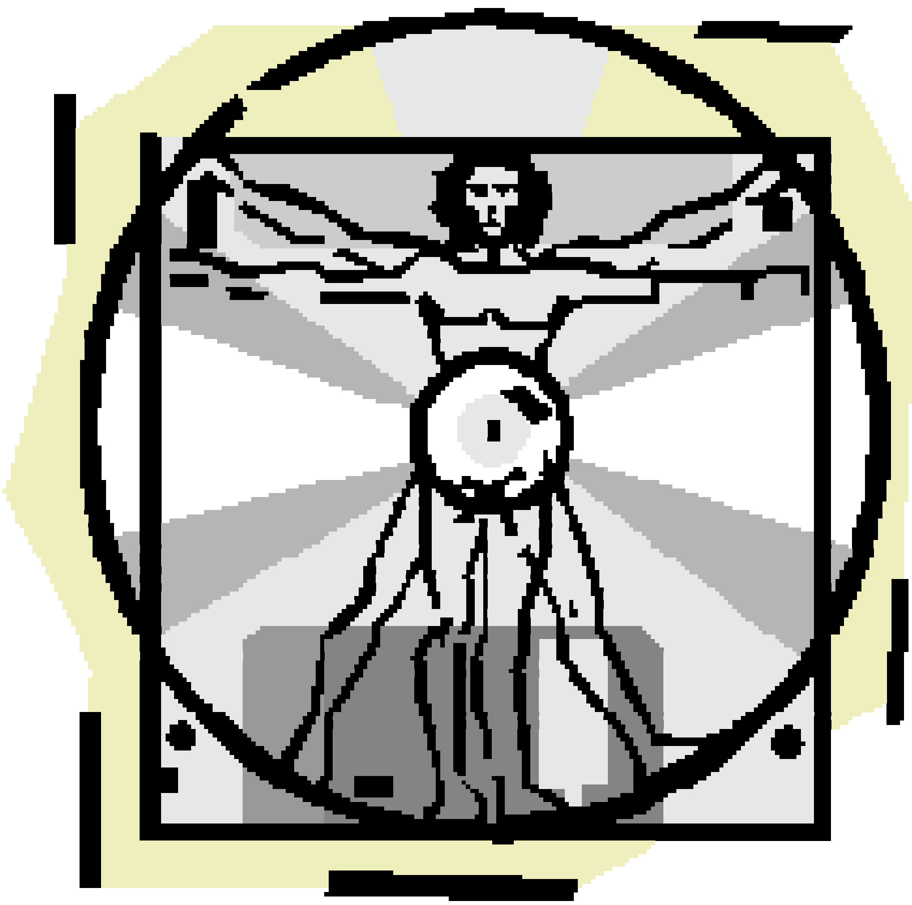
International Baccalaureate
Psychology
Standard/Higher Level II

The Biological Approach



"Everything psychological is simultaneously biological"

Name: ____________________________

Period: ____________________________

TITLE: The Biological Approach

INSTRUCTIONAL OBJECTIVE: After completing this lesson the student should be able to:

1. Identify the historical and cultural conditions that gave rise to the biological perspective.
2. Identify and explain the basic assumptions and key concepts of the biological perspective.
3. Describe the structure of a neuron, and explain how neural impulses are generated.
4. Explain how neurons communicate.
5. Identify the major neurotransmitters used in neural communication and their effect on behaviour.
6. Identify and explain how drugs and other chemicals alter neurotransmissions.
7. Identify the major divisions of the nervous system and describe their functions, noting the three types of neurons that transmit information through the system.
8. Describe the nature and functions of the endocrine system and its interaction with the nervous system.
9. Identify and describe several techniques for studying the brain.
10. Describe the functions of the brainstem, thalamus, cerebellum, and limbic system.
11. Identify the four lobes of the cerebral cortex and describe the sensory and motor functions of the cortex.
12. Discuss the importance of the association areas, and describe how damage to several different cortical areas can impair language functioning.
13. Discuss research on hemispheric specialization of the brain and brain reorganization.
14. Discuss research on the split brain, and what it reveals regarding normal brain functioning.

15 Describe the general position taken by neuroscientists on the self and discuss two specific approaches advanced by scientists to explain the sense of a unified self.

16. Summarize the evidence on whether there are sex differences in the brain and how any differences might affect behavior.
17. Explain current research on body rhythms and their effect on behaviour
18. Describe the process and various stages of sleep.
19. Discuss why we sleep.
20. Identify various sleep disorders and their effect on behaviour.

21. Discuss the process of dreaming and current theories on why we dream.

22. Explain how today's drug problem differs from that of other societies and time periods.

23. Discuss the use, abuse, and dependency of psycho-active drugs.

24. Identify and discuss various psycho-active drugs and their effect on behaviour.

REFERENCES:

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4 Myers, David G., Psychology, 6th ed. Worth Publishers: New York. 2001

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6 Wade, Carole (et al.) *Psychology,* 6th ed. Prentice-Hall: Upper Saddle River, NJ. 2000

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WEB SITES:

1. http://faculty.washington.edu/chudler/neurok.html - Superbly organized site providing information and links to other neuroscience sites

The Biological Approach

The focus of this perspective is on behaviour, although a basic understanding of physiology is needed. Until the middle of the 19th century, most humans regarded themselves as very distinct from animals. Since Darwin's discoveries there has been a general acceptance that humans have evolved from animals, that we have a substantial number of physiological and behavioural characteristics in common, and that we also share much of our genetic make-up.

This acceptance has led psychologists to increase research into basic physiological mechanisms and processes as a way of explaining human behaviour. Behavioural change can be regarded as arising from an interaction between innate disposition and environmental factors. Based on this premise, recent research has frequently used the experimental method to investigate behaviour.

There is an increasing awareness, through the use of scanning techniques of the brain, that physiological mechanisms play a central part in the behaviour of individuals in areas as diverse as aggression, stress and learning. These insights are also used with increasing frequency in the field of behavioural-based therapy to alleviate behaviour caused by psychological disorder.

There are issues which are relevant to the biological perspective, including criticisms that this may involve a reductionist approach and that behaviour exhibited by animals is not necessarily relevant to humans.

Introduction

The Nature of the Psychological System

Interactions of the Mind and Body in Behaviour

The Effects of Body on the Mind

Our Divided Brain - Hemispheric Specialization
Brain Reorganization
The Split Brain
Two Stubborn Issues in Brain Research
Biological Rhythms
Drugs and Consciousness

Interaction of the Mind and Body in Behaviour

The Effects of the Body on the Mind

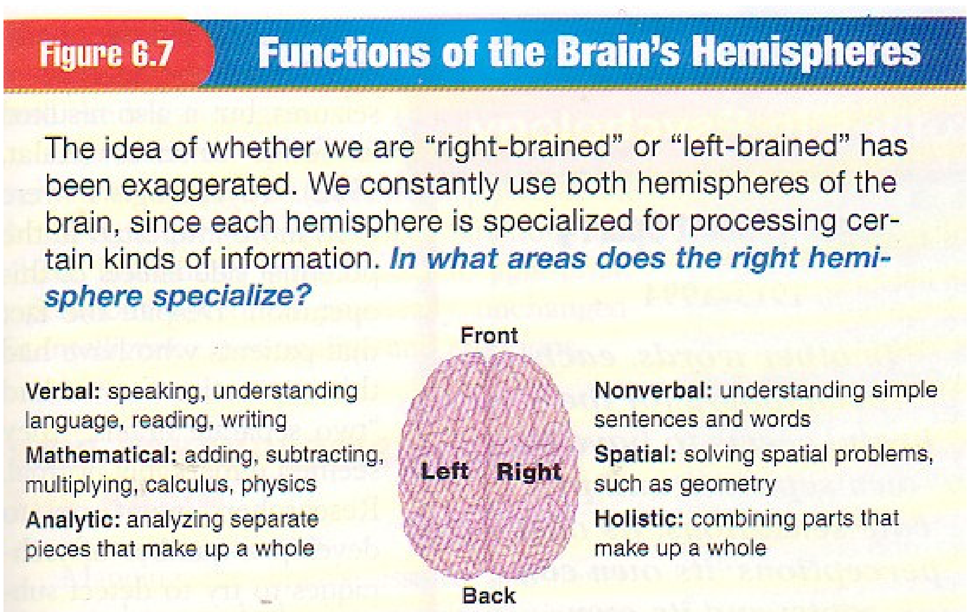
Discuss research on hemispheric specialization of the brain and brain reorganization.

Our Divided Brains – Hemispheric Specialization

For more than a century, clinical evidence has shown that the brain's two sides serve differing functions.

Accidents, strokes, and tumors in the left hemisphere generally impair ________________, ________________, ________________, ______________________, and ______________________.

Similar lesions in the right hemisphere generally impair ____________________________ tasks such as __________________________ and _______________, as well as synthetic or holistic ____________________.



It is small wonder that by 1960 the left hemisphere was well accepted as the "dominant" or "major" hemisphere, and its silent companion to the right as the "subordinate" or "minor" hemisphere.

The left, verbal hemisphere is rather like the moon's facing side-the one easiest to observe and study. The other side is there, of course, but less visibly noticeable.

For some people, including one-fourth of all lefthanders, speech is processed in the right hemisphere. But then researchers found that the "minor" right hemisphere was not so limited after all. The story of this discovery is a fascinating chapter in psychology's history.

Scientists have found our hemispheres to be similarly specialized in several different types of studies.

example - when a person performs a ________________________ task, brain waves, blood flow, and glucose consumption reveal increased activity in the _______________ hemisphere; when a person ______________ or __________________, activity increases in the _________ hemisphere.

On occasion, hemispheric specialization has been even more dramatically shown by briefly sedating an entire hemisphere. To check for the locus of language before surgery, a physician may inject a sedative into the neck artery that feeds blood to the hemisphere on its side of the body.

Before the drug is injected, the patient is lying down, arms in the air, conversing easily. You can likely predict what happens when the drug flows into the artery going to the left hemisphere: Within seconds, the person's right arm falls limp and, if the left hemisphere controls language, the subject becomes speechless until the drug wears off. When the drug goes into the artery to the right hemisphere, the *left* arm falls limp, but the person can still speak.

Other tests also confirm hemispheric specialization.

example - most people recognize a picture faster and more accurately when it is flashed to the right hemisphere. But they recognize a word faster and more accurately when it is flashed to the left hemisphere. If a word is flashed to your right hemisphere, perception takes a fraction of a second longer-the length of time it takes to send the information through the corpus callosum to the more verbal left hemisphere.

> ***study*** – Best and Avery, 1999. Left hemisphere advantage for click consonants is determined by linguistic significance and experience. *Psychological Science, 10*, 65-70
>
> Catherine Best and Robert Avery offer fresh evidence of the left hemisphere's contribution to speech perception. The Zulu language employs certain click sounds, such as the "tsk" sound made with the tip of the tongue, as consonants. Zulu speakers' brains process these sounds as language. Best and Avery designed a study in which participants heard competing sounds in their right and left ears. Zulu speakers more accurately recognized the click sounds heard in the right ear, which projects mostly to the left hemisphere. English speakers, for whom the same clicks are non-speech sounds, did not show this left hemisphere advantage.

Which hemisphere would you suppose enables sign language among deaf people?

The right, because of its visual-spatial superiority?
Or the left, because of its preparedness to process language?

> ***study*** - Corina et al, 1992. The linguistic basis of left hemisphere specialization. *Science 255*, 1258-1260
>
> Studies reveal that, just as hearing people use the left hemisphere to process speech, deaf people use the left hemisphere to read signs.

study - Corina, 1998. The processing of sign language: Evidence from aphasis. *Handbook of neurolinguistics*. San Diego: Academic Press

A stroke in the left hemisphere will disrupt a deaf person's signing much as it would disrupt a hearing person's speaking. Broca's area is similarly involved in both spoken and signed speech production.

To the brain, language is language, whether spoken or signed.

study - Beeman & Chiarello, 1998. Complementary right and left hemisphere language comprehension. *Current Directions in Psychological Science 7*, 2-8.

Although the left hemisphere is adept at making quick, literal interpretations of language, the right hemisphere excels in making subtle inferences. If "primed" with the flashed word *foot,* the left hemisphere will be especially quick to then recognize the closely associated word *heel. But* if primed with *foot, cry,* and *glass,* the right hemisphere will more quickly recognize another word that is distantly related to all three *(cut).*

And if given an insight like problem-what word goes with *high, district,* and *house*?-the right hemisphere has better access to the solution. (The right hemisphere more quickly than the left recognizes that the solution is school.)

As one patient explained after suffering right-hemisphere stroke damage, "I understand words, but I'm missing the subtleties." Thus, the right hemisphere helps us modulate our speech to make meaning clear-as when we ask "What's that in the road ahead?" instead of "What's that in the road, a head?"

Brain Reorganization

Nurture's sculpting of the ever-changing brain is evident in studies of the brain's ***plasticity*.**

Most severed neurons will not regenerate (if your spinal cord were severed, you likely would be permanently paralyzed). But neural tissue can *reorganize* in response to damage.

plasticity - ____
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study - Pons et al., 1991. Massive cortical reorganization after sensory deafferentation in adult macaques. *Science, 252*, 1857-1860

In one experiment, neuroscientists severed the neural pathways for incoming information from a monkey's arm. The area of the sensory cortex that formerly received this input gradually shifted its function and began to respond when researchers touched the animal's face

study - Barinaga, M., 1992. The brain remaps its own contours. Science 258, 216-218

Similarly, if a laser beam damages a spot in a cat's eye, the brain area that received input from that spot will soon begin responding to stimulation from nearby areas in the cat's eye. If a blind person uses one finger to read Braille, the brain area dedicated to that finger expands

study - Sadato et al, 1996. Activation of the primary visual cortex by Braille reading in blind subjects. Nature, 380, 526-528

The sense of touch invades the part of the brain that normally helps people see. PET scans also reveal activation of the *visual* cortex when blind people read Braille

Among deaf people who communicate with sign language, it is the **______________________** lobe area normally dedicated to **____________________** information that waits in vain for stimulation. Finally, it looks for other signals to process, such as those from the visual system.

Thus, the brain may not be as "hard-wired" as once thought. Unlike fixed computer circuits, brain hardware changes with time.

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

Kolb & Whishaw, 1998. Brain plasticity and behavior. *Annual Review of Psychology, 49*, 43-64

In response to changing stimulation, the brain can either rewire itself with new synapses or (according to another theory) select new uses for its pre-wired circuits.

When one brain area is damaged, other areas may in time reorganize and take over some of its functions. If neurons are destroyed, nearby neurons may partly compensate for the damage by making new connections that replace the lost ones. These new connections are one way the brain struggles to recover from a minor stroke.

study - Kempermann & Gage, 1999. New nerve cells for the adult brain. *Scientific American* 48-53

New evidence reveals that, contrary to long-held belief, adult humans can also generate new brain cells.

study – Gould, et al, 1999. Neurogenesis in neocortex of adult primates, *Science, 286,* 548-552

Moreover, monkey brains have recently been discovered to form thousands of new neurons each day. These baby neurons originate deep in the brain and then migrate to the thinking frontal lobe and form connections with neighboring neurons

Such are the brain's ways of partially compensating for the gradual loss of neurons with age. Master "stem cells" that can develop into any type of brain cell have also been discovered in the fetal brain.

These discoveries raise hopes that these recovery mechanisms might be enhanced to mend a disease-damaged brain.

example - if extracted, mass produced, and injected into a damaged brain, might stem cells turn themselves into replacements for damaged or dead brain cells?

study – Kolb, B. 1989. Brain development, plasticity, and behavior. American Psychologist, 44. 1203-1212.

Our brains are most plastic when we are young children. Children are born with a surplus of neurons. If an injury destroys one part of a child's brain, the brain will compensate by putting other surplus areas to work. Thus, if the speech areas of an infant's left hemisphere are damaged, the right hemisphere will take over much of its language function.

example - consider a 5-year-old boy whose severe seizures, caused by a deteriorating left hemisphere, require removing the *entire* hemisphere.

What hope for the future would such a child have?

Is there any chance he might attend school and lead a normal life, or would he suffer permanent retardation?

study - Smith & Sugar, 1975; Development of above normal language and intelligence 21 years after left hemispherectomy. Neurology, 25, 813-818

Astonishingly, one such individual was at last report an executive. Half his skull is filled with nothing but cerebrospinal fluid-functionally it might as well be sawdust-yet he has scored well above average on intelligence tests, has completed college, and has attended graduate school

study - Vining et al, 1997. Why would you remove half a brain? The outcome of 58 children after hemispherectomy – The Johns Hopkins Experience: 1968 to 1996. *Pediatrics, 100*, 163-171

Although paralyzed on the right side, this man (along with other such cases of "hemispherectomy") testifies to the brain's extraordinary powers of reorganization when damaged before it is fully developed. Indeed, one Johns Hopkins medical team, reflecting on the 58 child hemispherectomies they have performed, reports being " awed" by how well children retain their memory, personality, and humor after removal of either brain hemisphere.

Discuss brain plasticity and what it reveals about brain reorganization

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Discuss research on the split brain, and what it reveals regarding normal brain functioning.

The Split Brain

study **–** Gazzaniga, 1967. The split brain in man, *Scientific American 24-29*

In 1961, two Los Angeles neurosurgeons, Philip Vogel and Joseph Bogen, speculated that major epileptic seizures were caused by an amplification of abnormal brain activity that reverberated between the two hemispheres.

They therefore wondered whether they could reduce seizures in their patients with uncontrollable epilepsy by cutting communication between the hemispheres. To do this, Vogel and Bogen knew they would have to sever the ***corpus callosum*****,** the wide band of axon fibers connecting the two hemispheres.

The surgeons had reason to believe such an operation would not be incapacitating. Psychologists Roger Sperry, Ronald Myers, and Michael Gazzaniga had divided the brains of cats and monkeys in this manner with no serious ill effects. So Vogel and Bogen operated.

The result? The seizures were all but eliminated and the patients with these ***split brains*** were surprisingly normal, their personalities and intellect hardly affected. Waking from the surgery, one patient even managed to quip that he had a "splitting headache"

corpus callosum - ____

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split brain - ____

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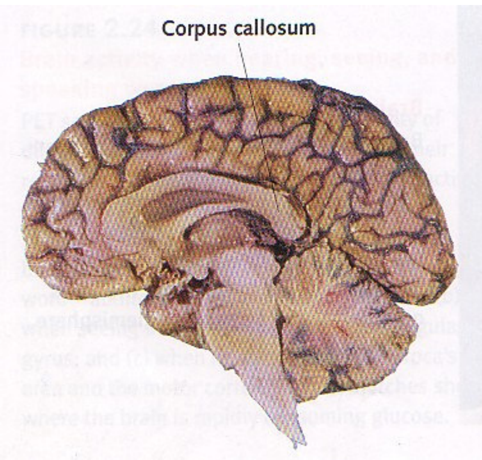
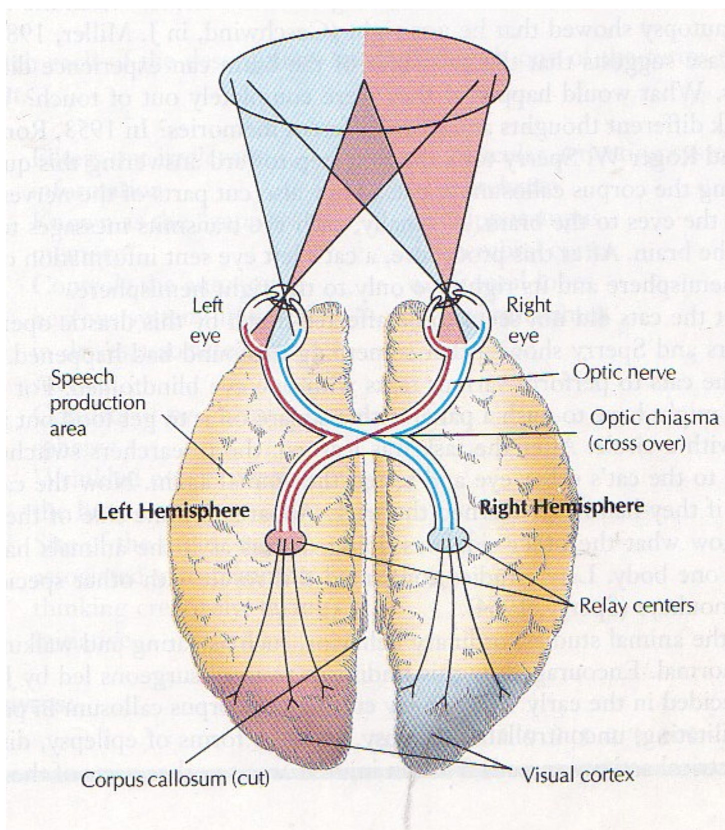


Only a decade earlier, neuropsychologist Karl Lashley had jested that maybe the corpus callosum served only "to keep the hemispheres from sagging." The ingenious experiments of Sperry and Gazzaniga revealed that this broad band of more than 200 million nerve fibers, capable of transferring more than a billion bits of information per second between the hemispheres, has a more significant purpose. Their work provided a key to understanding the two hemispheres' complementary functions.

Sperry and Gazzaniga were not surprised that, after the split-brain operation, a patient could not identify an unseen object, such as a spoon, placed in his left hand. They knew that information travels from the left hand to the right hemisphere, and their animal split-brain experiments suggested that the right hemisphere would be unable to send this information to the left hemisphere (which in most humans controls speech).

More extraordinary results came when Sperry and Gazzaniga conducted some perceptual tests.

> ***study*** - Gazzaniga, M., 1983. Right hemisphere language following brain bisection: A 20 year perspective. *American Psychology*, 38 525-537



Our eyes connect to our brains in such a way that, when we look straight ahead, the left half of our field of vision transmits through both eyes to our right hemisphere.

Likewise, the right side of our field of vision transmits to our left hemisphere. In most of us with healthy, intact brains, information presented only to our right hemisphere is quickly sent to our left hemisphere, which names it. But what happens in a person whose corpus callosum has been severed? To find out, experimenters ask the person to look at a designated spot. Then they send information to either the left or right hemisphere (by flashing it to the spot's right or left). Finally, they quiz each hemisphere separately.

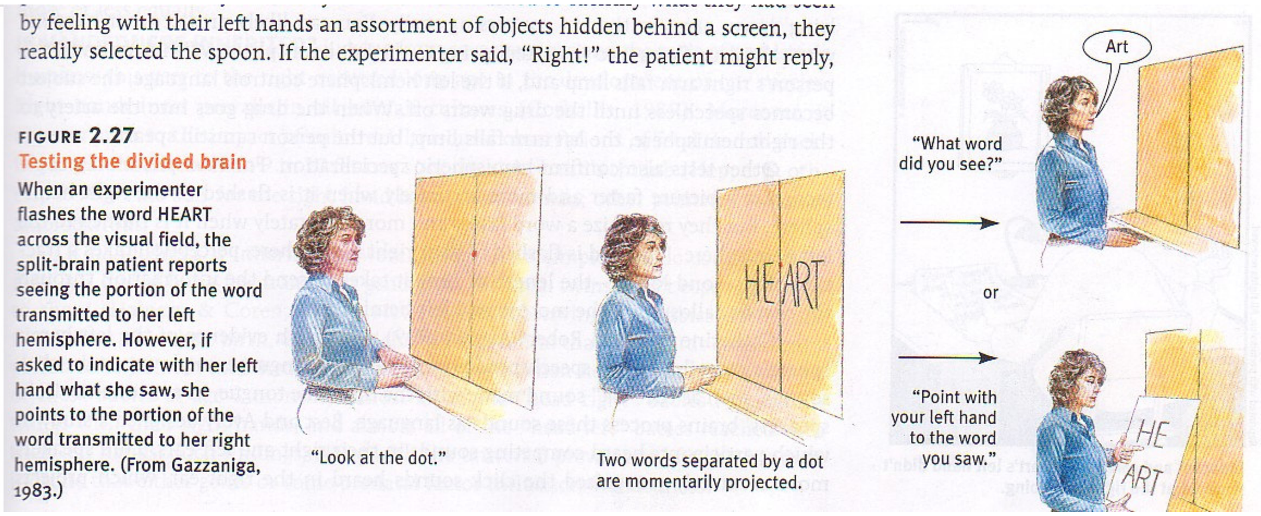


FIGURE 2.27
Testing the divided brain
When an experimenter flashes the word HEART across the visual field, the split-brain patient reports seeing the portion of the word transmitted to her left hemisphere. However, if asked to indicate with her left hand what she saw, she points to the portion of the word transmitted to her right hemisphere. (From Gazzaniga, 1983.)

See if you can guess the results of an experiment using this procedure. While the patients stared at a dot, the word HEART was flashed across the visual field with HE in the left visual field and ART in the right.

First, what did the patients *say* they saw?

Second, asked to identify with their *left* hands what they had seen, did they *point* to HE or ART?

As the figure shows, the patients *said* they saw ART and so were startled when their left hands *pointed* to HE. Given an opportunity to express itself, each hemisphere reports only what it has seen.

Similarly, when a picture of a spoon was flashed to their right hemisphere, the patients could not say what they saw. But when asked to identify what they had seen by_feeling with their left hands an assortment of objects hidden behind a screen, they readily selected the spoon.

If the experimenter said, "Right!" the patient might reply, "What? Right? How could I possibly pick out the right object when I don't know what I saw?"

It is, of course, the left hemisphere doing the talking here, bewildered by what its nonverbal right hemisphere knows.

A few people who have had split-brain surgery have been for a time bothered by the unruly independence of their left hand, which might unbutton a shirt while the right hand buttoned it or put grocery store items back on the shelf after the right hand put them in the cart. It was as if each hemisphere was thinking "I've half a mind to wear my green (blue) shirt today."

Indeed, said Sperry, split-brain surgery leaves people "with two separate minds." (Reading these reports, I fantasize a split-brain person enjoying a solitary game of "rocks, paper, and scissors"-left versus right hand.) When the "two minds" are at odds, the left hemisphere seems to act as the brain's press agent, doing mental gymnastics to rationalize reactions it does not understand. If a patient follows an order sent to the right hemisphere ("Walk"), the interpretive left hemisphere will offer a ready explanation ("I'm going into the house to get a Coke").

Thus, Michael Gazzaniga concludes that the left hemisphere is an "interpreter" that instantly constructs theories to explain our behavior. These experiments demonstrate that the right hemisphere understands simple requests and easily perceives objects.

> ***study*** - Hauser, 1993; Heller & others, 1998; Metcalfe & others, 1995; Skinner & Mullen, 1991.
>
> In fact, the right hemisphere is superior to the left at copying drawings, recognizing faces, perceiving differences, perceiving emotion, and expressing emotion through the more expressive left side of the face.

Most of the body's paired organs-kidneys, lungs, breasts - perform identical functions, providing a backup system should one side fail. Not so the brain's two halves. They are a biological odd couple, serving differing functions, each seemingly with a mind of its own.

Describe research on divided and undivided brains, and discuss what it reveals regarding normal brain functioning.

Describe the general position taken by neuroscientists on the self and discuss two specific approaches advanced by scientists to explain the sense of a unified self.

Two Stubborn Issues in Brain Research

Many mysteries remain about how the brain works.

Where Is the Self?

When we think about the remarkable blob of tissue in our heads that allows us to remember, to dream, and to think-the blob that can make our existence a hideous nightmare when it is diseased-we are led, inevitably, to a question that has been pondered for thousands of years:

Where, exactly, is the self?

When you say, "I am feeling unhappy," your amygdala, your serotonin receptors, your endorphins, and all sorts of other brain parts and processes are active, but who, exactly, is the "I" doing the feeling?

When you say, "I've decided to have a hot dog instead of a hamburger" who is the "I" doing the choosing?

When you say, "My mind is playing tricks on me," who is the "me" watching your mind play those tricks, and who is it that's being tricked?

Isn't the self observing itself a little like a finger pointing at its own tip?

Most religions resolve the problem by teaching that an immortal self or soul exists entirely apart from the mortal brain. But modern brain scientists usually consider mind to be a matter of matter. They may have personal religious convictions about a soul, but most assume that what we call "mind," "consciousness," "self-awareness," or "subjective experience" can be explained in physical terms as a product of the cerebral cortex.

> ***study*** – Restak, Richard. 1983. Is free will a fraud? *Science Digest, 91 52-55*
>
> Restak, Richard. 1994. *The modular brain.* New York: Macmillian
>
> Our conscious sense of a unified self may even be an illusion. Neurologist Richard Restak has noted that many of our actions and choices occur without any direction by a conscious self. He concludes that "the brains of all creatures are probably organized along the lines of multiple centers and various levels."
>
> ***study*** – Dennent, Daniel. 1991. *Consciousness explained*. Boston: Little, Brown.
>
> Cognitive scientist Daniel Dennett (1991) suggests that the brain or mind consists of independent parts that deal with different aspects of thought and perception, constantly conferring with each other and revising their "drafts" of reality.

study – Gazzaniga, M. 1998. *Mind Matters*. Boston: Houghton Mifflin

Gazzaniga, M. 1985. The social brain: *Discovering the networks of the mind*. New York: Basic Books.

Likewise, Michael Gazzaniga (1985, 1998) proposes that the brain is organized as a loose confederation of independent modules, or mental systems, all working in parallel. Most of these modules operate without our conscious awareness. The sense of a unified self occurs, he says, because one verbal module, an "interpreter" (usually in the left hemisphere), is constantly coming up with theories to explain the actions, moods, and thoughts of the other modules.

study – Klein & Kihlstrom, 1998. On bridging the gap between social – personality psychology and neuropsychology. *Personality and Social Psychology Review, 2*, 228-242

Some brain-injured patients who, like H. M., are unable to store new memories about their experiences can nonetheless describe what kind of person they have been since the brain damage occurred.

Where in the brain does this capacity to reflect on one's own personality reside?

Over a century ago, William James (1890) described the "self-as-knower," the subjective sense we all have of being a distinct person who thinks, feels, and acts. Psychologists, neuroscientists, cognitive scientists, and philosophers all hope to learn more about how our brains and nervous systems give rise to the self-as-knower.

What do you think about the existence and location of your "self" . . . and who, by the way, is doing the thinking?

Tolerate Uncertainty

We all have a sense of being a conscious “self," and brain research shows that consciousness arises from our brains. But if that is the case, where in the brain is this self located? Can this age-old question be answered?

Are There "His" and "Hers" Brains?

A second stubborn issue concerns the existence of sex differences in the brain. Historically, findings on male-female brain differences have often flip-flopped in a most suspicious manner, a result of the biases of the observers rather than the biology of the brain.

> ***study*** - Shields, 1975. Functionalism, Darwinism, and the psychology of women: A study in social myth. American Psychologist, 30, 739-754.
>
> In the 1960s, scientists speculated that women were more "right-brained" and men were more "left-brained," which supposedly explained why men were "rational" and women "intuitive." Then, when the virtues of the right hemisphere were discovered, such as creativity and ability in art and music, some researchers decided that *men* were more right-brained. But it is now clear that the abilities popularly associated with the two sexes do not fall neatly into the two hemispheres of the brain. The left side is more verbal (presumably a "female" trait), but it is also more mathematical (presumably a "male" trait). The right side is more intuitive ("female"), but it is also more spatially talented ("male").

To evaluate the issue of sex differences in the brain intelligently, we need to ask two questions:

Do male and female brains differ physically?

And if so, what, if anything, do these differences have to do with behavior?

Let's consider the first question.

study - McEwen, 1983. Gonadal steroid influences on brain development and sexual differentiation. *Reproductive Physiology IV*, 27, 99-145

Many anatomical and biochemical sex differences have been found in animal brains, especially in areas related to reproduction, such as the hypothalamus

Human sex differences, however, have been more elusive. Of course, we would expect to find male-female brain differences that are related to the regulation of sex hormones and other aspects of reproduction. But many researchers want to know whether there are differences that affect how men and women think or behave-and here, the picture is murkier.

study - de Lacoste-Utamsing & Holloway, 1982. Sexual dimorphism in the human corpus callosum. *Science, 216*, 1431-1432

Christine de Lacoste and Ralph Holloway, two anthropologists autopsied 14 human brains and reported an average sex difference in the size and shape of the *splenium,* a small section at the end of the corpus callosum, the bundle of fibers dividing the cerebral hemispheres

The researchers concluded that women's brains are less lateralized for certain tasks than men's are-that men rely more heavily on one or the other side of the brain, whereas women tend to use both sides. This conclusion quickly made its way into newspapers, magazines, and even textbooks as a verified sex difference.

Today, however, the picture has changed.

study - Byne W.,1993. Sexual orientation and brain structure: Adding up the evidence. Annual meeting of the International Academy of Sex Research, Pacific Grove, CA.

In a review of the available studies, neuroscientist William Byne found that only the 1982 study reported the splenium to be larger in women. Two very early studies in 1906 and 1909 found that it was larger in men, and 21 later studies found no sex difference at all.

study - Bishop & Wahlsten, 1997. Sex differences in the human corpus callosum: Myth or reality? Neuroscience and Biobehavioral Reviews, 21, 581-601.

Moreover, a Canadian analysis of 49 studies found only trivial differences between the two sexes, differences that paled in comparison with the huge individual variations *within* each sex

Most people are unaware of these findings because studies that find no differences rarely make headlines.

Researchers are now looking for other sex differences in the brain, such as in the density of neurons in specific areas.

study - Witelson, Glazer, Kigar, 1994. Sex differences in numerical density of neurons in human auditory association cortex. *Society for Neuroscience Abstracts, 30*, Abstract No. 582.12

One team, examining nine brains from autopsied bodies, found that the women had an average of 11 percent more cells in areas of the cortex associated with the processing of auditory information; all of the women had more of these cells than did any of the men.

Other researchers are searching for sex differences in the brain areas that are active when people work on a particular task.

study - Shaywitz et al., 1995. Sex differences in the functional organization of the brain for language. *Nature, 373*, 607-609

In this study 19 men and 19 women were asked to say whether pairs of nonsense words rhymed, a task that required them to process and compare sounds. MRI scans showed that in both sexes an area at the front of the left hemisphere was activated. But in 11 of the women and none of the men, the corresponding area in the right hemisphere was also active.

study - Inglis & Lawson, 1981. Sex differences in the effects of unilateral brain damage on intelligence. Science, 212, 693-695

These findings are further evidence for a sex difference in lateralization, at least for this one type of language function. Such a difference could help explain why left-hemisphere damage is less likely to cause language problems in women than in men after a stroke

Over the next few years, research may reveal additional anatomical and information processing differences in the brains of males and females. But even if such differences exist, we must then ask our second question: *What do the differences mean for the behavior of men and women in real life?*

Some popular writers have been quick to assume that brain differences explain, among other things, women's allegedly superior intuition, women's love of talking about feelings and men's love of talking about sports, women's greater verbal ability, men's edge in math ability, and why men won't ask for directions when they are lost. But there are at least three problems with these conclusions:

1. ***These supposed gender differences in behavior are stereotypes*** - the overlap between the sexes is greater than the difference between them. Although some differences may be statistically significant, most are small in practical terms.

2. ***A biological difference does not necessarily have behavioral implications*** - In the rhyme-judgment study, for example, men and women performed equally well, despite the differences in their MRIs-so what do those brain differences actually mean in practical terms?

When it comes to explaining how brain differences are related to more general abilities, speculations are as plentiful as ants at a picnic, but at present they remain just that-speculations.

To know whether sex differences in the brain translate into significant behavioral differences, we would need to know much more about how brain organization and chemistry affect human abilities and traits.

3. ***Sex differences in the brain could be the result rather than the cause of behavioral differences***- Remember that experiences in life are constantly sculpting the circuitry of the brain, affecting the way brains are organized and how they function and males and females often have different experiences.

Thus, the answer to our second question, whether physical differences are linked to behavior, is "No one really knows." It is important to keep an open mind about new findings on sex differences in the brain, but because the practical significance of these findings (if any) is not clear, it is also Important to be cautious and aware of how such results might be exaggerated and misused.

Examine the Evidence

Perhaps no topic in brain research generates as much muddy thinking and as many premature conclusions as that of sex differences in the brain.

Does the existing evidence tell us much about men's and women's behavior in their everyday lives?