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Culture, Cognition, and Evolution

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Most work in the cognitive sciences focuses on the manner in which an individual device -- be it a mind, a brain, or a computer -- processes various kinds of information. Cognitive psychology in particular is primarily concerned with individual thought and behavior. Individuals however belong to populations. This is true in two quite different senses. Individual organisms are members of species and share a genome and most phenotypic traits with the other members of the same species. Organisms essentially have the cognitive capacities characteristic of their species, with relatively superficial individual variations. In social species, individuals are also members of groups. An important part of their cognitive activity is directed toward other members of the group with whom they cooperate and compete. Among humans in particular, social life is richly cultural. Sociality and culture are made possible by cognitive capacities, contribute to the ontogenetic and phylogenetic development of these capacities, and provide specific inputs to cognitive processes.

Although population-level phenomena influence the development and implementation of cognition at the individual level, relevant research on these phenomena has not been systematically integrated within the cognitive sciences. In good part, this is due to the fact that these issues are approached by scholars from a wide range of disciplines, working within quite different research traditions. To the extent that researchers rely on methodological and theoretical practices that are sometimes difficult to harmonize (e.g., controlled laboratory versus naturalistic observations), the influence of these insights across disciplines and traditions of research is often unduly limited, even on scholars working on similar problems. Moreover, one of the basic notions that should bring together these researchers, the very notion of culture, is developed in radically different ways, and is, if anything, a source of profound disagreements.

The whole area reviewed in this chapter is fraught with polemics and misunderstandings. No one can claim an ecumenical point of view or even a thorough competence. We try to be fair to the many traditions of research we consider and to highlight those that seem to us most important or promising. We are very aware of the fact that the whole area could be reviewed no less fairly but from a different vantage point, yielding a significantly different picture. We

hope, at least, to give some sense of the relevance of the issues, of the difficulty involved in studying them, and of the creativity of scholars who have attempted to do so.

To better appreciate the combined importance of work on population-level phenomena, we sort relevant research into three categories:

1 - Cognition in a comparative and evolutionary perspective
2 - Culture in an evolutionary and cognitive perspective
3 - Cognition in an ecological, social, and cultural perspective

1 Cognition in a Comparative and Evolutionary Perspective Humans spontaneously attribute to nonhuman animals mental states similar to their own, such as desires and beliefs. Nevertheless, it has been commonplace, grounded in Western religion and philosophy, to think of humans as radically different from other species, and as being unique in having a true mind and soul. Charles Darwin's theory of EVOLUTION based on natural selection challenged this classical dichotomy between "man and beast." In the controversies that erupted, anecdotal examples of animal intelligence were used by DARWIN and his followers to question the discontinuity between humans and other species. Since that time, the study of animal behavior has been pursued by zoologists working on specific species and using more and more rigorous methods of observation. However, until recently, and with some notable exceptions such as the pioneering work of Wolfgang Köhler on chimpanzees (see GESTALT PSYCHOLOGY), zoological observation had little impact on psychology.

Psychologists too were influenced by Darwin and espoused, in an even more radical form, the idea that fundamentally there is no difference between the psychology of humans and that of other animals. Drawing in particular on the work of Edward Thorndike and Ivan Pavlov on CONDITIONING, behaviorists developed the view that a single set of laws govern LEARNING in all animals. Whereas naturalists insisted that animal psychology was richer and more human-like than was generally recognized, behaviorist psychologists insisted that human psychology was poorer and much more animal-like than we would like to believe. In this perspective, the psychology of cats, rats, and pigeons was worth studying in order, not to understand better these individual species, but to discover universal psychological laws that apply to humans as well, in particular laws of learning. COMPARATIVE PSYCHOLOGY developed in this behavioristic tradition. It made significant contributions to the methodology of the experimental study of animal behavior, but it has come under heavy criticism for its neglect of what is now called ECOLOGICAL VALIDITY and for its narrow focus on quantitative rather than qualitative differences in performance across species. This lack of interest in natural ecologies or species-specific psychological adaptations, in fact, is profoundly anti-Darwinian.

For behaviorists, behavior is very much under the control of forces acting on the organism from without, such as external stimulations, as opposed to internal

forces such as instincts. After 1940, biologically inspired students of animal behavior, under the influence of Konrad Lorenz, Karl von Frisch, and Niko Tinbergen, and under the label of ETHOLOGY, drew attention to the importance of instincts and species-specific "fixed action patterns." In the ongoing debate on innate versus acquired components of behavior, they stressed the innate side in a way that stirred much controversy, especially when Lorenz, in his book *On Aggression* (1966), argued that humans have strong innate dispositions to aggressive behavior. More innovatively, ethologists made clear that instinct and learning are not to be thought of as antithetic forces: various learning processes (such as "imprinting" or birds' learning of songs) are guided by an instinct to seek specific information in order to develop specific competencies.

By stressing the importance of species-specific psychological mechanisms, ethologists have shown every species (not just humans) to be, to some interesting extent, psychologically unique. This does not address the commonsense and philosophical interest (linked to the issue of the rights of animals) in the commonalties between human and other animals' psyche. Do other animals think? How intelligent are they? Do they have conscious experiences? Under the influence of Donald Griffin, researchers in COGNITIVE ETHOLOGY have tried to answer these questions (typically in the positive) by studying animals, preferably in their natural environment, through observation complemented by experimentation. This has meant accepting some of what more laboratory-oriented psychologists disparagingly call "anecdotal evidence" and has led to methodological controversies.

Work on PRIMATE COGNITION has been of special importance for obvious reasons: nonhuman primates are humans' closest relatives. The search for similarities between humans and other animals begins, quite appropriately, with apes and monkeys. Moreover, because these similarities are then linked to close phylogenetic relationships, they help situate human cognition in its evolutionary context. This phylogenetic approach has been popularized in works such as Desmond Morris's *The Naked Ape.* There have been more scientifically important efforts to link work on apes and on humans. For instance, the study of naïve psychology in humans owes its label, THEORY OF MIND, and part of its inspiration to Premack and Woodruff's famous article "Does the chimpanzee have a theory of mind?" (1978). As the long history of the study of apes' linguistic capacities illustrate, however, excessive focalization on continuities with the human case can, in the end, be counterproductive (see PRIMATE LANGUAGE). Primate psychology is rich and complex, and highly interesting in its own right.

Different species rely to different degrees and in diverse ways on their psychological capacities. Some types of behavior provide immediate evidence of highly specialized cognitive and motor abilities. ECHOLOCATION found in bats and in marine mammals is a striking example. A whole range of other examples of behavior based on specialized abilities is provided by various forms of ANIMAL COMMUNICATION. Communicating animals use a great variety of behaviors (e.g., vocal sounds, electric discharges, "dances," facial

expressions) that rely on diverse sensory modalities, as signals conveying some informational content. These signals can be used altruistically to inform, or selfishly to manipulate. Emitting, receiving, and interpreting these signals rely on species-specific abilities. Only in the human case has it been suggested -- in keeping with the notion of a radical dichotomy between humans and other animals -- that the species' general intelligence provides all the cognitive capacities needed for verbal communication. This view of human linguistic competence has been strongly challenged, under the influence of Noam Chomsky, by modern approaches to LANGUAGE ACQUISITION.

Important aspects of animal psychology are manifested in social behavior. In many mammals and birds, for instance, animals recognize one another individually and have different types of interactions with different members of their group. These relationships are determined not only by the memory of past interactions, but also by kinship relations and hierarchical relationships within the group (see DOMINANCE IN ANIMAL SOCIAL GROUPS). All this presupposes the ability to discriminate individuals and, more abstractly, types of social relationships. In the case of primates, it has been hypothesized that their sophisticated cognitive processes are adaptations to their social rather than their natural environment. The MACHIAVELLIAN INTELLIGENCE HYPOTHESIS, so christened by Richard Byrne and Andrew Whiten (1988), offers an explanation not only of primate intelligence, but also of their ability to enter into strategic interactions with one another, an ability hyperdeveloped in humans, of course.

Many social abilities have fairly obvious functions and it is unsurprising, from a Darwinian point of view, that they should have evolved. (The adaptive value of SOCIAL PLAY BEHAVIOR is less evident and has given rise to interesting debates.) On the other hand, explaining the very existence of social life presents a major challenge to Darwinian theorizing, a challenge that has been at the center of important recent developments in evolutionary theory and in the relationship between the biological, the psychological, and the social sciences.

Social life implies COOPERATION AND COMPETITION. Competition among organisms plays a central role in classical Darwinism, and is therefore not at all puzzling; but the very existence of cooperation is harder to accommodate in a Darwinian framework. Of course, cooperation can be advantageous to the cooperators. Once cooperation is established, however, it seems that it would invariably be even more advantageous for any would-be cooperator to "defect," be a "free-rider," and benefit from the cooperative behavior of others without incurring the cost of being cooperative itself (a problem known in GAME THEORY and RATIONAL CHOICE THEORY as the "prisoner's dilemma"). Given this, it is surprising that cooperative behavior should ever stabilize in the evolution of a population subject to natural selection.

The puzzle presented by the existence of various forms of cooperation or ALTRUISM in living species has been resolved by W. D. Hamilton's (1964) work on kin selection and R. Trivers's (1971) work on reciprocal altruism. A gene for

altruism causing an individual to pay a cost, or even to sacrifice itself for the benefit of his kin may thereby increase the number of copies of this gene in the next generation, not through the descendents of the self-sacrificing individual (who may thereby lose its chance of reproducing at all), but through the descendents of the altruist's kin who are likely to carry the very same gene. Even between unrelated individuals, ongoing reciprocal behavior may not only be advantageous to both, but, under some conditions, may be more advantageous than defecting. This may in particular be so if there are cheater-detection mechanisms that make cheating a costly choice. It is thus possible to predict, in some cases with remarkable precision, under which circumstances kin selection or reciprocal altruism are likely to evolve.

The study of such cases has been one of the achievements of SOCIOBIOLOGY. In general sociobiologists aim at explaining behavior, and in particular social behavior, on the assumption that natural selection favors behaviors of an organism that tends to maximize the reproductive success of its genes. Sociobiology, especially as expounded in E. O. Wilson's book *Sociobiology: The New Synthesis* (1975) and in his *On Human Nature* (1978), has been the object of intense controversy. Although some social scientists have espoused a sociobiological approach, the majority have denounced the extension of sociobiological models to the study of human behavior as reductionist and naïve. Sociobiology has had less of an impact, whether positive or negative, on the cognitive sciences. This can probably be explained by the fact that sociobiologists relate behavior directly to biological fitness and are not primarily concerned with the psychological mechanisms that govern behavior.

It is through the development of EVOLUTIONARY PSYCHOLOGY that, in recent years, evolutionary theory has had an important impact on cognitive psychology (Barkow, Cosmides, and Tooby 1992). Unlike sociobiology, evolutionary psychology focuses on what Cosmides and Tooby (1987) have described as the "missing link" (missing, that is, from sociobiological accounts) between genes and behavior, namely the mind. Evolutionary psychologists view the mind as an organized set of mental devices, each having evolved as an adaptation to some specific challenge presented by the ancestral environment. There is, however, some confusion of labels, with some sociobiologists now claiming evolutionary psychology as a subdiscipline or even describing themselves as evolutionary psychologists.

This perspective may help discover discrete mental mechanisms, the existence of which is predicted by evolutionary considerations and may help explain the structure and function of known mental mechanisms. As an example of the first type of contribution, the evolutionary psychology of SEXUAL ATTRACTION has produced strong evidence of the existence of a special purpose adaptation for assessing the attractiveness of potential mates that uses subtle cues such as facial symmetry and waist-to-hips ratio (Symons 1979; Buss 1994). As an example of the second type of contribution, Steven Pinker has argued in *The Language Instinct* (1994) that the language faculty is an evolved adaptation, many aspects of which are best explained in evolutionary terms. Both types of

contribution have stirred intense controversies.

Evolutionary psychology has important implications for the study of culture, significantly different from those of sociobiology. Sociobiologists tend to assume that the behaviors of humans in cultural environments are adaptive. They seek therefore to demonstrate the adaptiveness of cultural patterns of behavior and see such demonstrations as explanations of these cultural patterns. Evolutionary psychologists, on the other hand, consider that evolved adaptations, though of course adaptive in the ancestral environment in which they evolved, need not be equally adaptive in a later cultural environment. Slowly evolving adaptations may have neutral or even maladaptive behavioral effects in a rapidly changing cultural environment.

For instance, the evolved disposition to automatically pay attention to sudden loud noises was of adaptive value in the ancestral environment where such noises were rare and very often a sign of danger. This disposition has become a source of distraction, annoyance, and even pathology in a modern urban environment where such noises are extremely common, but a reliable sign of danger only in specific circumstances, such as when crossing a street. This disposition to pay attention to sudden loud noises is also culturally exploited in a way that is unlikely to significantly affect biological fitness, as when gongs, bells, or hand-clapping are used as conventional signals, or when musicians derive special effect from percussion instruments. Such nonadaptive effects of evolved adaptations may be of great cultural significance.

2 Culture in an Evolutionary and Cognitive Perspective There are many species of social animals. In some of these species, social groups may share and maintain behaviorally transmitted information over generations. Examples of this are songs specific to local populations of some bird species or nut-cracking techniques among West African chimpanzees. Such populations can be said to have a "culture," even if in a very rudimentary form. Among human ancestors, the archaeological record shows the existence of tools from which the existence of a rudimentary technical culture can be inferred, for some two million years (see TECHNOLOGY AND HUMAN EVOLUTION), but the existence of complex cultures with rich CULTURAL SYMBOLISM manifested through ritual and art is well evidenced only in the last 40,000 years. COGNITIVE ARCHAEOLOGY aims in particular at explaining this sudden explosion of culture and at relating it to its cognitive causes and effects.

The study of culture is of relevance to cognitive science for two major reasons. The first is that the very existence of culture, for an essential part, is both an effect and a manifestation of human cognitive abilities. The second reason is that the human societies of today culturally frame every aspect of human life, and, in particular, of cognitive activity. This is true of all societies studied by anthropologists, from New Guinea to Silicon Valley. Human cognition takes place in a social and cultural context. It uses tools provided by culture: words, concepts, beliefs, books, microscopes and computers. Moreover, a great deal

of cognition is about social and cultural phenomena.

Thus two possible perspectives, a cognitive perspective on culture and a cultural perspective on cognition, are both legitimate and should be complementary. Too often, however, these two perspectives are adopted by scholars with different training, very different theoretical commitments, and therefore a limited willingness and ability to interact fruitfully. In this section, we engage the first, cognitive perspective on culture and in the next the second, cultural perspective on cognition, trying to highlight both the difficulties and opportunities for greater integration.

Let us first underscore two points of general agreement: the recognition of cultural variety, and that of "psychic unity." The existence of extraordinary cultural variety, well documented by historians and ethnographers, is universally acknowledged. The full extent of this variety is more contentious. For instance, although some would deny the very existence of interesting HUMAN UNIVERSALS in matters cultural, others have worked at documenting them in detail (Brown 1991). Until the early twentieth century, this cultural variation was often attributed to supposed biological variation among human populations. Coupled with the idea of progress, this yielded the view that, as biological endowment progressed, so did cultural endowment, and that some populations (typically Christian whites) were biologically and culturally superior. This view was never universally embraced. Adolf Bastian and Edward Tylor, two of the founders of anthropology in the nineteenth century, insisted on the "psychic unity" of humankind. FRANZ BOAS, one of the founders of American anthropology, in a resolute challenge to scientific racism, argued that human cultural variations are learned and not inherited. Today, with a few undistinguished exceptions, it is generally agreed among cognitive and social scientists that cultural variation is the effect, not of biological variation, but of a common biological, and more specifically cognitive endowment that, given different historical and ecological conditions, makes this variability possible.

No one doubts that the biologically evolved capacities of humans play a role in their social and cultural life. For instance, humans are omnivorous and, sure enough, their diet varies greatly, both within and across cultures. Or to take another example, humans have poorly developed skills for tree climbing, and, not surprisingly, few human communities are tree-dwelling. But what are the human *cognitive* capacities actually relevant to understanding cultural variability and other social phenomena, and in which manner are they relevant?

In the social sciences, it has long been a standard assumption that human learning abilities are general and can be applied in the same way to any empirical domain, and that reasoning abilities are equally general and can be brought to bear on any problem, whatever its content. The human mind, so conceived, is viewed as the basis for an extra somatic adaptation -- culture -- that has fundamentally changed the relationship between humans and their environment. Culture permits humans to transcend physical and cognitive limitations through the development and use of acquired skills and artifacts.

Thus, humans can fly, scale trees, echolocate, and perform advanced mathematical calculus despite the fact that humans are not equipped with wings, claws, natural sonars, or advanced calculus abilities. Cultural adaptations trump cognitive ones in the sense that cultural skills and artifacts can achieve outcomes unpredicted by human cognitive architecture.

Many social scientists have concluded from this that psychology is essentially irrelevant to the social sciences and to the study of culture in particular. It is, however, possible to think of the mind as a relatively homogeneous general-purpose intelligence, and still attribute to it some interesting role in the shaping of culture. For instance, Lucien Lévy-Bruhl assumed that there was a primitive mentality obeying specific intellectual laws and shaping religious and magical beliefs. BRONISLAW MALINOWSKI sought to explain such beliefs, and culture in general, as a response to biological and psychological needs. CLAUDE LÉVI-STRAUSS explicitly tried to explain culture in terms of the structure of the human mind. He developed the idea that simple cognitive dispositions such as a preference for hierarchical classifications or for binary oppositions played an important role in shaping complex social systems such as kinship and complex cultural representations such as myth.

Most research done under the label COGNITIVE ANTHROPOLOGY (reviewed in D'Andrade 1995) accepts the idea that the human mind applies the same categorization and inference procedures to all cognitive domains. Early work in this field concentrated on classification and drew its conceptual tools more from semantics and semiotics (see SEMIOTICS AND COGNITION) than from a cognitive psychology (which, at the time, was in its infancy). More recently, building on Shank and Abelson's idea of scripts, cognitive anthropologists have begun to propose that larger knowledge structures -- "cultural schema" or "cultural models" -- guide action and belief, in part by activating other related cultural SCHEMATA or models, and as a whole encapsulate tenets of cultural belief. Some of this work has drawn on recent work on FIGURATIVE LANGUAGE, in particular, on METAPHOR (Lakoff and Johnson 1980; Lakoff 1987; Lakoff and Turner 1989) and has focused on cultural models structured in metaphorical terms (see METAPHOR AND CULTURE).

In an extended analysis, Quinn (1987), for instance, identifies a number of interconnecting metaphors for marriage in contemporary North America: marriage is enduring, marriage is mutually beneficial, marriage is unknown at the outset, marriage is difficult, marriage is effortful, marriage is joint, marriage may succeed or fail, marriage is risky. These conjoined metaphors -- which together constitute a cultural model -- in turn contain within them assumptions derived from models of other everyday domains: the folk physics of difficult activities, the folk social psychology of voluntary relationships, the folk theory of probability, and the folk psychology of human needs. Through this embedding, cultural schema or models provide a continuity and coherency in a given culture's systems of belief. Schema- and model-based analyses are intended to bridge psychological representations and cultural representations. They also provide a basis for relating MOTIVATION AND CULTURE. Not surprisingly,

CONNECTIONISM, seen as a way to model the mind without attributing to it much internal structure, is now popular in this tradition of cognitive anthropology (Strauss and Quinn 1998).

Still, it is possible to acknowledge that culture has made the human condition profoundly different from that of any other animal species, and yet to question the image of the human mind as a general-purpose learning and problem-solving device. It is possible also to acknowledge the richness and diversity of human culture and yet to doubt that the role of human-evolved cognitive capacities has been merely to enable the development of culture and possibly shape the form of cultural representations, without exerting any influence on their contents. It is possible, in other terms, to reconcile the social sciences' awareness of the importance of culture with the cognitive sciences' growing awareness of the biological grounded complexity of the human mind.

For example, cognitive scientists have increasingly challenged the image of the human mind as essentially a general intelligence. Arguments and evidence from evolutionary theory, developmental psychology, linguistics, and one approach in cognitive anthropology render plausible a different picture. It is being argued that many human cognitive abilities are not domain-general but specialized to handle specific tasks or domains. This approach (described either under the rubric of MODULARITY or DOMAIN SPECIFICITY) seeks to investigate the nature and scope of these specific abilities, their evolutionary origin, their role in cognitive development, and their effect on culture.

The most important domain-specific abilities are evolved adaptations and are at work in every culture, though often with different effects. Some other domain-specific abilities are cases of socially developed, painstakingly acquired EXPERTISE, such as chess (see CHESS, PSYCHOLOGY OF), that is specific to some cultures. The relationship between evolved adaptations and acquired expertise has not been much studied but is of great interest, in particular for the articulation of the cognitive and the cultural perspective. For instance, writing -- which is so important to cognitive and cultural development (see WRITING SYSTEMS and LITERACY) -- is a form of expertise, although it has become so common that we may not immediately think of it as such. It would be of the utmost interest to find out to what extent this expertise is grounded in specific psychomotor evolved adaptations.

The first domain-specific mechanisms to be acknowledged in the cognitive literature were input modules and submodules (see Fodor 1982). Typical examples are linked to specific perceptual modality. They include devices that detect edges, surfaces, and whole objects in processing visual information; face recognition devices; and speech parsing devices; abilities to link specific outcomes (such as nausea and vomiting but not electric shock) to specific stimuli (such as eating but not light) through rapid, often single trial, learning.

More recently, there has been a growing body of evidence suggesting that central (i.e., conceptual) mechanisms, as well as input-output processes, may

be domain-specific. It has been argued, for instance, that the ability to interpret human action in terms of beliefs and desires is governed by a naive psychology, a domain-specific ability, often referred to as THEORY OF MIND; that the capacity to partition and explain living things in terms of biological principles like growth, inheritance, and bodily function is similarly governed by a FOLK BIOLOGY; and that the capacity to form consistent predictions about the integrity and movements of inert objects is governed by a NAIVE PHYSICS. These devices are described as providing the basis for competencies that children use to think about complex phenomena in a coherent manner using abstract causal principles. Cultural competencies in these domains are seen as grounded in these genetically determined domain-specific dispositions, though they may involve some degree of CONCEPTUAL CHANGE.

The study of folk biology provides a good example of how different views of the mind yield different accounts of cultural knowledge. A great deal of work in classical cognitive anthropology has been devoted to the study of folk classification of plants and animals (Berlin, Breedlove, and Raven 1973; Berlin 1992; Ellen 1993). This work assumed that the difference in organization between these biological classifications and classifications of say, artifacts or kinship relations had to do with differences in the objects classified and that otherwise the mind approached these domains in exactly the same way. Scott Atran's (1990) cognitive anthropological work, drawing on developmental work such as that of Keil (1979), developed the view that folk- biological knowledge was based on a domain-specific approach to living things characterized by specific patterns of CATEGORIZATION and inference. This yields testable predictions regarding both the acquisition pattern and the cultural variability of folk biology. It predicts, for instance, that from the start (rather than through a lengthy learning process) children will classify animals and artifacts in quite different ways, will reason about them quite differently, and will do so in similar ways across cultures. Many of these predictions seem to be borne out (see Medin and Atran 1999).

Generally, each domain-specific competence represents a knowledge structure that identifies and interprets a class of phenomena assumed to share certain properties and hence be of a distinct and general type. Each such knowledge structure provides the basis for a stable response to a set of recurring and complex cognitive or practical challenges. These responses involve largely unconscious dedicated perceptual, retrieval, and inferential processes. Evolutionary psychology interprets these domain-specific competencies as evolved adaptations to specific problems faced by our ancestral populations.

At first, there might seem to be a tension between the recognition of these evolved domain-specific competencies and the recognition of cultural variety. Genetically determined adaptations seem to imply a level of rigidity in cognitive performance that is contradicted by the extraordinary diversity of human achievements. In some domain, a relative degree of rigidity may exist. For example, the spontaneous expectations of not only infants but also adults about the unity, boundaries, and persistence of physical objects may be based on a

rather rigid naïve physics. It is highly probable that these expectations vary little across populations, although at present hardly any research speaks to this possibility, which thus remains an open empirical question. After all, evidence does exist suggesting that other nonconscious perceptual processes, such as susceptibility to visual illusions, do vary across populations (Herskovits, Campbell, and Segall 1969).

Generally, however, it is a mistake to equate domain-specificity and rigidity. A genetically determined cognitive disposition may express itself in different ways (or not express itself at all) depending on the environmental conditions. For instance, even in a case such as fear of snakes and other predators, where a convincing argument can be made for the existence, in many species, of evolved mechanisms that trigger an appropriate self-protection response, the danger cues and the fear are not necessarily directly linked. Marks and Nesse (1994: 255), following Mineka et al. (1984), describe such a case in which fear does not emerge instinctively but only after a specific sort of learning experience: "Rhesus monkeys are born without snake fear. Enduring fear develops after a few observations of another rhesus monkey taking fright at a snake . . . Likewise, a fawn is not born with fear of a wolf, but lifelong panic is conditioned by seeing its mother flee just once from a wolf."

Thus, even low-level effects like primordial fears develop out of interactions between prepotentials for discriminating certain environmental conditions, a preparedness to fast learning, and actual environmental inputs. In general, domain-specific competencies emerge only after the competence's initial state comes into contact with a specific environment, and, in some cases, with displays of the competence by older conspecifics. As the environmental inputs vary so does the outcome (within certain limits, of course). This is obviously the case with higher-level conceptual dispositions: It goes without saying, for instance, that even if there is a domain-specific disposition to classify animals in the same way, local faunas differ, and so does people's involvement with this fauna.

There is another and deeper reason why domain-specific abilities are not just compatible with cultural diversity, but may even contribute to explaining it (see Sperber 1996: chap. 6). A domain-specific competence processes information that meets specific input conditions. Normally, these input conditions are satisfied by information belonging to the proper domain of the competence. For instance, the face recognition mechanism accepts as inputs visual patterns that in a natural environment are almost exclusively produced by actual faces. Humans, however, are not just receivers of information, they are also massive producers of information that they use (or seek to use) to influence one another in many ways, and for many different purposes. *A reliable way to get the attention of others is to produce information that meets the input conditions of their domain-specific competencies*. For instance, in a human cultural environment, the face recognition mechanism is stimulated not just by natural faces, but also by pictures of faces, by masks, and by actual faces with their features highlighted or hidden by means of make-up. The effectiveness of these

typically cultural artifacts is in part to be explained by the fact that they rely on and exploit a natural disposition.

Although the natural inputs of a natural cognitive disposition may not vary greatly across environments, different cultures may produce widely different artificial inputs that, nevertheless, meet the input conditions of the same natural competence. Hence not all societies have cosmetic make-up, pictures of faces, or masks, and those that do exhibit a remarkable level of diversity in these artifacts. But to explain the very existence of these artifacts and the range of their variability, it is important to understand that they all rely on the same natural mechanism. In the same way, the postulation of a domain-specific competence suggests the existence of a diversified range of possible exploitations of this competence. Of course these exploitations can also be enhancements: portraitists and make-up technicians contribute to culturally differentiated and enhanced capacities for face recognition (and aesthetic appraisal).

Let us give three more illustrations of the relationship between a domain-specific competence and a cultural domain: *color classification, mathematics, and social classifications*.

Different languages deploy different systems of COLOR CATEGORIZATION, segmenting the color spectrum in dramatically different ways. Some languages have only two basic color terms (e.g., Dani). Other languages (e.g., English) have a rich and varied color vocabulary with eleven basic color terms (and many nonbasic color terms that denote subcategories such as *crimson* or apply to specific objects such as *a bay horse*). Prior to Berlin and Kay's (1969) now classic study, these color naming differences were accepted as evidence for the LINGUISTIC RELATIVITY HYPOTHESIS, the doctrine that different modes of linguistic representation reflect different modes of thought. Thus, speakers of languages with two-term color vocabularies were seen as conceptualizing the world in this limited fashion.

Berlin and Kay found that although the boundaries of color terms vary across languages, the focal point of each color category (e.g., that point in the array of reds that is the reddest of red) remains the same no matter how the color spectrum is segmented linguistically. There are, they argued, eleven such focal points, and therefore eleven possible basic color terms. Although there are over two thousand possible subsets of these eleven terms, only twenty-two of these subsets are ever encountered. Moreover, the sequence in which color terms enter a language is tightly constrained. Further research has led to minor revisions but ample confirmation of these findings. Here, then, we have a case where the evolved ability to discriminate colors both grounds culturally specific basic color vocabularies and constrains their variability. Further work by Kay and Kempton (1988) showed that linguistic classification could have some marginal effect on nonverbal classification of color. Nevertheless, once the paradigm example of linguistic relativity, the case of color classification, is now the paradigm illustration of the interplay between cognitive universals and

cultural variations, variations that are genuine, but much less dramatic than was once thought.

NAIVE MATHEMATICS provides another instance of the relationship between a domain-specific competence and cultural variation. It has been shown that human infants and some other animals can distinguish collections of objects according to the (small) number of elements in the collection. They also expect changes in the number of objects to occur in accordance with elementary arithmetic principles. All cultures of the world provide some system for counting (verbal and/or gestural), and people in all cultures are capable of performing some rudimentary addition or subtraction, even without the benefit of schooling. This suggests that humans are endowed with an evolved adaptation that can be called naive mathematics. Counting systems do vary from culture to culture. Some, like that of the Oksapmin of New Guinea, are extremely rudimentary, without base structure, and allow counting only up to some small number. Others are more sophisticated and allow, through combination of a few morphemes, the expression of any positive integer. These counting systems, drawing on the morpho-syntactic resources of language, provide powerful cultural tools for the use and enhancement of the naive mathematical ability. Cultural differences in counting largely reflect the degree of linguistic enhancement of this universal ability.

There are mathematical activities that go beyond this intuitive counting ability. Their development varies considerably and in different directions across cultures. Concepts such as the zero, negative numbers, rational numbers, and variables; techniques such as written arithmetical operations; and artifacts such as multiplication tables, abacus, rulers, or calculators help develop mathematics far beyond its intuitive basis. Some of these concepts and tools are relatively easy to learn and use, others require painstaking study in an educational setting. From a cognitive point of view, explaining these cultural developments and differences must include, among other things, an account of the cognitive resources they mobilize. For instance, given human cognitive dispositions, mathematical ideas and skills that are more intuitive, more easily grasped, and readily accepted should have a wider and more stable distribution and a stronger impact on most people's thinking and practice (see NUMERACY AND CULTURE).

NAIVE SOCIOLOGY provides a third example of the relationship between a domain-specific cognitive disposition and a varying cultural domain. According to the standard view, children learn and think about all human groupings in much the same way: they overwhelmingly attend to surface differences in forming categories and they interpret these categories virtually only in terms of these superficial features. Of course, knowledge of all social categories is not acquired at the same time. Children sort people by gender before they sort them by political party affiliation. The standard explanation is that children learn to pick out social groups that are visibly distinct and culturally salient earlier than they learn about other, less visually marked, groups.

Recent research suggests that surface differences determine neither the development of categories nor their interpretation (Hirschfeld 1996). In North America and Europe one of the earliest-emerging social concepts is "race." Surprisingly, given the adult belief that the physical correlates of "race" are extremely attention demanding, the child's initial concept of "race" contains little perceptual information. Three-year-olds, for instance, recognize that "blacks" represent an important social grouping long before they learn which physical features are associated with being "black." What little visual information they have is often inaccurate and idiosyncratic; thus, when one young child was asked to describe what made a particular person black, he responded that his teeth were longer. (Ramsey 1987.) Another set of studies suggests that even quite young children possess a deep and theory-like understanding of "race" (but not other similar groupings), expecting "race" to be a fundamental, inherited, and immutable aspect of an individual -- that is, they expect it to be biological (Hirschfeld 1995).

Conceptual development of this sort -- in which specific concepts are acquired in a singular fashion and contain information far beyond what experience affords -- are plausibly the output of a domain-specific disposition. Since the disappearance of the Neanderthals, humans are no longer divided into subspecies or races, and the very idea of "race" appeared only relatively recently in human history. So, although there may well exist an evolved domain-specific disposition that guides learning about social groupings, it is very unlikely that it would have evolved with the function of guiding learning about "race." As noted previously, however, many cultural artifacts meet a device's input conditions despite the fact that they did not figure in the evolutionary environment that gave rise to the device. "Race" might well be a case in point.

As many have argued, "race" was initially a cultural creation linked to colonial and other overseas encounters with peoples whose physical appearance was markedly different from Europeans. The modern concept of "race" has lost some of this historic specificity and is generally (mis)interpreted as a "natural" system for partitioning humans into distinct kinds. That this modern concept has stabilized and been sustained over time owes as much to cognitive as cultural factors (Hirschfeld 1996). On the one hand, it is sustainable because a domain-specific disposition guides children to spontaneously adopt specific social representations, and "race" satisfies the input conditions of this disposition. On the other hand, it varies across cultures because each cultural environment guides children to a specific range of possible groupings. These possibilities, in turn, reflect the specific historical contexts in which colonial and other overseas encounters occurred. It is worth bearing in mind that "race" is not the only cultural domain that is "naturalized" because it resonates with an evolved disposition. It is plausible that children in South Asia, guided by the same domain-specific disposition but in another cultural context, find "caste" more biological than "race." Similarly, children in some East-African societies may find "age-grades" more biological than either "race" or "caste." In all such cases, the fact that certain social categories are more readily learned contributes to the social and cultural stability of these categories.

The cases of color classification, mathematics, and naïve sociology illustrate a fairly direct relationship between a domain-specific ability and a cultural domain grounded in this ability, enhancing it, and possibly biasing it. Not all cultural domains correspond in this simple way to a single underlying domain-specific competence. For instance, are RELIGIOUS IDEAS AND PRACTICES grounded in a distinct competence, the domain of which would be supernatural phenomena? This is difficult to accept from the point of view of a naturalistic cognitive science. Supernatural phenomena cannot be assumed to have been part of the environment in which human psychological adaptations evolved. Of course, it is conceivable that a disposition to form false or unevidenced beliefs of a certain tenor would be adaptive and might have evolved. Thus Malinowski and many other anthropologists have argued that religious beliefs serve a social function. Nemeroff and Rozin (1994) have argued that much of MAGIC AND SUPERSTITION is based on intuitive ideas of contagion that have clear adaptive value. Another possibility is that domain-specific competencies are extended beyond their domain, in virtue of similarity relationships. Thus, Carey (1985) and Inagaki and Hatano (1987) have argued that ANIMISM results from an overextension of naïve psychology.

The cultural prevalence of religious and magical beliefs may also be accounted for in terms of a domain-specific cognitive architecture without assuming that there is a domain-specific disposition to religious or magical beliefs (see Sperber 1975, 1996; Boyer 1990, 1994). Religious beliefs typically have a strong relationship with the principles of naïve physics, biology, psychology, and sociology. This relationship, however, is one of head-on contradiction. These are beliefs about creatures capable of being simultaneously in several places, of belonging to several species or of changing from one species to another, or of reading minds and seeing scenes distant in time or space. Apart from these striking departures from intuitive knowledge, however, the appearance and behavior of these supernatural beings is what intuition would expect of natural beings. Religious representations, as argued by Boyer (1994), are sustainable to the extent that a balance between counterintuitive and intuitive qualities is reached. A supernatural being with too few unexpected qualities is not attention demanding and thus not memorable. One with too many unexpected qualities is too information rich to be memorable (see MEMORY). Thus, religious beliefs can be seen as parasitical on domain-specific competencies that they both exploit and challenge.

So far in this section, we have illustrated how evolutionary and cognitive perspectives can contribute to our understanding of specific cultural phenomena. They can also contribute to our understanding of the very phenomenon of culture. Until recently, the evolutionary and the cognitive approaches to the characterization of culture were very different and unrelated. In more recent developments, they have converged to a significant degree.

From an evolutionary point of view, there are two processes to consider and articulate: the biological evolution of the human species, and the CULTURAL

EVOLUTION of human groups. There is unquestionably a certain degree of coevolution between genes and culture (see Boyd and Richerson 1985; William Durham 1991). But, given the very different rates of biological and cultural evolution -- the latter being much more rapid than the former -- the importance of cultural evolution to biological evolution, or equivalently its autonomy, is hard to assess.

Sociobiologists (e.g., Lumsden and Wilson 1981) tend to see cultural evolution as being very closely controlled by biological evolution and cultural traits as being selected in virtue of their biological functionality. Other biologists such as Cavalli-Sforza and Feldman (1981) and Richard Dawkins (1976, 1982) have argued that cultural evolution is a truly autonomous evolutionary process where a form of Darwinian selection operates on cultural traits, favoring the traits that are more capable of generating replicas of themselves (whether or not they contribute to the reproductive success of their carriers). Neither of these evolutionary approaches gives much place to cognitive mechanisms, the existence of which is treated as a background condition for the more or less autonomous selection of cultural traits. Both evolutionary approaches view culture as a pool of traits (mental representations, practices, or artifacts) present in a population.

From a cognitive point of view, it is tempting to think of culture as an ensemble of representations (classifications, schemas, models, competencies), the possession of which makes an individual a member of a cultural group. In early cognitive anthropology, culture was often compared to a language, with a copy of it in the mind of every culturally competent member of the group. Since then, it has been generally recognized that cultures are much less integrated than languages and tolerate a much greater degree of interindividual variation (see CULTURAL CONSENSUS THEORY and CULTURAL VARIATION). Moreover, with the recent insistence on the role of artifacts in cognitive processes (see COGNITIVE ARTIFACTS), it has become common to acknowledge the cultural character of these artifacts: culture is not just in the mind. Still, in a standard cognitive anthropological perspective, culture is first and foremost something in the mind of every individual. The fact that culture is a population- scale phenomenon is of course acknowledged, but plays only a trivial role in explanation.

Some recent work integrates the evolutionary and cognitive perspectives. Sperber (1985, 1996) has argued for an "epidemiological" approach to culture. According to this approach, cultural facts are not mental facts but distributions of causally linked mental and public facts in a human population. More specifically, chains of interaction -- of communication in particular -- may distribute similar mental representations and similar public productions (such as behaviors and artifacts) throughout a population. Types of mental representations and public productions that are stabilized through such causal chains are, in fact, what we recognize as cultural.

To help explain why some items stabilize and become cultural (when the vast

majority of mental representations and public productions have no recognizable descendants), it is suggested that domain-specific evolved dispositions act as receptors and tend to fix specific kinds of contents. Many cultural representations stabilize because they resonate with domain-specific principles. Because such representations tend to be rapidly and solidly acquired, they are relatively inured to disruptions in the process of their transmission. Hence the epidemiological approach to culture dovetails with evolutionary psychology (see Tooby and Cosmides 1992) and with much recent work in developmental psychology, which has highlighted the role of innate preparedness and domain-specificity in learning (Hirschfeld and Gelman 1994; Sperber, Premack, and Premack 1995).

Children are not just the passive receptors of cultural forms. Given their cognitive dispositions, they spontaneously adopt certain cultural representations and accept others only through institutional support such as that provided by schools. The greater the dependence on institutional support, the greater the cultural lability and variability. Other inputs, children reject or transform. A compelling example is provided by the case of CREOLES. When colonial, commercial, and other forces bring populations together in linguistically unfamiliar contexts a common result is the emergence of a pidgin, a cobbled language of which no individual is a native speaker. Sometimes, children are raised in a pidgin. When pidgin utterances are the input of the language acquisition process, a creole, that is a natural and fully elaborated language, is the output. Children literally transform the contingent and incomplete cultural form into a noncontingent and fully articulated form. This happens because children are equipped with an evolved device for acquiring language (Bickerton 1990).

Cultural forms stabilize because they are attention- grabbing, memorable, and sustainable with respect to relevant domain-specific devices. Of course, representations are also selected for in virtue of being present in any particular cultural environment. Domain-specific devices cannot attend to, act on, or elaborate representations that the organism does not come into contact with. For the development of culture, a cultural environment, a product of human history, is as necessary as a cognitive equipment, a product of biological evolution.

3 Cognition in an Ecological, Social, and Cultural Perspective Ordinary cognitive activity does not take place in a fixed experimental setting where the information available is strictly limited and controlled, but in a complex, information- rich, ever-changing environment. In social species, conspecifics occupy a salient place in this environment, and much of the individual-environment interaction is, in fact, interaction with other individuals. In the human case, moreover, the environment is densely furnished with cultural objects and events most of which have, at least in part, the function of producing cognitive effects.

In most experimental psychology this ecological, social, and cultural dimension of human cognition is bracketed out. This practice has drawn strong criticisms, both from differently oriented psychologists and from social scientists. Clearly, there are good grounds for these criticisms. How damning they are remains contentious. After all, all research programs, even the most holistic ones, cannot but idealize their objects by abstracting away from many dimensions of reality. In each case, the issue is whether the idealization highlights a genuinely automous level about which interesting generalizations can be discovered, or whether it merely creates an artificial pseudodomain the study of which does not effectively contribute to the knowledge of the real world. Be that as it may, in the debate between standard and more ecologically oriented approaches to cognition, there is no doubt that the latter have raised essential questions and developed a variety of interesting answers. It is to these positive contributions that we now turn.

Issues of ecological validity arise not just when the social and cultural dimension of cognition is deployed, but at all levels of cognition. As argued by ECOLOGICAL PSYCHOLOGY, even the perceptions of an individual organism should be understood in ecological terms. Based on the work of J. J. GIBSON, ecological psychology relates perception not to "stimuli" but to the layout of the environment, to the possibilities it opens for action (the AFFORDANCES), and to the perceiver's own situation and motion in the environment. When the environment considered is social and cultural, there are further grounds to rethink even more basic tenets of cognitive science, particularly the notion that the individual mind is *the* site of cognitive processes. This is what recent work on SITUATED COGNITION AND LEARNING and on SITUATEDNESS/EMBEDDEDNESS has been doing.

Many of the issues described today in terms of situated cognition were raised in the pioneering work of the Russian psychologist LEV VYGOTSKY (1896 - 1934), whose work was introduced to English readers in the 1970s (see Wertsch 1985b). Vygotsky saw cognitive activity as being social as well as mental. He stressed the importance of cultural tools for cognition. His insight that historical, cultural, and institutional contexts condition learning by identifying and extending the child's capacities animates several ecological approaches in psychology. Writing in the first half of the twentieth century, Vygotsky was not aiming at an explicit modeling of the processes he discussed, nor were the first studies inspired by his work in the 1970s and 1980s (see Wertsch 1985a). Some of the more recent work about situated cognition, though inspired by Vygotsky, does involve modeling of cognitive processes, which means, of course, departing from Vygotsky's original conceptual framework.

To what extent is cognition in a social and cultural environment still an individual process? Regarding cognition in a social environment, James Wertsch raises the issue with a telling anecdote about helping his daughter remember where she left her shoes. When she was unable to remember, he began to pose questions that directed her recall until she "remembered" where they were. Wertsch asks who remembered in this case: he didn't since he had no prior

information about the shoes' location, nor did his daughter because she was unable to recall their location without his intervention. Regarding cognition in an environment containing cultural artifacts, a striking example is provided by Edwin Hutchins (1995), who has demonstrated how the cognitive processes involved in flying a plane do not take place just in the pilot's head but are distributed throughout the cockpit, in the members of the crew, the control panel, and the manuals.

This interpenetration of processes internal and external to the individual can be studied in technologically rich environment such as that provided in HUMAN-COMPUTER INTERACTION, and also in more mundane circumstances such as finding one's way with the help of a map (see HUMAN NAVIGATION), or shopping at the supermarket where the arrangement of the shelves serves as a kind of shopping list (Lave et al. 1984). This type of research is being applied in COGNITIVE ERGONOMICS, which helps design technologies, organizations, and learning environments in a way informed by cognitive science.

The study of cultural tools and the form of cognitive activity they foster is of importance for the historical and anthropological study of culture. It is an old commonplace to contrast societies with and without writing systems. As Lévi-Strauss (1971) suggested, the very structure of oral narratives reflects an optimal form for memory unaided by external inscriptions. More recent work (e.g., Goody 1977, 1987; Rubin 1995; Bloch 1998) has attempted to elaborate and in part rethink this contrast by looking at the cognitive implications of orality and writing and of other systems for displaying information in the environment (see ARTIFACTS AND CIVILIZATION). EDUCATION too has been approached in a Vygotskyan perspective, as a collaborative enterprise between teacher and learner using a specially designed environment with ad hoc props. Education is thus described at a level intermediary between individual cognitive development and cultural transmission, thus linking and perhaps locking together the psychological and the cultural level (Bruner 1996).

From the point of view of the epidemiological approach to culture evoked in the preceding section, the situated cognition approach is quite congenial. The epidemiological approach insists on the fact that the causal chains of cultural distribution are complex cognitive *and* ecological processes that extend over time and across populations. This, however, dedramatizes the contrast between a more individualistic and a more situated description of cognitive processes (see INDIVIDUALISM). Consider a situated process such as a teacher-learner interaction, or the whole cockpit of a plane doing the piloting. These processes are not wholly autonomous. The teacher is a link in a wider process of transmission using a battery of artifacts, and the learner is likely to become a link, possibly of another kind, in the same process. Their interaction cannot be fully explained by abstracting away from this wider context. Similarly, the cockpit is far from being fully autonomous. It is linked to air control on the ground, through it to other aircrafts, but also, in time, to the engineering process that designed the plane, to the educational process that trained the pilot, and so on. Of course, both the teacher-learner interaction and the cockpit have enough

autonomy to deserve being considered and studied on their own. But then so do the individual cognitive processes of the teacher, the learner, the pilot, and so on at a lower level, and the complex institutional networks in which all this take place at a higher level. Cognitive cultural causal chains extend indefinitely in all directions. Various sections of these chains of different size and structure are worth studying on their own.

The study of psychological processes in their social context is traditionally the province of *social psychology* (see Ross and Nisbett 1991; Gilbert, Fiske, and Lindzey 1998). The contribution of this rich discipline to the cognitive sciences can be read in two ways. On the one hand, it can be pointed out that, at a time where mainstream psychologists were behaviorists and not interested in contentful cognitive processes, social psychologists were studying beliefs, opinions, prejudices, influence, motivation, or attitudes (e.g., Allport 1954). On the other hand, it could be argued that the interest of social psychologists for these mental phenomena is generally quite different from that of cognitive scientists. The goals of social psychologists have typically been to identify trends and their causal factors, rather than mechanisms and their parts, so that most of social psychology has never been "cognitive" in this strong sense. In the practice of standard cognitive psychology too, it is quite often the case that a trend, a tendency, a disposition is identified well before the underlying mechanisms are considered.

Many of the phenomena identified by social psychologists could be further investigated in a more standardly cognitive way, and, more and more often, they are. For instance, according Festinger's (1957) theory of cognitive DISSONANCE, people are emotionally averse to cognitive inconsistencies and seek to reduce them. Festinger investigated various ways in which such dissonances arise (in decision making or in forced compliance, for instance), and how they can be dealt with. Recently, computational models of dissonance have been developed using artificial neural networks and relating dissonance to other psychological phenomena such as analogical reasoning. ATTRIBUTION THEORY, inspired by Heider (1958) and Kelley (1972), investigates causal judgments (see CAUSAL REASONING), and in particular interpretations of people's behavior. Specific patterns have been identified, such as Ross's (1977) "fundamental attribution error" (i.e., the tendency to overestimate personality traits and underestimate the situation in the causing of behavior). As in the case of dissonance, there has been a growing interest for modeling the inferential processes involved in these attributions (e.g. Cheng and Novick 1992). STEREOTYPING of social categories, another typical topic of social psychology, is also approached in a more cognitive way by focusing on information processing and knowledge structures.

The domain of social psychology where the influence of cognitive science is the most manifest is that of SOCIAL COGNITION (Fiske and Taylor 1991), that is the cognition of social life, sometimes extended to cognition as shaped by social life. Social cognition so understood is the very subject matter of social psychology, or at least its central part (leaving out emotion), but the reference to

cognition, rather than to psychology generally, signals the intent to join forces with mainstream cognitive psychology. With the development of the domain-specificity approach, however, social cognition so understood may be too broad an area. For instance, it does not distinguish between naïve psychology and naïve sociology, when the trend may be rather toward distinguishing even more fine-grained mechanisms.

One issue that has always been central to social psychology and that has become important in cognitive science only later is rationality. Social judgment exhibits blatant cases of irrationality, and their study by social psychologists (see Nisbett and Ross 1980) has contributed to the development of the study of reasoning in general (see JUDGMENT HEURISTICS; CAUSAL REASONING; PROBABILITIC REASONING; DEDUCTIVE REASONING). One area of social life where rationality plays a special role is economics. It is within economics that RATIONAL CHOICE THEORY was initially developed (see also RATIONAL DECISION MAKING). The actual behavior of economic agents, however, does not fully conform to the normative theory. Drawing in particular on the work of Kahneman and TVERSKY (see Kahneman, Slovic, and Tversky 1982), experimental and behavioral economists explore and try to model the actual behavior of economic agents (see ECONOMICS AND COGNITIVE SCIENCE). In principle, economics should provide a paradigmatic case of fruitful interaction between the social and the cognitive sciences. The economic domain is quite specific, however, and it is an open question to know to what extent the cognitive approach to this area, based as it is on an abstract normative theory of rationality, can serve as a model in other areas (but see Becker 1976).

From the points of view of evolutionary psychology and situated cognition, it is tempting to adopt an alternative approach by developing a notion of evolutionarily grounded BOUNDED RATIONALITY as a criterion for evaluating the manner in which human inferential mechanisms perform their functions. Such a criterion would involve not just considerations of epistemic reliability, but also of processing speed and cost. In this perspective, evolutionary psychologists have investigated how reasoning abilities may be adjusted to specific problems and domains, and how they may privilege information available in ordinary environments (see Cosmides and Tooby 1992; Gigerenzer and Goldstein 1996; Gigerenzer and Hoffrage 1995).

We now turn to anthropological research on the role of culture in cognitive and more generally mental processes. It is hardly controversial that cultural factors enable, constrain, and channel the development of certain cognitive outcomes. Some cultural environments inhibit normal cognitive development (e.g., inequitable distributions of cultural resources underlie uneven performance on standardized tests). Other cultural environments promote the elaboration of complex knowledge structures such as modern science by providing the appropriate artifactual and institutional support. In fact, it takes little more than a trip abroad to appreciate that our abilities to make the best use of the natural and artifactual environment and to interpret the behaviors of others is culture-bound.

The social sciences, and anthropology in particular, tend to approach the relationship between culture and mind in a much more radical way. Quite commonly the claim made is not just that cultural factors affect mental activity, it is that the human mind is socially and culturally constituted. This could be understood as meaning just that human mental processes use at every moment and in every activity cultural tools, language to begin with, and also schemas, models, expertises, and values. This, surely, is correct, and makes human minds very complex and special. What is generally meant goes well beyond this triviality, however, and is part of an antinaturalistic approach common in the social sciences. On this view, there may be brains but there are no minds in nature, and, anyhow, there is no human nature. Minds are not natural systems informed and transformed by culture, they are made by culture, and differently so by different cultures. From this point of view, naturalistic psychology, at least when it deals with true mental functions, with thinking in particular, is a Western ethnocentric pseudoscience. Piaget's study of the acculturation of Swiss children is mistaken for the study of a universal human cognitive development; the study of American college students reasoning on laboratory tasks is mistaken for that of human (ir)rationality, and so on.

Such culturalism -- in this extreme or in more hedged forms -- goes together with a specific view of culture. We saw in the last section how cognitive anthropology puts culture essentially in the mind and how evolutionary and epidemiological approaches treat culture in terms of population-wide distributions of individual mental and artifactual phenomena. These are naturalistic views of culture, with little following in the social sciences. Much more characteristic are the influential views of the anthropologist Clifford Geertz. He writes: "The concept of culture I espouse is essentially a semiotic one. Believing, with Max Weber, that man is an animal suspended in webs of significance he himself has spun, I take culture to be those webs, and the analysis of it to be therefore not an experimental science in search of law but an interpretive one in search of meaning" (Geertz 1973: 5). Attacking cognitive anthropology for placing culture in the mind, and drawing on Wittgenstein's dismissal of the idea of a private meaning, Geertz (1973: 12) insists that "culture is public because meaning is."

This understanding of the notion of culture goes together with a strong individuation of individual cultures (comparable to the individuation of languages), each seen as a separate system of meanings. Cultures so understood are viewed as being not just different environments, but, literally, different worlds, differing from each other in arbitrary ways. This view, known as CULTURAL RELATIVISM, is, except in very watered-down versions, difficult to reconcile with any naturalistic approach to cognitive development. Given that the initial inputs to cognitive development are just myriad stimulations of nerve endings, the process of extracting from these inputs the objective regularities of a relatively stable world is already hard enough to explain. If, in fact, even the world in which cognitive development takes place is not given, if the child can draw neither from expectable environmental regularities nor from internal

preparedness to deal with just these regularities, then the process is a pure mystery. It is a sign of the lack of concern for psychological issues that this mystery seems never to have worried defenders of cultural relativism.

In one area, anthropological linguistics, cultural relativism has guided positive research programs that continue to this day. The linguist and anthropologist Edward SAPIR and the linguist Whorf developed the thesis of linguistic relativity (the " Sapir-Whorf hypothesis") according to which lexical and grammatical categories of language determine the way the world is perceived and conceptualized, and each language is at the root of a different worldview (see also LANGUAGE AND COMMUNICATION). On this view, human cognition can be understood only through analysis of the linguistic and cultural structures that support it. The classical example is Whorf's treatment of the Hopi notion of time. Noting that the Hopi language "contains no words, grammatical forms, construction or expressions that refer directly to what we call 'time,' or to the past, or future, or to enduring or lasting," he concluded that the Hopi have "no general notion or intuition of time as a smooth flowing continuum" (Whorf 1956: 57). Subsequent research (see Brown 1991 for a review) tended to show that this radical linguistic relativity is not supported by closer analysis. However, less radical versions of linguistic relativity can be sustained (Lucy 1992; Gumperz and Levinson 1996). Recent comparative work on LANGUAGE AND CULTURE has been carried out with the methods of cognitive psycholinguistics at the Max Planck Institute for Psycholinguistics in Nijmegen. It has, in particular, gathered impressive evidence of the fact that the manner in which different languages encode spatial coordinates strongly affects people's conceptualization of spatial relations and movements (see Levinson 1996).

The standard anthropological characterization of cultures as relatively bounded, homogeneous, and coherent entities has repeatedly been challenged (e.g., Leach 1954; Fried 1975). The idea of discrete tribes each with its own culture was a colonial administrator's dream -- a dream they forced on people -- before being an anthropologist's presupposition. In fact, different flows of cultural information -- linguistic, religious, technological -- have different boundaries, or, quite often, do not even have proper boundaries, just zones of greater of lesser intensities. From an epidemiological point of view, of course, these ongoing cultural flows and the fuzziness of cultural boundaries are just what one should expect. From such a point of view, the notion of *a* culture should not have more of a theoretical status than that of a region in geography. Culture is best seen not as a thing, but as a property that representations, practices, and artifacts possess to the extent that they are caused by population- wide distribution processes.

It is the standard notion of a culture as an integrated whole that has guided most anthropological research bearing, directly or indirectly, on psychological issues. Much early anthropology, notably in North America, focused on the social and cultural correlates of psychological phenomena. A major and influential program of research, pioneered by Margaret Mead and Ruth Benedict, and lasting well after World War II, examined the relationship between

personality and culture. The "personality and culture" school adapted the language of psychopathology to describe and analyze cultural phenomena. Still, the thrust of this approach was an abiding skepticism about psychological claims. Relying on ethnographic data, scholars assessed and critiqued universalist claims about the mind. Both Mead and Malinowski drew considerable attention from their challenges to several of Freud's generalizations about human nature, particularly claims about the development of sexuality. Ultimately the appeal of the culture and personality school waned in part as national character studies began more to resemble national stereotypes than cultural analysis, but also in part because the approach increasingly identified the sociocultural level with the psychological level, a move that made most anthropologists uncomfortable.

Much anthropological research, although deliberately apsychological, is nevertheless of genuine cognitive interest in that it investigates knowledge structures, from specific notions to ideological systems. For example, much work has been devoted to examining different notions of person across cultures. In contrast to work in psychology that tends to take the person as a fundamental and invariant concept (see, e.g., Miller and Johnson-Laird 1976), anthropologists challenge the assumption that a person implies a bounded and unique sense of individuality and self. Rather the person is a socially situated concept that can only be understood from the perspective of social and cultural relations (Mauss 1985; Geertz 1973). For instance, Lutz (1988) argues that the Ifaluk of Melanesia do not conceive of emotions as something occurring with an individual person, but as a relation between several individuals in which the emotion exists independent of (and outside) the psyche of any one person. The notion of persons as unique self-oriented entities, in its turn, has been analyzed as arising from the specific cultural and political-economic environments of North America and Europe (Bellah et al. 1985). Like all relativist ideas, these views are controversial. Notice, however, that, unlike the claim that the mind itself is a cultural product, the claim that the person, or the SELF, is socially and culturally constituted is compatible with a naturalistic cognitive science, and has been defended from a naturalistic point of view, for instance by Dennett (1991).

Standard anthropological evidence for the cultural character and variability of notions like "person" consists of cultural narratives and expression of conventional wisdom. More recently, however, researchers in social psychology, CULTURAL PSYCHOLOGY and ETHNOPSYCHOLOGY have used innovative experimental methods to support ethnographic findings (see Markus and Kityama 1991; Shweder 1991). Shweder and colleagues have made important contributions (in both method and theory) toward integrating ethnographic and experimental approaches. Work on moral development, especially the way culture may fundamentally shape it, has been influential (Shweder, Mahapatra, and Miller 1990; see also Turiel 1983 for a carefully crafted and persuasive challenge to the antiuniversalist point of view).

Conclusion The various strains of research rapidly reviewed in this last section -- the Vygotskian, the social-psychological and the anthropological -- are extremely fragmented, diverse, and embattled. This should not obscure the fact that they all deal with important and difficult issues, and provide extremely valuable insights. It is encouraging to observe that, in all these approaches, there is a growing concern for explicit theorizing and sound experimental testing. More generally, it seems obvious to us that the various perspectives we have considered in this chapter should be closely articulated, and we have attempted to highlight the works that particularly contribute to this articulation. We are still far from the day when the biological, the cognitive, and the social sciences will develop a common conceptual framework and a common agenda to deal with the major issues that they share.

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He is the Canada Research Chair in Culture, Cognition and Coevolution at University of British Columbia. Joseph Henrich's Edge Bio Page. [39:00 minutes]. [ED. NOTE: This conversation with Joe Henrich was conducted in Vancouver for Edge by Jennifer Jacquet.] How culture drove human evolution.Â Think back to when humans first got the capacity for cumulative cultural evolutionâ€”and by this I mean the ability for ideas to accumulate over generations, to get an increasingly complex tool starting from something simple. One generation adds a few things to it, the next generation adds a few more things, and the next generation, until it's so complex that no one in the first generation could have invented it.