jerome kagan

on being human

why mind matters

On Being Human

Why Mind Matters

JEROME KAGAN

Yale
UNIVERSITY PRESS
NEW HAVEN AND LONDON

Published with assistance from the foundation established in memory of Calvin Chapin of the Class of 1788, Yale College.

Set in Electra type by IDS Infotech Ltd., Chandigarh, India.
Printed in the United States of America.

ISBN 978-0-300-21736-0 (cloth : alk. paper)

Library of Congress Control Number: 2015947641
A catalogue record for this book is available from the British Library.

This paper meets the requirements of ANSI/NISO Z39.48–1992
(Permanence of Paper).

10 9 8 7 6 5 4 3 2 1

CONTENTS

Michel de Montaigne was only thirty-eight years old when he retired to his chateau and began write the essays that are still being read more than four hundred years later. When he die twenty-one years after initiating this task, in 1582, he had filled three volumes with essays who themes ranged from liars to cannibalism. When I reread some of these narratives on a cold Saturday March 2013, the thought of composing such a collection relevant to this century evoked a feeling associate with action. Although considerably older and lacking a chateau, I vowed to adopt m model's strategy of avoiding pretense and choosing words with minimal ambiguity. I also decided free myself, for the first time in fifty-two years of writing scholarly books, of the burden of providi a footnote for the source of every conclusion. Instead, a list of suggested readings is appended at t end of the text.

These essays are best read in the evening, preferably over a glass of wine, as the reflections of retired academic psychologist who has morphed into a well-fed stowaway admiring the talented cre solving problems he could not have imagined in the summer of 1954 when he left New Haven with h pregnant wife to take his first faculty position at Ohio State University.

Only after typing more revisions than I care to remember did a semblance of structure emerg "What does it mean to know something?" which is a complement to Montaigne's preoccupyi question "What do I know?" is a seminal theme. This question assumes a special relevance wh humans are the knowers because Homo sapiens is the only species that adds words, mathematic concepts, inferences of things that do not exist, and logical deductions to the products of sensatio The initial two essays argue that human knowledge combines representations of the physical featur of events, which I call schemata and others call images, with words to form an extraordinarily lar number of networks whose patterns of connections change with the setting, much like the collectio of contacts among members of a large family from dawn to bedtime.

A person whose knowledge of Alzheimer's disease consisted only of the words *old*, *memory,* a *brain* has to be distinguished from the expert whose understanding contains schemata for the vari memory difficulties and density of amyloid plaques in the brains of patients. The social scientis whose only evidence consists of the words people use when they reply to questionnaires or intervie cannot be sure of the depth or the meaning of the knowledge their informants claim to possess.

Too many social scientists treat what people say about their feelings, beliefs, or past lives faithful replicas of their actual experiences. The fact that most adults are willing to answer a pollst who asks, "How has your life been lately?" does not guarantee that the reply "Very good" has th same meaning when given by a happily married, white lawyer in Montreal, an African America health aide who is a single mother earning $25,000 a year working in a nursing home in Atlanta, a

an illiterate peasant from rural Bolivia.

The titles of many papers in psychological journals have ambiguous meanings because the contain abstract words that fail to evoke the same networks in all readers. The terms *regulate, stres* and *maltreatment,* which appear often in the titles of psychological articles, are ambiguous becau readers activate different networks to these words. By contrast, the terms *default network, dors stream,* and *dopamine,* which appear in the titles of articles in neuroscience journals, evoke a simil understanding because they are linked to consensual networks. The first two essays elaborate the ideas and the conclusions they imply.

The social scientist's habit of using single abstract words to name pro-cesses independent of the context continues to obstruct progress. Each kind of setting selects one particular perception, emotio thought, or behavior from a collection of candidates that could occur to a question, event, instruction. A windowless room in a university, the narrow tube of a magnetic scanner, the livin room of a home, an Internet cafe, and an airport waiting area generate dissimilar answers from colleg students asked by a friend or a stranger to report their major worries.

The settings that characterize a person's social class, culture, and historical era have extraordinar power to shape personality traits, abilities, values, and the interpretations of events. The great prevalence of physical and mental illness among the poor in every society affirms this claim. Th details of the procedure a scientist chooses to generate evidence are part of the setting. A sing measure reveals only some properties of the phenomenon of interest. A woman's description of ho she felt when she confronted a group of adolescents in a dark alley and her pattern of brain activi measured in a laboratory when she was asked to recall this event provide different evidence about h state of fear in the alley that night.

Because most behaviors and verbal descriptions can be the result of more than one set conditions, scientists must collect patterns of measures in order to distinguish among the caus sequences that generate the same outcome. Social scientists are fond of trying to prove that a sing condition whose potency depends on being part of a pattern can make a significant contribution to a outcome. The consequences of being bullied as a youth are apt to depend on whether the victi belongs to a minority or a majority group, grew up in a poor or affluent home, is excessively timid bold, a nerd or a low-achieving student, deferential or bossy, and whether the evidence came from questionnaire, observations of behavior, or measures of the brain.

The contexts created by historical events, woven into many of the essays, have altered the ease social mobility, the balance between the individual and the community as the primary beneficiary action, and sources of unhappiness. Essays 3 and 4 elaborate the influence of contexts, especial settings that characterize social class categories, on human actions, emotions, and beliefs.

The prominence of explanations of human psychological properties that emphasize genes an brains, while excluding thoughts, is another theme. Natural scientists have become reluctant to awa thoughts an autonomous influence on human actions because, unlike genes and brain circuits, they a immaterial, cannot be visualized, and are absent in the mice and rats that are frequent targets of stud If thoughts had a partial autonomy from the brain activity from which they emerged, investigato would be forced to question the practice of relying on animal models to illuminate human desires an worries. They could not, for example, equate a rat's reaction to being confined in a narrow tube wi the response of a single mother of three children who just lost her job. Nor could they assume that th state of a mouse who avoids entering a brightly lit alley resembles the state of an adolescent who anxiety over a coming examination has led to insomnia. As a result, pharmacological companies cou not cite the "benevolent" effects of a drug on mice who avoid lit alleys as evidence for i

effectiveness in reducing anxiety in humans.

The natural scientist's conviction that material entities are the fundamental origins of all natur events makes it easy to treat thoughts as epiphenomena which, one day, will be predicted an explained by patterns of activity in neurons, circuits, and molecules. This premise denies th possibility, acknowledged by physicists, chemists, and biologists, that emergent processes can posse properties that cannot be predicted from the events that were their foundation. The properties of a fo are not present in the molecules of hydrogen and oxygen; the properties of insulin are denied to th amino acids that are its foundation. It is perfectly reasonable, therefore, to argue that a person interpretation of a racing heart has properties that cannot be found in the brain profile that provoke the increase in heart rate.

Currently popular explanations of human altruism are burdened with a materialistic perspectiv Rather than acknowledge that the thought "I am a good person" is often the only satisfactio accompanying an act of kindness toward a stranger, biologists and like-minded social scientists insi that an altruist must gain something tangible in return for giving a stranger money, food, or blood. materialistic explanation of charitable behaviors enjoys a broad reception among natural scientis because they can point to brain circuits that respond to the receipt of material rewards, like food sex, but cannot find a circuit that accompanies the private affirmation of oneself as a good person.

Natural scientists celebrate machines such as the electron microscope, space telescope, and line accelerator because they make hypothetical things perceptible and, therefore, real. The magazin *Science* announced that the breakthrough event of 2014 was the landing of the space probe Philae o the comet 67P after a journey of 6.4 billion kilometers. The thoughts of the scientists and enginee who made this feat possible, which machines cannot reveal, were not mentioned.

Essays 5 and 6, on genes and brains, summarize the many fascinating facts scientists have learne about these material entities. Although this knowledge complicates an earlier and much simpler viev some scientists continue to award genes and brain states a deterministic power that ignores th cascade of events that precedes every observable outcome. The vast majority of traits require th joining of particular life histories and current experiences with genes and brain patterns.

As a result, the vocabulary that describes brain activity cannot replace the words that descril actions, thoughts, and feelings. Because neuroscientists have not yet invented a vocabulary th describes the brain profile recorded when a person looks away from a picture of a snake with ope jaws, is nostalgic over a past event, or plans the day's activities, they decided to borrow psychologist words and apply them to brain patterns—hoping that the meanings had not changed. Unfortunatel brains cannot be fearful or nostalgic and can neither plan, decode, nor compute. Future investigato will have to invent a vocabulary that is appropriate for what is happening in neurons and circuits whe a person engages in a psychological process.

The person is at the center of the final six essays, which discuss the role of the family, the degre to which early traits are preserved over time, the functions of education, the significance expectations, the interpretations of bodily feelings, and the meanings of morality. The neuroscientist dismissal of thoughts as having causal power turned psychologists away from studying the vicario emotions that accompany a person's identification with a family, class, ethnic group, religion, o nation. An explanation of an adolescent's depression a week after he learned that his grandfather was callous killer must include the youth's interpretation of his genetic relationship to a grandfather h never met. The conflicts between Shia and Sunni Muslims or between the residents in Eastern Ukrain and Kiev are fueled by emotional identifications with religion or nationality.

Almost all the research on the relation between a child's family experiences and his or her futu

traits emphasizes observable events, such as parental neglect, sexual abuse, harsh punishments, or lac
of physical affection, and not the child's interpretation of those experiences. These interpretation
depend on expectations. Children in colonial America expected to be punished harshly fo
disobedience. Hence, their interpretation of being spanked, locked in a closet, or deprived of pleasur
for many days was more benign than the one contemporary children would impose on the sam
experiences.

Many psychologists defend their failure to evaluate identifications and interpretations by arguin
that they are too difficult to measure. Natural scientists are less likely to use difficulty as an excu
for not studying an important process. When physicists decided they had to determine whether th
Higgs boson did or did not exist, they persuaded governments to give them $9 billion to build th
Hadron Collider.

I made morality the theme of the final essay because a concern with good and bad is one of th
defining properties of Homo sapiens. Only humans insist on sorting things, people, and experienc
into bins marked bad, good, or neither. Although children and adults hunger for a set of mora
demands that must be honored under all circumstances, this prize continues to elude humanity becau
circumstances matter. Montaigne understood this truth.

Essay 12 distinguishes between moral behaviors, defined by conformity to a community's mor
code, and a person who is loyal to his or her private conscience. Edward Snowden's defense of h
actions illustrates the difference between these two meanings of moral. Humans want to believe the
are some moral demands that are unquestioningly right and deserve to be honored. The historic
events of the past century have frustrated that need. As a result, many seek to understand a malais
that affects many members of industrialized, democratic societies. What is its cause? What is its cur
Misdiagnosing the malaise as due to loneliness, unbridled capitalism, too much stress, or rebellio
immigrants prevents recognition of a more critical basis for the mood of uneasiness.

Some facts from my history may help readers evaluate my conclusions and speculations. I wa
born in 1929 to an agnostic Jewish family in a small New Jersey town of close to thirty thousan
residents about twenty miles south of New York City. Only recently have some of the scars created b
the economic Depression of the 1930s begun to heal. I have always identified with the underdog—
rooted for the Dodgers when they were in Brooklyn—feel empathy for victims coping with conditio
they cannot control, and am peeved when those in positions of authority become arrogant. A
automatic skepticism toward all statements issued by such authorities is probably one of my defini
traits.

The ingenuous belief that a deeper understanding of the family experiences of young childr
would automatically yield wise recommendations that, if adopted by parents, would create utopia
societies free of crime, hatred, and misery was the reason I chose developmental psychology rath
than biochemistry when, in 1950, a career decision had to be made. The bursting of that illusio
combined with the events of the past century have generated an unwanted pessimism about the futu
state of our species. I wish I were as optimistic today as I was forty years ago. The natural scientist
declaration that the origin of the universe and the emergence of life-forms were accidents and life wi
disappear in about 4 billion years when a giant red sun will evaporate the earth's water call for mo
humility and less narcissism.

Biology's four seminal unsolved mysteries center on the conditions that led to the varie
anatomies and physiologies of animals, the processes that explain why offspring resemble the
biological parents, the detailed functions of cells, and the reasons for the current distribution
species across the world's regions.

Psychology's primary puzzles resemble the biologist's quartet. What patterns of conditions a responsible for the changes in an individual over a lifetime, which psychological properties are like to be preserved and which altered or lost, how does any psychological outcome emerge from bra activity, and what factors explain the variation in adaptation to a society?

Montaigne titled his collection *Essais*, which means attempts. Readers who now know my bias should be better able to judge whether my attempts to illuminate some extraordinarily complex ide contain a measure of truth. I used two criteria in selecting the dozen themes. I wanted each essay to b interesting but also comprehensible to readers who do not possess detailed technical knowledge b wish to have an appreciation of the complexity of the phenomena. The processes that allo perceptions of events are of great interest to scientists, but most readers do not have the background appreciate a comprehensive discussion of this domain. But the meaning of words, the influence social class, the relation between brain and mind, and the role of the family recruit a broad curiosi and can be discussed without an overly technical jargon.

The elegant victories of the physical and biological sciences have attracted the support philanthropies and federal agencies that used to be friendlier to the social sciences. The media, to are more interested in the genetic contributions to a behavior than the experiential conditions that giv rise to it. I hope these essays persuade both constituencies that the events of the mind, althoug requiring a brain, possess a degree of independence that requires a vocabulary that is inappropriate f genes and brains. The brain's response to a hand placed in boiling water has an equivalent autonom from the physics of the heated water molecules contacting the surface of the skin. An understanding the feelings and thoughts evoked by listening to Beethoven's Ninth Symphony in a quiet room on winter night, seeing the torture of a prisoner on a television screen, or walking in an autumn fore when the foliage is at peak color requires evidence that a brain cannot provide and sentences that a inappropriate for neurons and circuits.

I hope these essays will persuade those who question the power of the mind that thoughts an feelings are not wispy, ghostlike phenomena that one day will be explained away by measures brains. I share the view of the physicist Lewis Victor de Broglie, who wrote, "Two seemingl incompatible conceptions can each represent an aspect of the truth. . . . They may serve in turn represent the facts without ever entering into direct conflict."

I thank Robert Kagan and Charles Nelson for comments on one or more essays and Robin DuBlanc f perfectly superb editing and the ability to detect incoherence.

Schemata and Words

Humans are the only species that operates in two realities. The one we share with animals consis of representations of the salient features of objects, movements, places, smells, sounds, tastes, ar feelings. Taste is salient for cookies; flying for birds. These representations, which I call schemat are the foundations of the images that humans generate when they try to re-create an event in th mind. My schema for the face of a person I just met retains the spatial arrangement of the eyes, nos and mouth and color and length of the hair, but usually omits the shape of the ears and length of th eyebrows. I possess schemata for the sound of an airplane, the texture of sandpaper, the odor o mothballs, my actions in the morning, and the feelings that accompany cold fingers, hunger, and th first glass of wine after a day of work.

Schemata are created effortlessly. Most adults can generate a separate schema for each of tw hundred pictures they examined for only a few seconds. Eleven-year-olds living in isolated villages Guatemala preserved for at least two days schemata of pictures of objects they had never seen- including a toaster, a telescope, and golf clubs. These observations imply that the brain can create an preserve schemata for a very large number of events.

Objects and events that are encountered frequently become prototypic schemata that contain th features that usually accompany each phenomenon. A six-month-old has acquired a prototypic schem of her mother's face that allows her to distinguish the mother from another woman. My prototyp schema for one of the pine trees on my lawn consists of the distinctive shape, height, and location th differentiate it from a nearby spruce. The features of a prototypic schema can change with experienc An adult's schema for a parent's face contains features that were missing from his schema as a infant.

When an object or action typically occurs in a particular setting—say, brushing one's teeth in th bathroom, buckling up in an airplane, or cooking dinner in the kitchen—the features of the setting a part of the prototype. My prototypic schema of the treadmill I use in a nearby athletic club contai features of the room in which the treadmill is located. When the setting is an element of a schem adults might not notice a small change in some of the objects in that setting: for example, most adul would not detect a slightly different faucet on the kitchen sink.

Schemata allow rapid recognition of a familiar event, detection of an unfamiliar one, and facilita the understanding of abstract ideas. Niels Bohr drew a picture of a spherical drop of water bei transformed into the shape of a peanut to help him understand how a stream of bombarding neutro could fission a uranium atom. Werner Heisenberg frustrated his colleagues by replacing Bohr schema of an electron as a planet orbiting the sun with a mathematical operation that was difficult represent as a schema.

Words: The Other Reality

The second reality, unique to humans, consists of words, only some of which describe the reality th schemata represent. The first humanoid species possessed schemata for the distance between tw trees, the interval between sunrise and sunset, and the array of fingers on a hand. Modern huma invented special words to describe the distances between objects, the durations between events, an the number of objects in an array.

Human languages contain three broad categories. One set of words is used to evaluate a perso object, event, intention, or feeling as good, pleasant, or appropriate, as opposed to bad, unpleasant, inappropriate. The second category consists of names for observable objects, events, or their physic features. Most of these words are linked to a schema. Amanda Holland found that four-year-old learning English found it easier to remember new words that named a whole object than new word that named the color or texture of an object. This principle may hold for children learning an language. That is, children appear to be biased by their biology to assume that when an adult utters new word while looking at an object, the word probably refers to the whole entity. Young children ar apt to remember that the word *avocado* names an object with a particular shape, size, and color, b are likely to forget that a pineapple is "prickly" and a tulip is "turquoise" when they hear these term for the first time because prickly and turquoise are features.

The third category contains names for abstract ideas, such as knowledge, truth, resiliency, justic number, and time, that do not possess a particular set of physical features. A team at the Max Planc Institute in Nijmegen noted that the word *time* activates different schemata and, therefore, h dissimilar meanings for Mandarin and English speakers. The former conceive of time as approachi a passive person. English speakers rely on a schema in which an active person moves through passive time.

Number words name a property of objects or events that is not contained in their individu features. A person looking at two decks of playing cards would be equally correct if she said ther were 104 cards, two decks, or one pile. Time and number, like sacred and holy, are not inherer properties of natural events but words humans invented because they are useful. Chimpanzees walkin to a grove, picking and eating bananas, and returning to the nesting area are natural events that occ sequentially. We find it useful to say that six chimps spent eighty minutes away from their nestin site. In the debate between scientists who believe that numbers are the language of nature and tho who insist that numbers are mental inventions that happen to describe some phenomena, I side wi the latter.

Natural scientists are suspicious of the social sciences because many of the latter's concepts- perception, memory, regulation, stress, emotion, and well-being—are not linked to a single set features that can be imagined or, better yet, photographed. Only 1 percent of the words in the abstrac of papers published in the July 2014 issue of *Psychological Science*, a leading journal in psycholog had a link to a consensual schema. One of the abstracts contained the terms *negative emotion*, *aversio sensitivity*, *stress*, and *discomfort*. None evokes the same schema in all readers. Negative emotio could refer to fear, worry, anger, jealousy, or sadness; aversion sensitivity could mean the avoidanc of parties, flying, or dirt; and stress could refer to an illness, poverty, loss of a job, social rejectio death of a loved one, or a tornado that destroyed one's home.

By contrast, 5 percent of the words in the abstracts taken from the July 2014 issue of *Neuron*, leading journal in neuroscience, contained words such as *glia*, *Schwann cell*, and *interneuron*, whic would evoke a similar schema in all readers. The French biologist Jean Rostand captured th

ambiguous meanings of abstract words in a pithy quote: “Theories come and theories go, the fr remains.” Rostand meant that a word can change its meaning over time by referring to a differe phenomenon. The phenomenon, however, remains the same. The meanings of the terms *species* a *gene* in 2015 are not the meanings biologists understood in 1930.

A Brief History

The first spoken language appeared long after the first humanlike species created schemata f objects, actions, and feelings. The first written language did not appear until about eight thousa years ago, more than ninety thousand years after Homo sapiens evolved. Words, therefore, appear be an “add-on” to talents that are millions of years old.

Humans had to first inherit an anatomy of the tongue and larynx that allowed them to articula vowels and consonants and a brain that sent projections to the larynx. These anatomical facts expla why human infants babble but monkey infants do not. Humans also had to be able to infer that son sounds coming from a human mouth were intended to represent events. These properties had to occ before humans could invent a language that informed others of facts they needed or wanted to kno obligations they had to obey, and dangers they ought to avoid. This spoken communication united th members of a community into a more coherent collective, just as honeybees rely on their abilities produce and detect select odors to unite the members of the hive into a coherent collective.

The Specialness of Words

An infant watching *The Wizard of Oz* for the twentieth time, seeing Dorothy release the straw ma from the pole on which he hangs, anticipates that the object is about to move. A five-year-old expec to see a “scarecrow dancing.” Dancing scarecrows belong to the symbolic reality of language, whi carves schemata into semantic forms that often convey little or no information about the physic features of the events. The name for my schema of the space where I work—my study—wipes awa the physical details of the room because the main purpose of language is to communicate informatio as efficiently as possible. My wife only wants to know where I am, was, or will be, and does not ca about the prototypic schema residing in my brain.

The words that name the legal status and diverse roles of the person named Jerome Kagan have n changed over the past sixty years, even though his actions, beliefs, emotions, genes, brain, gu muscles, and immune system have been altered in nontrivial ways. Words freeze-frame changin events into forms that invite the belief that nothing has changed. The fact that the Mesopotamians ha words for the English terms *life, liberty, happiness, right, wrong, fair,* and *unjust* does not mean th the phenomena to which these words refer have not changed.

Words distort experience by digitizing events into bins containing different kinds of things. Mo speakers, as well as the media, refer to African Americans as one group and fail to distinguis between African Americans whose families have been in the United States for generations and rece black immigrants from the Caribbean or Africa. Mary Waters of Harvard University points out tha many members of these two groups live in different regions and have dissimilar educational and jo histories. Hence, it would be useful to give them distinctive names. Jonathan Schooler of th University of California reported that individuals who used only words to register faces or object compared with those who also created schemata, were impaired when they had to recognize the events later because the words failed to name critical features. If I represent the new Tesla in neighbor’s driveway as a car, without also creating a schema for its exact shape, I may have difficul

later distinguishing it from a new model of a Lexus or Cadillac.

Consider a person who is asked one month after seeing a gang of boys tease a small child but n physically harm him whether any gang member had hit the child during the incident. If the observ had registered the scene as "aggression," he is likely to say yes because of the strong associatio between the words *aggression* and *hitting.* This error is less likely if the person had registered th event as a schema, with or without a semantic label. Adults who do not regularly activate schema when planning a future action often fail to consider similar occasions in the past when a less tha pleasant experience occurred. For example, a person who decides to travel the day befo Thanksgiving because it is convenient and fails to retrieve schemata representing the three times sh did this and was frustrated by the traffic is at risk for another unhappy experience.

The different microanatomies of the left and right hemispheres of the brain may contribute to a asymmetry in the different kinds of associations to words compared with schemata. The neuron collections that make the most important contributions to language are in the left hemisphere ar favor analysis of the features of events. The neurons of the right hemisphere are prepared to proce the whole patterns that are more characteristic of schemata. The language sites in the left hemisphe are prepared to detect a single feature shared by objects with different shapes. For exampl rattlesnakes and black widow spiders share the property of being dangerous. Hence, reading the wo *rattlesnake* is apt to evoke a schema for a black widow spider. By contrast, a picture of a rattlesnake unlikely to evoke a schema of or the word for spider.

Most philosophers ignore the schemata that contribute to the meanings of words. The verb *kno* for example, is often conceptualized as a yes or no dichotomy rather than a continuum of certaint Too many philosophers and social scientists treat word meanings as natural kinds, as if the properti of the terms *good*, *moral*, and *truth* were as discoverable as the properties of the soft green stu growing at the base of trees. This premise explains why some psychologists thought it was perfect appropriate to ask the staff at different zoos to rate animals belonging to diverse species o personality traits that were invented to apply only to humans. The staff members were willing to ra lions and leopards on curiosity and self-confidence, as if these words had a meaning as fixed as ea meat, sleeps during the daylight hours, and has a tail.

Adults who have mastered a second language later in life are unlikely to activate schemata for th feelings linked to emotional words. As a result, they find it easier to swear or to say "I love you" i their second language than in their first because these words are stripped of feeling. Renaming even in order to remove a feeling linked to a stigmatizing property works. Unskilled laborers are now calle entry-level workers, prostitutes are sex workers, and torture is enhanced interrogation. Perha "exaggerated sexual dominance" will replace rape and "chronic indifference" will become the nam for parental neglect.

Words are poor at describing events that are changing, such as a bird in flight, a rush of feelings, train of thoughts, and the movements of a person opening a bottle of wine. Words have the powe however, to dilute a feeling of uncertainty over the appropriate action to implement. A messag labeled "spam" resolves unsureness over whether it should be opened and read. Transgendered adul feel uncomfortable when asked to state their gender on official documents. The Australian High Cou resolved their uncertainty by ruling that they could write "nonspecific" in the box asking for gender.

The writer José Ortega y Gasset worried about the human proclivity to assume that if a word used, it probably is the name of an observable event. "Create a concept," he wrote, "and reality leav the room." Alfred North Whitehead phrased this truth differently: "Language . . . foists on us exa concepts as though they represented . . . experience."

The Variation in the Parsing of Experience

The world's six thousand or so languages sort many events into different semantic categories. Englis invented different words for mice and rats. The Thai language has one word for both species, eve though Thai speakers perceive the size difference between the two animals. The ancient Greek distinguished between physical pain and mental distress; the Romans invented only one wo —*dolor*—for both experiences.

Very few English verbs describe variations of common actions. The English verb *eat*, for exampl is used when a person is eating nuts, an apple, or a popsicle. An Australian language, by contras invented three different verbs to capture the different actions of the mouth and teeth with these food Barbara Malt of Leigh University asked speakers of English, Dutch, Spanish, or Japanese to describe woman displaying thirty-six different movements. Although all the speakers had words th distinguished between fast and slow movements, some languages did not have different words f skipping in place versus skipping forward.

Speakers of Fijian use different words to describe an object that belongs to a person compare with a person's body part. English speakers ignore this difference when they say "Mary's cup" an "Mary's arm." The English term *in* ignores both the kind of object and the type of container. Speake of Tzeltal, a Mayan Indian language, have six different ways to capture the combinations of certa objects and containers that are possible in: "The water is in the bucket," "The water is in the cup "The water is in the ground," "The spider is in the bucket," "The spider is in the cup," and "The spid is in the ground."

Psychologists, as a language community, use some words in ways that are foreign to the gener public and to natural scientists. For example, psychologists are fond of the adjectives *positive* an *negative* to describe feelings and emotions. Most adults, by contrast, say they are happy, not positiv when they receive a gift and sad, not negative, upon hearing about the death of a friend. Chemis might lose their grant if they used the words positive or negative to describe a molecule that caused collection of neurons to either fire or grow silent.

Reward is another popular psychological term that is supposed to apply to an extremely broa range of events that animals seek to experience. Some eminent psychologists write about rewards "value systems in the brain." This phrase implies that a similar brain profile accompanies a ma mouse preparing to mount a female, a monkey in a laboratory expecting three drops of grape juice f moving his eyes to a certain location, a child in school anticipating praise from a teacher for a examination performance, two lovers anticipating their first sexual intimacy, a scientist in her stud anticipating a particular result as she pores over a collection of numbers, and a speeding driver pulle over by a state trooper anticipating only a warning and not a ticket. It is unlikely that the brains these life-forms respond to these diverse events in the same way.

Communities are unlikely to invent words for infrequent events that convey little informatio There is no need, for example, to invent a word to describe a person skipping in place. On the oth hand, one regularly sees a person or animal move slowly or quickly and the words *walk*, *shuffle*, *jo* and *run* convey important information about the kind of movement and, by inference, th psychological state of the agent. People invent and use words for a purpose—they want communicate a fact or idea that both speaker and listener care about.

Networks

The collection of schemata and words associated with an event form a network. The strengths of th

associations among the members of the network vary with the number and salience of the featur shared by those members. The shared feature could refer to shape (balls, apples, and pebbles a round), size (pennies, peas, and a doll's shoes are small), function (soap, water, washcloth, and sir are used to clean things), usual location (gulls, sand, and waves are found near the sea), kind movement (slow, smooth, graceful), sound when spoken (peach, preach, teach), a contrasting relatio (up versus down or bad versus good), a condition with salient consequences (a hurricane earthquake), or a semantic category (animals, natural, manufactured, common).

The network for peach contains schemata and words for physical properties (sweet, smooth, ar round), usual function (edible), locations (on trees, in grocery stores, in kitchens), category (food), ar words with a similar sound (preach, beach, each, teach, reach, and leach). The network for woman, least among Americans, has strong links to the network for mother which, in turn, evokes associatio to the networks for child, food, cook, kitchen, sink, soap, clean, good, and attractive, which bring back to woman to close the circle.

French adults familiar with Eugene Delacroix's painting *Liberty Leading the People*, who central figure is a bare-breasted woman holding a musket in her left hand and the tricolor flag of th French revolution in her right, probably possess links between the network for woman, on the on hand, and the networks for liberty, sacred, France, and rebellion on the other. Americans, German and Japanese are unlikely to possess this network of associations. Medieval Europeans had stron associations among the networks for woman, green, cold, and jealous because they regarded green as cold color and women as both coldhearted and prone to jealousy.

Contemporary Europeans possess an association between the color yellow and a triangle and a equally strong association between red and a circle. One interpretation rests on the fact that yello objects and triangular shapes are less common in nature than objects that have a red hue and a circul shape. Hence, the terms *uncommon* and *common* provide the link that explains why yellow goes wi triangle and red with circle. The image of two wheels, each with many spokes, provides a visu metaphor for the associations between two networks: an association is represented by a spoke fro one wheel touching a spoke on the other.

The discovery of the structure of deoxyribonucleic acid—DNA—in 1953 had to occur befo geneticists could have made so many major advances over the past fifty years. I suggest that the futu discovery of the range of network structures linked to frequently used concepts, such as woma father, good, earth, and food, will be followed by an equally significant set of advances. This tas requires measuring the strengths of the associations among the schemata and words that are part each network. Too few psychologists are working on this problem because the appropriate metho have not been developed.

Most adults are able to detect at least one feature that is shared by any pair of words in the language because elementary contrasting word pairs, such as good-bad, active-passive, strong-wea and male-female, provide a link that unites pairs of seemingly disparate words. For example, aspir and vacations are good; blizzards and athletes are active; babies and raindrops are weak; and the s and queen bees are female. Magic rituals are based on these kinds of links. A woman in ancient Egy who wanted to attract a man's ardor melted a wax figurine of the man on the assumption that wax ar a man's feelings were both capable of being softened.

Because educated, high-status parents in eighteenth-century Europe usually gave their children middle initial, most adults possessed an association between higher status and a middle initia Contemporary Irish college students hold the same belief. American parents during the country's fir century rarely gave their children middle names. Neither George Washington, John Adams, no

Thomas Jefferson had middle names. This practice changed after the Civil War, and today almost 9
percent of American infants are given a middle name.

Most contemporary adults follow the ancient Greeks and Chinese in associating odd numbers wi
maleness and even numbers with femaleness. Although there is no consensual explanation of this fac
two interpretations are possible if we assume that the numbers 1 and 2 are prototypes of the concep
odd and even. One explanation relies on the fact that a person who is number 1 in a hierarch
dominates the one ranked 2—and, traditionally, men dominated women. There is only one God and h
is usually pictured as male. A second, more speculative, account rests on the fact that things that caus
pain often consist of a single article (a knife, pin, or needle), whereas many objects that bring pleasu
consist of a pair of features (two lips that kiss, two breasts that nurse, a pair of arms that embrace
Men are more likely than women to harm others; women more likely to embrace them.

Because most of the teachers in America's elementary schools are women, children acquire a
association between schoolwork and femaleness. One implication of this unconscious associatio
which psychologists affirmed with German children, is that young boys who are unsure of their ma
identity might be threatened by a conscientious approach to school assignments. As a result, they a
less diligent.

Punctate or Smooth?

The brain is remarkably sensitive to the differences between punctate and gradual events. Sounds th
are punctate have a short duration, higher pitch (frequency), and fast rise time (the peak intensity
reached quickly). Screams, alarms, and the nonsense word *kiki* are punctate. By contrast, gradu
sounds last longer, have a lower pitch, and display a slower rise time. Lullabies, murmurs, and th
nonsense word *bouba* are gradual. The shapes of objects can be punctate or gradual depending on th
rate of change in their contours. Angular shapes are punctate; curved ones are gradual. Children an
adults alike select objects with a punctate shape—say, a picket fence—as matching words with
punctate sound such as kiki, and select objects with a gradual contour—such as a ball—as a match f
a word like bouba, which has a gradual sound. Experiences humans judge as pleasant, such as
lullaby, caress, a flower's scent, and the texture of silk, are marked by gradualness. Experienc
judged as unpleasant, such as sour tastes, acrid smells, and the prick of a needle, have a puncta
quality.

When the pitch of the first syllable is lower than the second in three-syllable meaningless word
as in *babopu, bibapo,* and *bopipa,* adults judge these sounds, which ascend in pitch, as pleasant an
match them with pictures of puppies, babies, and heaven. However, when the first syllable is high
than the second, as in *tatoku, didago,* and *dodiga,* adults match these sounds, which descend in pitc
with pictures of snarling wolves, snakes, and sad faces. It may not be a coincidence that the fir
syllable in the most popular two-syllable names for American boys—Jacob, William, Ethan, an
Michael—is higher than the second syllable. By contrast, the first syllable in two of the four mo
popular girls' names—Sophia and Olivia—has a lower pitch than the second and the sound ascends
pitch. The names of three popular cars—Chevrolet, Lexis, and Mazda—have the sound pattern
popular boys' names, whereas the names of the popular flowers azalea, begonia, camellia, an
carnation match the sound pattern in girls' names.

The Setting

The setting affects the networks that are likely to be activated by an event or a sentence. If I rememb

T. S. Eliot's line "I will show you fear in a handful of dust" while reading Eliot's biography, I ar likely to activate networks representing the First World War, Barbara Tuchman, Serbia, the film *To & Viv*, and my father, who served in that war. Remembering the same line while reading a biograph of John Maynard Keynes, who knew Eliot, will activate networks that include reparations, German Adolf Hitler, World War II, and the Marshall Plan. And if I remember the line after listening to lecture on the conditioning of fear in rats, a different collection of networks would be activated.

I do not possess one network for "woman." Rather, I possess a number of related networks th have different probabilities of being activated when I see an attractive woman on the street, read abo women presidents, think about women caring for young children, see the play *Macbeth*, or hear a rad program discussing competitiveness among professional women. The networks that are prepared to b activated by an event resemble a smorgasbord that diners sample—all items are potentially availabl A person's perception of the pattern of reflected light on the crest of ocean waves provides a secon analogy, for the perception is contingent on where the viewer stands.

Are Words Locatable in the Brain?

Some scholars are attracted to the idea that each word has a single home in a person's brain. It is mo reasonable to assume that most words in a person's vocabulary belong to a large number of differe networks located in different places. The sentence in which they appear and the setting determine th network that will be activated or, in some cases, assembled at the moment a provocative event occur The word *train* evokes distinct networks in sentences describing travel compared with sentences abo a woman's bridal gown. Consider the seemingly simple word *female*. Some women who were bo with a female genome, ovaries, and uterus cannot conceive. Others with a female genome are bo with a penis and replace it with female genitals. A few individuals with a female genome ask surgeon to remove their female genitals and prescribe male hormones so that they can look like male. A person who knows these facts does not possess a single network for this word.

Adults often create a new network, or alter an old one, when they must answer a question they ha never considered. For example, most adults would answer a psychologist who asked, "How confuse have you been over the past ten years? Please rate your feeling on a ten-point scale," even though the had never considered this question until that moment. And the mental events that preceded the answer could have generated a network for the word *confused* that did not exist before the questio was posed.

Alan Rosenthal, a commentator on European culture, reminds us that the names of nations for networks that change with history. The network for contemporary (but not medieval) France ha strong associations with culture, art, romance, wine, and women. The network for Germany, b contrast, has stronger associations with the masculine concepts of cars, machines, Prussian general and war. Freud's trio of id, ego, and superego has been transformed into the current concepts o impulsivity, executive processes, and emotional regulation.

Early humans possessed a network for the idea of time that is not the contemporary understandin The languages of premodern societies untouched by science talked about the intervals betwee specific events that had either occurred—"We planted corn two full moons ago"—or might occur i the future—"We will plant corn when the leaves reappear on the trees." The Egyptians invented water clock, relying on the same principle as the hourglass, to measure the interval during which person could take water from a public well. The network for the word *time* that includes a schema f the spatial patterns formed by the hands of a clock did not emerge until the thirteenth century whe

the mechanical clock was invented.

The words *month* and *year* as units of time correspond to natural intervals (the lunar and su cycles), but *second*, *minute*, *hour,* and *week* are arbitrary. The term *week* originated in a decision b Sargon I, the king of Akkad in 2350 BCE, to name an interval of seven days as a basic unit of tim because the Sumerians, whom Akkad had conquered, worshipped seven gods symbolized by th planets that were visible in the night sky. Had the Sumerians worshipped eight gods, a week mig have had eight days. The citizens who took over after the French Revolution created a ten-day wee and a 140-minute hour.

The idea that the numeral 4 can name a collection that consists of a goat's hoof, a clay bowl, a arrowhead, and a white stone resting next to each other in a hole in a cave does not come easily to th human mind because the four objects look different and belong to different semantic categories. Th is why set theory was invented relatively late in human history. The words *time* and *number,* like *ev* and *sacredness,* are abstract concepts that have belonged to different networks throughout history. Th poet e. e. cummings captured the distinction between abstract words and schemata when he wrot "Life's not a paragraph / And death I think is no parenthesis."

Semantic Versus Schematic Prototypes

A word that possesses many features of the network held by most speakers in a community is calle the semantic prototype. The word *robin* is the semantic prototype for "bird" among Americans livin in the mid-Atlantic states because robins are common and combine the features possessed by mo birds: small size, the ability to fly and sing, and winter migration. For Norwegian residents livin close to the sea, the word *gull* is the semantic prototype.

The prototypic schema of a bird, however, can differ from the semantic prototype. My prototyp schema for bird is not a robin but an average of the salient features of robins, wrens, gulls, sparrow and crows. Jerry Fodor and Zenon Pylyshyn in *Minds without Meaning* emphasize the distinctio between a prototypic schema and a semantic prototype. They note that the word *triangularity* appli to every possible bounded figure composed of three connected lines and, therefore, differs from th usual schematic prototype for a triangle, which has sides of equal length.

The members of each scientific discipline possess a semantic prototype for an ideal member their discipline and, perhaps, a schematic prototype of that person's face. The name Albert Einste accompanied by a schema of his distinctive face is probably common among physicists. Francis Cric and James Watson looking at their model of the DNA molecule may work for biologists. Th members of a discipline whose research resembles that of the prototype enjoy more respect and w more prizes than those who deviate from the ideal.

The Special Properties of Words

The primary purpose of words is to communicate information. The function of thought is understand experience. Communicating these understandings is secondary, especially when they a insights about the self that one does not wish to share or thoughts filled with schemata that lack a appropriate vocabulary. I do not have words that are able to convey the train of thoughts and feelin that occurs when I am standing on a deserted, unlit beach staring at the Milky Way in a cloudless sk filled with the light of a full moon.

Many words, but especially nouns that name objects, are part of a hierarchy of terms. Every pupp belongs to the category dog, all dogs belong to the category mammal, mammals are animals, an

animals belong to the category living things. The members of a language community select on element of the hierarchy as the basic term, which is usually dog in most languages.

Social scientists and the public often differ in the basic-level terms they use to describe psychological trait. The latter prefers words that are lower in the hierarchy. Most Americans woul say, "Mary was afraid of her father's harsh criticisms when she was a child." Psychologists, wh prefer words higher in the hierarchy, make *stress* the basic-level term: "Mary experienced stress as child." This sentence ignores the cause and quality of the stress and the feeling that accompanied Since words that are used less frequently are susceptible to more than one meaning, English speake agree more on the meaning of *afraid* than the meaning of *stress.*

Although young children can discriminate between dogs, cats, cows, on the one hand, and boxe telephones, and furniture, that fact does not mean they understand the meanings of the words *mamma* or *artifacts.* The brains of infants display different profiles of activity in response to patterns moving lights produced by filming adults (with small lights attached to their limbs and trun adopting a happy or a fearful posture. The psychologists who did this study concluded that the infan were distinguishing between happiness and fear. It is more likely that the infants' brains wer responding to the physical differences in the light patterns generated by adults spreading their tw arms, as in joy, versus bringing their arms close to the body, as in fear. The four-year-old who asks h mother, "Why is the sky blue?" is not a budding epistemologist. Developmental psychologists a tempted to attribute abstract competencies to infants based on behaviors or brain patterns that, many instances, are simply responses to variations in physical features.

The brains of infants, like the brains of all vertebrates with intact vision, detect changes in th orientation, density, and movement of the contours of an event by activating circuits that cause th infant to orient to these changes. Psychologists who attribute an understanding of number to infan because their looking behavior indicates they can detect the difference between arrays of two and fo circles, or attribute to toddlers an appreciation of geometry because they perceive the differe orientations of contours in drawings of rooms are using the vocabulary of the mathematician f observations that have a simpler, less abstract, explanation. Three-year-olds who say, "Wha's tha Mama?" do not have an understanding of the linguist's concept of the interrogative.

The Attractiveness of Abstract Words

The social scientist's habit of inventing abstract concepts, such as extraversion, theory of min utility, and resilience, to describe different collections of events contrasts with the biologist preference for particularity. Psychologists would profit by adopting the biologist's understanding nature's attention to detail. A gene is expressed in a specific cell in a particular tissue, a neuro responds to a restricted range of events, a limb begins to form in an embryo at a particular time. Th processes in life-forms are restricted to particular contexts and times. Psychology is a life science an its investigators would profit from heeding this principle.

Instead of assuming that social anxiety is a property an individual carries into all settings, it wi prove useful to code variation in the frequency of talking, smiling, and small hand and leg movemen in adolescents sitting with four strangers during a thirty-minute exchange of views on politic compared with the behaviors the same youths display at home with their family. Psychologists shou descend from the high rung on the semantic ladder they now occupy to a lower rung from which the observe particular events in specific contexts.

Both Richard McNally of Harvard University and Angelique Cramer of the University

Amsterdam urge social scientists to study the actual relations among a variety of behaviors, feeling and beliefs rather than assume that these phenomena are simply examples of a hypothetical, abstra trait. For example, some victims of a trauma develop insomnia because their hyperaroused sta prevents them from falling asleep. The lack of sleep is likely to produce fatigue which, in turn, ca lead to an apathy that the person interprets as depression. This cascade of events is more faithful to th facts than the current belief among psychiatrists that insomnia, hyperarousal, fatigue, apathy, an depression are the products of a hypothetical state called post-traumatic stress disorder.

Successful writers, poets, and politicians regularly use words that activate schemata. Cynth Emrich of Purdue University and her colleagues performed a fascinating analysis of the inaugur address and one major speech given by each U.S. president from Washington to Reagan. The computed the number of words in each speech that had either a strong or a weak link to a schema. Th first term in the following word pairs is more firmly linked to a schema than the second: sweat versu work, heart versus commitment, path versus alternative, and rock versus dependable. The presiden whose speeches contained many words evocative of schemata—Franklin Roosevelt, Lyndon Johnso Abraham Lincoln, and Andrew Jackson—were judged more charismatic by students and as mo inspiring leaders by historians. Four verbs in Lincoln's Gettysburg Address on November 19, 1863– brought forth, conceived, endure, and perish—evoke schemata.

By contrast, the speeches of Jimmy Carter, Warren Harding, U. S. Grant, and William Howar Taft contained fewer schematically related words and these men were judged less charismatic and le effective leaders. The phrases in Barack Obama's second inaugural speech in January 2013 wer schematically lean. He talked about "life's worst hazards," "fidelity to founding principles," an "common effort and common purpose." Perhaps it is not surprising that he is regarded as a pragmati rational, and intellectual leader but not a charismatic one. Compare Obama's abstract prose with s phrases from Franklin Roosevelt's first inaugural address in March 1933 given in the midst of th Depression: "terror which paralyzes," "convert retreat into advances," "money changers stand indicte in the court of public opinion," "withered leaves of industrial enterprise," "mad chase of profits," an the famous line "The only thing we have to fear is . . . fear itself."

Types of Meaning

It is time to consider the controversy surrounding the definition of the term *meaning*. When schola disagree on the meaning of a word, the wisest strategy is to focus on the phenomena the term supposed to name rather than defend one definition. Any event that reliably signals a second event ha meaning. The sight of a piece of chocolate cake has meaning when it is followed by the anticipation a sweet taste. At least four different kinds of phenomena meet this simple criterion.

The first refers to the occasions when one schema automatically evokes a second schema simp because they typically occur together at the same time or in the same location, as in the case of th sight of the chocolate cake and the sweet taste. No special tutoring or mental effort is needed establish these associations. Antonio Damasio of the University of Southern California reminds u that repeatedly seeing a violin and hearing its distinct sounds create a connection between the tw events. As a result, seeing a picture of a violin activates brain sites normally activated by the sound of a violin, including sites in the motor cortex that represent the hand movements of a violinist.

A second kind of meaning has to be taught. We have to learn that an arrow pointing to the left in parking garage means one should turn left, and a moving red truck emitting a loud siren means there a fire somewhere. Linguists invented the word *sign* to designate the meaning of the arrow and siren.

The third and fourth kinds of meaning are called semantic because the associations contain word
The association can be between a word and a schema—for example, a child learns that an object wi
a particular shape is called a fork—or between two words, as in the link between the terms *fork* a
knife. The rest of this discussion is limited to semantic meaning. The two important facts are th
sentences, not single words, are the usual carriers of meaning, and the meaning of a sentence depe
on how the members of a language community interpret it.

The philosopher W. V. Quine used the sentence "Bachelors are unmarried males" to argue that a
definitions necessarily involve particular events whose meaning depends on how members of
language community understand them. The words *unmarried* and *bachelor* have very specif
meanings in societies that require a legal marital contract between two persons. One cann
understand this sentence without activating networks referring to men living without a partner and
marital contract.

Technical advances in reproductive biology are altering the schemata and, therefore, the meanin
of networks containing the term *mother*. Although most of a woman's genes are located in the nucl
of her eggs, a small number, about thirty-seven, lie in structures called mitochondria located in th
portion of the cell outside the nucleus. Because a woman possessing a deleterious gene in th
mitochondria of one of her eggs might pass it on to her child, it would be advantageous to elimina
this gene but retain the majority of genes in the nucleus. Scientists have successfully removed th
nucleus from the egg of one female monkey and placed it in a cell, taken from a second female, fro
which the nucleus had been removed. The egg of the recipient female contains her mitochondri
genes but the nuclear genes of the first female. This egg was then fertilized with sperm, placed back
the uterus of the first female, and allowed to develop into a newborn monkey.

The Federal Drug Administration is considering approval of this manipulation in cases where
mother has a risk gene in her mitochondria. Should this technique eventually become accepte
medical practice (the British recently approved this procedure), it would be correct to state that th
children born of this process have two mothers. A child would have three mothers if the fertilized eg
were placed in the uterus of a third woman who carried the infant to term and then gave the newbo
to the woman who supplied the nuclear genes.

The Embodiment Theorists

There is a lively controversy surrounding the processes that generate semantic meaning. A majority o
social scientists argue that most meanings originate in learned associations between words and event
Presumably, I understand the meaning of "The forecast calls for rain" because I acquired associatio
between the words *forecast, calls,* and *rain,* on the one hand, and a set of corresponding schemata.

A smaller group, called embodiment theorists, favors a different perspective, especially for th
meanings of verbs. They suggest that a person infers the meaning of an action verb automatical
when a relevant motor circuit that simulates the action is activated. There is no role for schemata
this conception. When a person reads the sentence "Mary grasped the cup," the activation of the mot
circuit for grasping awards meaning to the sentence. Benjamin Bergen in *Louder Than Word*
summarizes the evidence supporting the idea of embodiment.

Alfonso Caramazza of Harvard University is skeptical of a strong form of embodiment. Adul
born with no arms have no difficulty understanding verbs like grab and throw. Liuba Papeo of th
University of Trento found that patients who have a serious loss of motor control due to ALS, or Lo
Gehrig's disease, comprehend the meanings of action verbs and carry out verbal requests for mot

acts. And Iris Berent of Northeastern University, with colleagues, found that adults can correct perceive nonsense words, such as *blif*, *bdif*, and *lbif*, when the site in the motor cortex that controls th muscles around the mouth is temporarily silenced. These observations are inconsistent with a stron version of embodiment theory.

Embodiment theorists do not award enough power to the setting in which a sentence is spoke Jana Basnakova and colleagues at the Max Planck Institute in Nijmegen note that the context especially critical when the intended meaning of a sentence is sarcastic, ironic, or intended to reduc another's worry. A parent who says to her adolescent daughter, "You're dressed to the nines" intend one meaning if she is wearing a new dress for a date and another if she is wearing dirty jeans and torn blouse at the dinner table.

In one study, adults listened to dialogues that ended with the same sentence but were preceded b sentences that either made the final sentence informative or required the inference of an indire meaning. For example, the final sentence "It's hard to give a good presentation," spoken by a teach to a student, has informative meaning if the student had asked the teacher whether it was difficult give an oral presentation to a large audience. However, if the student had given a presentation but wa not certain of its quality and asked, "How was my presentation?" the teacher's reply, "It's hard to giv a good presentation" was intended to allay the student's anxiety. In this context the student must infe the intended meaning. The brain sites that are activated by these indirect utterances are in th prefrontal cortex, which embodiment theorists regard as less relevant to discerning meaning.

Even if discerning the meaning of sentences with action words occasionally requires the activatio of motor circuits, there are advantages to theorizing about the contribution of schemata. By assumin that a schema is activated when a person reads "The boy grabbed the cup," investigators can theoriz about the action's properties, such as its smoothness, speed, and direction. Measures of the brain motor cortex cannot, at present, detect these properties. As is often the case, the disagreement boi down to the best way to describe a phenomenon. Is my granddaughter's puppy best described as a do domesticated wolf, vertebrate, mammal, canine, or pet?

Sentences Are the Site of Meaning

The earlier assertion that sentences, not single words, carry meaning is easily illustrated because th sentence selects the specific networks that will be retrieved. The meaning of *cell*, for exampl depends on whether it occurs in a sentence about animals or prisons. The word *fork* assumes on meaning at a restaurant and another in an automobile when the driver asks a question about direction

An accurate understanding of most English verbs requires listeners to know the noun. The listen has to know whether rain or a ball is falling, a cloud or a mouse is moving, or a window or a mouth opening in order to extract the correct meaning of the verbs *fall*, *move*, and *open.*

The same holds for the objects of verbs. Listeners have to know whether a person is regulatin lust, attention, or nervous motor movements in order to understand the meaning a speaker intende Some social scientists fail to appreciate that the meaning of most verbs depends on their nou partners. Economists are fond of the sentence "Humans choose actions in which the reward exceed the cost." This sentence has different meanings when the reward is food and the cost is the physic effort needed to obtain the food, on the one hand, and when the reward is appointment as a profess in an elite university and the cost is the many years of lost pleasure from social relationships an favorite avocations.

Michael Tomasello wrote that apes "know" select causal sequences. Because the term *know* in th