Nervous System	32. Autonomic Nervous System Differences
Biological Clocks/ Rhythms	30. Time *Is* the Essence
Blood-Brain Barrier (BBB)	4. Gateway to the Brain
Body Weight	18. Hypothalamic Neuropeptide Y
Brain Damage	21. Biology of Violence 26. Torrid Affair 37. Miscoding
Brain Tissue Transplant	45. Neural Transplantation
Cancer	20. Diet and Health 33. Stress, Emotion, and Human Immune Function
Cerebellum	3. Expression of C-Fos Protein in Brain
Cerebral Cortex	3. Expression of C-Fos Protein in Brain 6. New Job for the Thalamus 7. Return of Phineas Gage 37. Miscoding
Chromosomes	25. Is Homosexuality Biologically Influenced? 41. Nancy Wexler
Circadian Clocks/ Rhythm	28. Alert at the Switch 30. Time *Is* the Essence
Coronary Heart Disease	20. Diet and Health 34. How Dangerous to the Heart Is Anger?
Depression	33. Stress, Emotion, and Human Immune Function 43. Thinking About Prozac
Development	9. Innocent Victims 10. Nutrition and Mental Development 11. It's All in the Timing
Developmental Disorders	11. It's All in the Timing 39. Autism, Amnesia, Hippocampus, and Learning
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Dopamine	18. Hypothalamic Neuropeptide Y 26. Torrid Affair 42. Schizophrenia Reviewed
Dyslexia/Dysphasia	11. It's All in the Timing
Eating	16. Metabolic Sense 18. Hypothalamic Neuropeptide Y 20. Diet and Health
Emotions	7. Return of Phineas Gage 9. Innocent Victims 31. Emotions Research 33. Stress, Emotion, and Human Immune Function 34. How Dangerous to the Heart Is Anger?
Estrogen	27. Male Hormone Molds Women, Too 40. Brain-boosting Sex Hormone
Ethics	44. Agency Faults a UCLA Study 45. Neural Transplantation 46. Human Morality and Animal Research 47. Toxicity Tests Minus Animals? 48. Germ-Line Gene Modification and Disease Prevention
Frontal Lobe	26. Torrid Affair 37. Miscoding 38. Comprehending Those Who Can't Relate 42. Schizophrenia Reviewed
Genes	22. Violence in the Blood 25. Is Homosexuality Biologically Influenced? 48. Germ-Line Gene Modification and Disease Prevention
Health	20. Diet and Health
Hearing	11. It's All in the Timing 17. Brain Locates Source of a Sound
Hippocampus	3. Expression of C-Fos Protein in Brain 39. Autism, Amnesia, Hippocampus, and Learning 40. Brain-boosting Sex Hormone

TOPIC AREA	TREATED IN:
Homosexuality	25. Is Homosexuality Biologically Influenced?
Hostility	34. How Dangerous to the Heart Is Anger?
Huntington's Disease	41. Nancy Wexler
Hypothalamus	18. Hypothalamic Neuropeptide Y 25. Is Homosexuality Biologically Influenced? 28. Alert at the Switch 31. Emotions Research 33. Stress, Emotion, and Human Immune Function
Immune Response	33. Stress, Emotion, and Human Immune Function
Language	39. Autism, Amnesia, Hippocampus, and Learning
Lateralization	11. It's All in the Timing
Learning	36. Learning by Diffusion 38. Comprehending Those Who Can't Relate 39. Autism, Amnesia, Hippocampus, and Learning
Magnetic Resonance Imaging (MRI)	1. Visualizing the Mind 2. Mapping the Mind
Memories	37. Miscoding 38. Comprehending Those Who Can't Relate
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Neuropeptide Y	18. Hypothalamic Neuropeptide Y
Neurotransmitter Release	36. Learning by Diffusion
Neurotransmitters	18. Hypothalamic Neuropeptide Y 26. Torrid Affair
Nitric Oxide (NO)	36. Learning by Diffusion
Neurotrophic Growth Factors	12. Neurotrophic Factors Enter the Clinic 40. Brain-boosting Sex Hormone
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Opiates/Opioids	23. Human Aggression While Under the Influence 33. Stress, Emotion, and Human Immune Function
Parkinson's Disease	12. Neurotrophic Factors Enter the Clinic 45. Neural Transplantation
Pheromones	13. In the Realm of the Chemical 14. Sniff of Legend
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Reproduction	16. Metabolic Sense
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Sensation	11. It's All in the Timing 13. In the Realm of the Chemical 14. Sniff of Legend 15. Touching the Phantom 16. Metabolic Sense 17. Brain Locates Source of a Sound
Sensory Processing	6. New Job for the Thalamus
Sexual Abuse	37. Miscoding
Sexual Behavior/ Preference	25. Is Homosexuality Biologically Influenced? 26. Torrid Affair
Sleep/Wake Cycle	28. Alert at the Switch 29. Mystery of Sleep
Smell	13. In the Realm of the Chemical 14. Sniff of Legend
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Synapse/Synaptic Transmission	36. Learning by Diffusion
Taste	13. In the Realm of the Chemical
Techniques	1. Visualizing the Mind 2. Mapping the Mind 3. Expression of C-Fos Protein in Brain 4. Gateway to the Brain
Testosterone	27. Male Hormone Molds Women, Too
Thalamus	3. Expression of C-Fos Protein in Brain 6. New Job for the Thalamus
Toxicity Tests	47. Toxicity Tests Minus Animals?
Visual Cortex	6. New Job for the Thalamus
Vomeronasal Organ (VNO)	14. Sniff of Legend

Methods in Biopsychology

The biopsychological perspective subscribes to the idea that there is an underlying biological basis to mental processes and behaviors amenable to investigations using practicable techniques. What do we mean by "mental processes"? Mental processes are often considered as events associated with thinking or consciousness. Some consider these processes as attributes of the mind. Is the biological basis of the mind located in the brain? And does the brain control the performance of behaviors? If so, how do we go about investigating the biological basis of the mind-brain-behavior interaction?

It is important to remember that although the brain is the frequent focus of biopsychology, other systems also influence brain activity. For example, hormones secreted by certain organs and expression of genes found in the DNA can significantly influence brain function.

Biopsychological techniques have developed through the years. Some techniques in the past were rather ridiculous, if not appalling. Circa 1900, a method known as phrenology endorsed the idea that the size and location of the bumps and depressions in the skull were indicative of personality characteristics and intelligence. The premise was that these bumps and depressions reflected the mass of the brain tissue lying underneath the skull. An unusually large mass or depression indicated enhanced or diminished behavioral qualities, respectively. A related technique that was developed around the same time involved measuring head circumference. It was reported that university professors had larger head size than military officers, which indicated the intellectual superiority of the former. No measurements were done on women because it was believed that women could not achieve great intelligence! Certainly there were no scientific validations to these reports, but the techniques brought into focus the role of the brain in the regulation of behavior.

Modern techniques of brain analysis are more reliable in assessing the morphological and functional status of the brain. These techniques have the ability to take images of the brain during varying states of activity. One technique known as computed tomography (CT) uses X rays to acquire images of the brain taken from several planes, to be synthesized by a computer. Another technique of brain imaging, known as positron emission tomography (PET), uses a scanner to measure radioactivity from parts of the brain exposed to an injected radioactive substance. The areas in the brain that are more active will take in more of the radioactive substance and show more radioactivity when measured by the scanner. Pictorial representations or images of radioactivity show the varying degrees of activity across the different areas of the brain. Another technique of imaging is magnetic resonance imaging (MRI). Instead of X rays used in CT scans, radio-wave pulses are passed through the brain surrounded by a strong magnetic field. Variations in the frequencies of radio waves emitted reflect the state of activity of the brain tissue and are then detected by the MRI scanner.

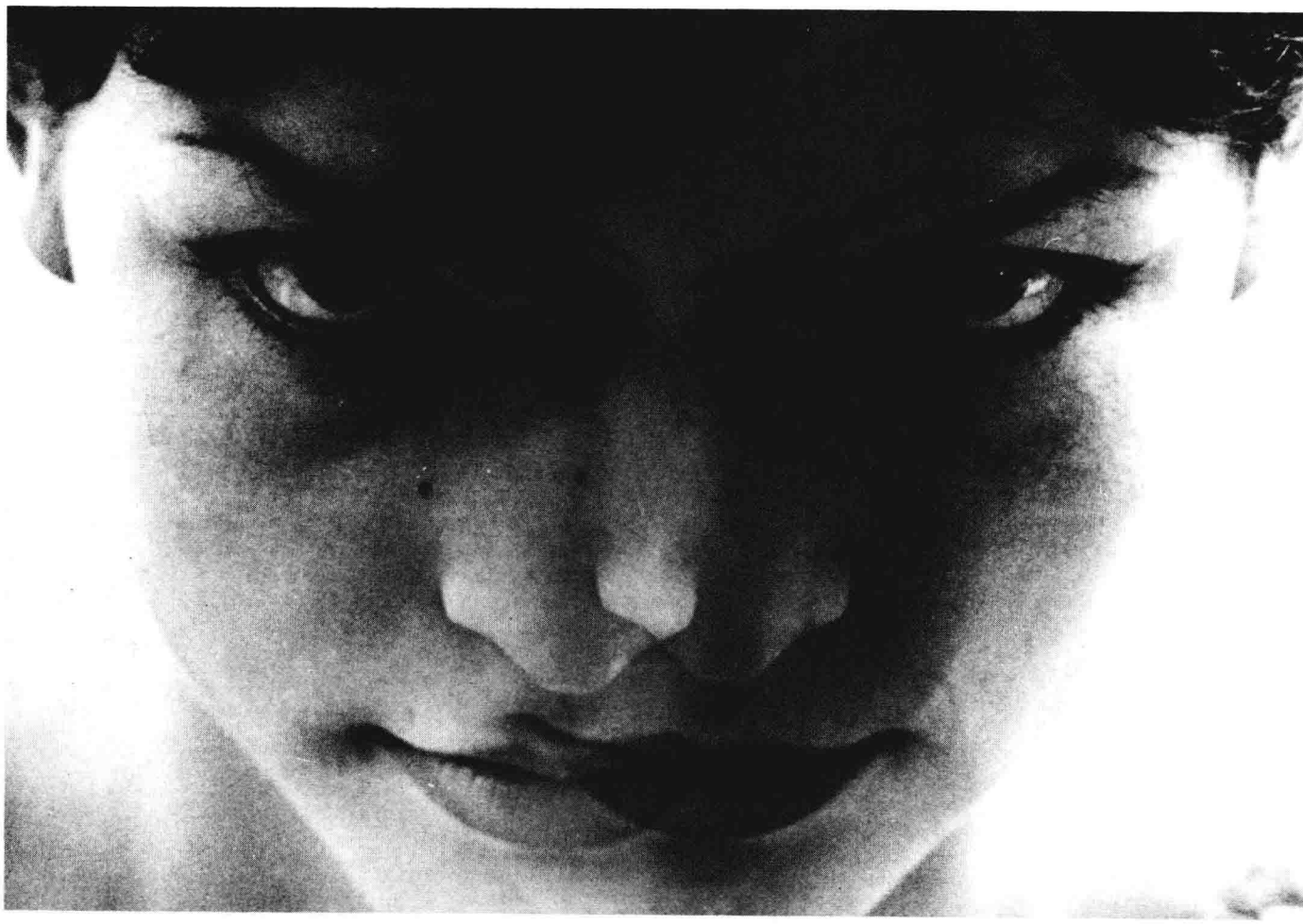
Using the images generated by these techniques, it is possible to see areas of the brain activated by particular situations. For example, scans are made of the brain while a person silently reads words, reads words aloud, plays chess, and similar activities. The areas of the brain responsible for these activities can then be identified. Scans also differentiate the levels of activity in certain areas of the brain between individuals suffering from neurological disorders and those who are apparently normal.

A relatively novel approach in identifying regions of the brain associated with behavior is by searching for a product of neuronal activity that results from stimulation. When the nervous system is stimulated, specific neurons involved in the response become activated, and the activation is manifested by a production of a protein called Fos. Fos is visualized by staining the neurons, using immunocytochemistry techniques. Since the production of Fos is not specific to any particular behavior, the role of Fos in the elicitation of a behavioral response is still unclear.

Knowing that the brain plays a very important role in regulating various bodily processes, it is generally expected that this organ be well protected from potentially harmful substances. The brain is protected by a rigid system known as the blood-brain barrier (BBB). One major disadvantage of this barrier is that some therapeutic drugs are prevented from reaching the brain, but new techniques are being developed to overcome this barrier. Some of these techniques use mechanical devices such as implants to deliver drugs, while others use the biochemical approach of loosening the tight junctions between cells that compose the barrier.

The biological basis of behavior is also attributed to the influence of the genes. Similarity in behavior patterns among close relatives signifies a genetic influence on behavior. Gene technology helps uncover the genetic basis for certain neurological disorders, such as Hunt-

Unit 1



ington's disease and Down's syndrome. Gene technology also reveals the role of the genes in the pathogenesis of aberrant behaviors, such as violence and addiction. Although reports on the genetic basis of behavior are quite convincing, one must bear in mind that "nature" (i.e., the genes) and "nurture" (i.e., the environment) usually interact in shaping behavior.

The techniques described in this unit are some of the most promising methods in biopsychology. Techniques from other domains such as physics and computer science and theories from philosophy are helpful in developing new strategies in understanding the biological basis of behavior.

Looking Ahead: Challenge Questions

Describe how the following techniques work: computed tomography, positron emission tomography, magnetic resonance imaging. What are the advantages of each technique? Can these techniques help understand cognitive processes? How can these techniques assess neurological disorders?

What is the significance of the blood-brain barrier? Describe the mechanical and biochemical approaches developed to overcome this barrier.

What is c-*fos*? Can neurons produce this protein? If so, under what circumstances? How can the c-*fos* immunocytochemistry explain the biological basis of behavior?

Visualizing the Mind

Strategies of cognitive science and techniques of modern brain imaging open a window to the neural systems responsible for thought

Marcus E. Raichle

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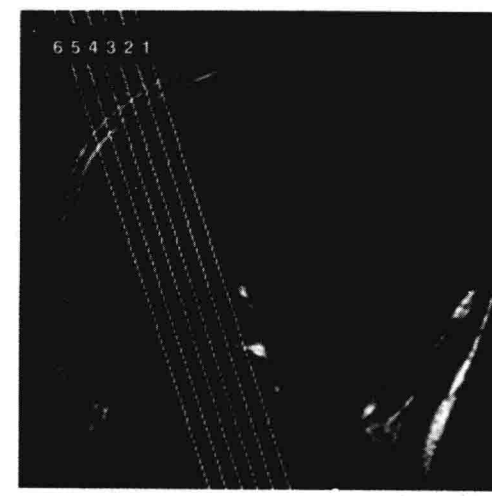
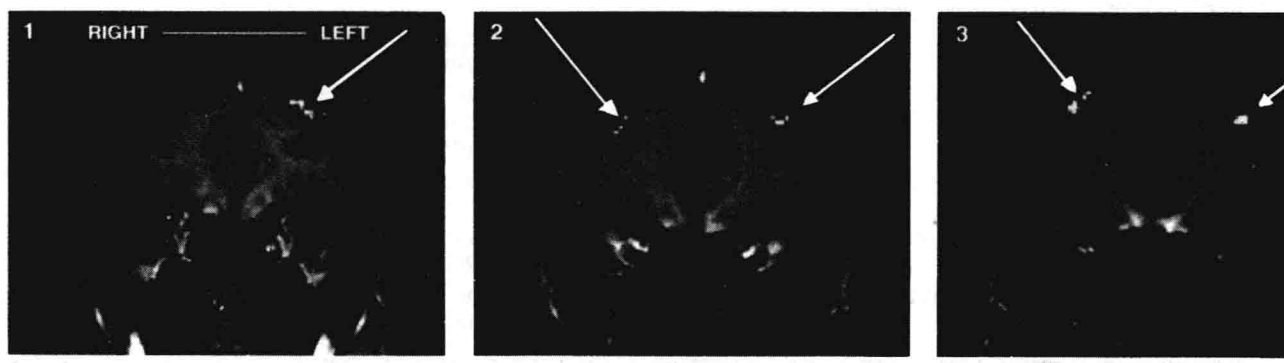
What causes the pity we might feel for the melancholy Dane in *Hamlet* or the chill during a perusal of the *Raven?* Our brains have absorbed from our senses a printed sequence of letters and then converted them into vivid mental experiences and potent emotions. The "black box" description of the brain, however, fails to pinpoint the specific neural processes responsible for such mental actions. While philosophers have for centuries pondered this relation between mind and brain, investigators have only recently been able to explore the connection analytically—to peer inside the black box. The ability stems from developments in imaging technology that the past few years have seen, most notably positron-emission tomography and magnetic resonance imaging. Coupled with powerful computers, these techniques can now capture in real time images of the physiology associated with thought processes. They show how specific regions of the brain "light up" when activities such as reading are performed and how neurons and their elaborate cast of supporting cells organize and coordinate their tasks. The mapping of thought can also act as a tool for neurosurgery and elucidate the neural differences of people crippled by devastating mental illnesses, including depression and schizophrenia.

I hasten to point out that the underlying assumptions of current brain mapping are distinct from those held by early phrenologists. They posited





ACTIVE NEURAL AREAS from a subject remembering a sequence of letters are mapped by magnetic resonance imaging. The images below represent six slices through the frontal cortex. The slices are identified by numbers in the corners that correspond to those in the scan at the right. Arrows indicate areas of increasing activity. Jonathan D. Cohen and his colleagues at the University of Pittsburgh and Carnegie Mellon University Departments of Psychiatry formed the images.