CULTURAL GUIDANCE IN THE DEVELOPMENT OF THE HUMAN MIND

Aaro Toomela

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Edited by
Aaro Toomela

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Introduction: Culture as an Explanation of the Human Mind

Aaro Toomela

BACKGROUND

This volume tries, from different perspectives, to answer the same question: What role do culture and socially structured environment play in the development of the human mind? The question, of course, is not whether cultural environment is important. The answer "yes" would be accepted by most, if not all, developmentalists. Rather, the question is qualitative: Does culture introduce something entirely novel into the structure of the developing mind? The most obvious way to approach this last question would seem to be to carefully study child development. This edited volume as a whole, however, proceeds from the position that one single perspective is not sufficient for understanding the role of culture in the developing human mind. That position reflects my long-standing fascination with Vygotsky's theory. Very few in the history of psychology have dared to approach the study of the human mind in all main perspectives—evolution of the mind, evolution of culture, retrogression after brain damage, child development—as complementary. Vygotsky and his followers, especially Luria, were among those few (e.g., Luria, 1979; Vygotsky, 1983; Vygotsky & Luria, 1930, 1994).

So the question is why only one perspective is insufficient. In principle, the answer lies in the concept that for understanding a phenomenon it is insufficient to describe only what the phenomenon is. Rather, it is as necessary to understand what the phenomenon is not. The study of child development can tell a lot about how a child develops, but there is knowledge that cannot be constructed in child studies. First, only human children in the human social–cultural environment are able to appropriate human culture. No other animal can do that. Thus, the brain of a human child must be special. Studies of child development cannot give us an understanding of what makes the human brain special. The development of the mind is determined by both neural and environmental factors. And if we want to understand child development, we need to understand what characteristics of the brain allow children—only human children—to develop into cultural human beings. To understand the unique characteristics of the human brain, it must be compared with that of nonhumans. These are questions for comparative psychology.

Second, the study of child development cannot sufficiently inform us about what makes the human social–cultural environment special. Even healthy human children do not develop into cultural human beings in nonhuman (and inhuman) environments. The result of mental development embeds the contribution of developing neural systems and the environment in such a complex web that it is not possible to determine what the role of the brain is and what specific role the environment has (see Baldwin, 1906, for an explanation of why such contributions cannot be separated). The specific characteristics of the brain are studied in neuropsychology. The specific characteristics of the social–cultural environment also need to be studied separately. That is done in cultural psychology.

The history of psychology has demonstrated that it is not easy to answer the questions studied in different subfields of psychology—comparative, developmental, cultural, or neuropsychology. Naturally, it is even more intricate to understand how these fragments should be put together. At the same time it seems obvious that it is not only useful but also absolutely necessary to create such a "big picture." If our goal is to understand child development, we must know what is specifically human in the nervous system, what makes the human environment special, what is "inborn" to the brain and what is environmental, and what emerges as a qualitatively novel result of the interaction of both.

With this volume we, of course, did not start with the attempt to look at the "big picture" from an empty space. Actually, we are proceeding from an overcrowded field of knowledge. That field is loosely organized into independent or competing camps who either ignore the existence of the others or claim their truth is better than that of the others. For example, many scholars believe that the social–cultural nature of the human environment is the clue to understanding individual human development. Many in this field, however, have forgotten to tell us what exactly they mean by *culture* and why. Too often the main or only defining attribute of culture is a political border between geographic areas. Apparently the imaginary political border is a marker for something else. If so, then it would be much more appropriate to define and measure that "something else" instead of using an indirect correlate of culture. Many others have to choose among hundreds of definitions of culture or create new ones. Usually such choices remain implicit.

To proceed meaningfully, the choices have to be made explicit. Otherwise it is too easy to fall into a trap of very hot and absolutely useless debates over the relationships among essentially unrelated fragments of knowledge. An example would be the question of whether animals "have" culture or whether culture is unique to humans. Since there certainly are both similarities and differences between humans and other animals, the "yes" or "no" depends solely on what specific definition of culture has been chosen. To be involved in any kind of useful discussion it is imperative at least to make explicit how the battlefield is marked; "apples" and "oranges" can be put together only in the "fruits" battlefield. So the least we should do is to state explicitly what we are looking for. If we are looking for culture in animals or cross-cultural differences between humans or the role

of culture in child development, we must define what we mean by culture. And it is even better when we can answer *the question* why we made that particular choice or why we prefer to define culture in one or another way.

This volume can give answers or possible answers to many questions. Directly or indirectly, however, the main axis around which the ideas revolve is language and its role in the human mind. Does language make humans unique or not? If yes, then how? If no, then how can we tell that? Again, these questions are old and have many different ways and different justifications to give "yes" or "no" answers that we would like. As an editor I asked myself whether we could agree with F. Max Müller, who a long time ago wrote that "Language is our Rubicon, and no brute will dare to cross it" (Müller, 1887, p. 173). Maybe we can go further and suggest, together with Lev Vygotsky or Grace Andrus de Laguna, among others, that language is *the* clue, in addition to human uniqueness, to understanding the differences between cultures and the differences between cultural individuals, and the mechanisms of human child development. Perhaps we can go even further and declare that culture is best defined as language.

If I want to be coherent and follow the rules I myself mentioned above, I should also have an answer to the why-question. Why should language be that important? I have argued elsewhere (e.g., Toomela, 1996) that language seems to be the only mental tool that allows us to perceive the world in a way that is not available to our direct senses—visual, auditory, tactile, olfactory, gustatory, or visceral. We cannot perceive directly things or phenomena that are too big/too far from us (e.g., a solar system), that are too small (e.g., electrons), or that are unavailable to our senses (e.g., electrical field). We seem to know about such things and phenomena only because of our verbalized theories about them. Such theories are our eyes to see the invisible and our fingers to touch the untouchable. It also seems that no animals other than humans and only sufficiently old humans with certain cultural experiences are able to construct and understand such theories. Thus, maybe language is *the* answer. Maybe it is not at all.

That was from where I started as an editor. Every potential contributor to this volume was provided with the following information:

Basic ideas on which the book will focus are presented below.

1. Human environment is structured in a way that qualitatively differs from the environments of all other animals. These qualitative differences constitute "culture."

   Possible views to defend:

   a. There are no qualitative differences between structures of human and nonhuman (animal, primate, ape) environments; or
   b. There are qualitative differences—in defending that view the difference(s) should be defined. (That view *does not* imply that the structures of human and nonhuman environments differ in all respects. There is continuity from nonhuman to human environment that introduces similarities.)

2. The specifically human characteristics of environment (i.e., culture) allow humans to achieve psychological processes/systems qualitatively different from those of all animals.

Possible views to defend:

a. The human mind does not qualitatively differ from the minds of animals (or only primates or apes): or
b. The human mind is qualitatively different from animal minds. In defending that view, at least some specific examples of qualitative differences should be proposed and discussed. In addition, (possible) mechanisms of how culture enters the mind and allows achieving qualitatively new psychological functions should be proposed.

3. It is (primarily) language that makes the difference between human and nonhuman environments and, correspondingly, between human and nonhuman minds. (Language should be taken broadly as any system for communication: speech, sign language, written language, etc.)

Possible views to defend:

a. Language does not make the difference, or language is not enough.
b. Language does make the difference—analysis of specific processes should be used as examples.

The authors were not constrained in their answers to these questions. Even more, if the contributor chose an approach where these ideas were not directly addressed, the contribution still remained acceptable. For some "camps" in our scattered field of "knowledge about the human mind and its development," even asking certain questions may make no sense.[1] It will appear in the end whether we can go beyond "camps" and approach a bigger picture. If we do not succeed, either we are not ready (should be read: "the editor is not smart enough") or there is no coherent big picture at all.

STRUCTURE OF THE BOOK

This book is divided into four parts. Part I, Human Development from the Perspective of Comparative Psychology, is dedicated to questions regarding the evolution of the (human) mind and possible similarities and differences between the minds of humans and those of other animals. In the first chapter, Jacques Vauclair discusses developmental relationships between animal and human minds. Vauclair argues that it is possible to observe both continuities and non-continuities in the evolution of the human mind. Kathleen R. Gibson approaches the same questions from a slightly different angle. She shows that the differences between humans and animals cannot be fine grained. Rather, growth in brain size and asymmetry may be responsible for most differences. In the last chapter in Part I, Jaan Valsiner directs attention to basic theoretical questions that have not been taken seriously in comparative and developmental psychology. Instead of asking what mental operations or characteristics animals or children "have," researchers should focus on the questions of emergence and development of novel forms. Development can be understood quite differently, and research questions that follow from usually implicit understanding of the nature of development are constrained by that implicit theoretical background. This, in turn, has led most of

the mainstream psychology to answer questions that do not help to understand the phenomena under study.

Part II, Culture in the Developing or Regressing Brain, includes two chapters. Both chapters ask what characteristics of the human mind are related to basic, biologically determined construction of the brain and what characteristics/operations result from the interaction with (social–cultural) environment. In Chapter 4, Alfredo Ardila develops two ideas: First, the human brain possesses certain basic capabilities, that is, ways of processing information, and second, culture provides content to these capabilities. In Chapter 5, Tabassum Ahmed and Bruce L. Miller analyze the relationships between the brain and visual arts. They propose that certain brain regions are responsible for artistic abilities. These artistic abilities, according to them, are independent of culture; art is processed and produced by specific brain regions that emerged in the evolution of the anatomically modern humans.

Part III, Cultural Perspective on Human Development, is dedicated to the study of culture. John Berry describes ecocultural perspective on human diversity according to which human activity can be understood only within the context in which it develops and takes place. Ecocultural perspective has two roots. First, all human societies exhibit commonalities, and second, behavior that is based on these commonalities is differentially developed and expressed in response to ecological and cultural contexts. In Chapter 7, Ivana Markova discusses competing theories on how to understand culture and human activity in cultural context. Bakhtinian "dialogical," simultaneous nature of cultural mechanisms is opposed to Lotmanian sequential and relatively stable understanding of culture. Markova also demonstrates that theoretical ideas developed by scholars are shaped by culture and ideology; sometimes scientific ideas may be shadowed by politically correct ways of expressing them.

Part IV, The Role of Culture in Child Development, discusses relationships between culture and child development. All three authors' chapters in this part, by Katherine Nelson, Aaro Toomela, and Eve Kikas, argue that child development is a much more complex process than it is usually understood. Acquisition of cultural tools for the mind—language—is a complex hierarchical process. Children first acquire words, or symbols in general, that only externally resemble adult symbols. Internally, these symbols may have a structure that is different from that of adults. All three authors' chapters also propose that symbol development seems to proceed over general stages. Development of symbols, in turn, leads to changes in other psychological processes, perhaps even to the emergence of qualitatively novel mental structures and corresponding operations. All three authors also suggest that child development and cultural development are in many respects similar and that individual mental development can be understood better by studying evolution of human culture and vice versa.

Finally, in the afterword I have tried to synthesize ideas from all different perspectives on the human mind, discussed in the four parts of this book. That emerging synthesis, indeed, seems to be a productive way for going further in the study

of the human mind. Different perspectives can be taken as complementary; each of the perspectives has something to say that other perspectives alone cannot.

NOTE

1. Indeed, sometimes researchers have been quite explicit in questioning the relevance of some questions. Esther Thelen, the leading scholar in the "Dynamic Systems Approach" to child development, for example, declared that "from a dynamic point of view, therefore, the developmental questions are not what abilities or core knowledge infants and children really have or what parts of their behavior are truly organic or genetic but how the parts cooperate to produce stability or engender change (Thelen, 1995, p. 94)."

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Part I: Human Development from the Perspective of Comparative Psychology

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1. Would Humans Without Language Be Apes?

Jacques Vauclair

THE POSTULATE OF MENTAL CONTINUITY

The bedrock of comparative psychology of cognition, especially where nonhuman primates are concerned, rests on Darwin's famous account according to which continuity would be the main trait leading from the animal to the human mind. This idea was popularized through the statement in which Darwin postulated only quantitative differences between humans and the other species, namely "the difference in mind between man and the higher animals, great as it is, certainly is one of degree and not of kind" (Darwin, 1871, p. 128).

We can only agree with Darwin's continuity position as concerns the existence of some kind of mental organizations in animals, in particular in nonhuman primates, as a necessary part of the perception of objects and their localization and interrelationships in space and time (Walker, 1983) and in many adaptive functions, including problem solving and memory (e.g., Vauclair, 1996). In effect, human and animal brain functions show sufficient similarity to allow comparisons if one assumes that animal brains are devices for selecting and organizing perceived information, and that the neural systems that accomplish perception and memory exhibit evolutionary continuity. It thus appears that these global functions are performed by the animal in ways that are basically similar to human performance, that is, through the construction and use of representations of various degrees of schematization and abstraction (Roitblat, 1982).

One of the main assignments of comparative psychology of cognition is to attempt to describe similarities between animals and between animals and humans. But its task is also to uncover possible differences between two or more species. Primate communication and language (including the attribution of mental states to others: Povinelli & Edy, 1996) are obviously good candidates for revealing such differences. However, a close inspection of the available literature in relation to other aspects of general human cognition (e.g., spatial behavior, coordination of movements in hand usage) can also help to shed light on the issue of resemblance and difference between human and nonhuman primates.

THE LANGUAGE ISSUE: A CASE OF DISCONTINUITY

I plan to show that animal communication and human language differ in some crucial ways that are related both to the structure of these communicative systems

and to their functional use. This demonstration will be made by borrowing examples from natural and spontaneous communications among primates as well as from experiments that attempted to train ape species to use some of the features of human language.

To return to evolutionary theory, Darwin also considered that some characteristics of human behavior were clearly more on the discontinuous side than on the continuous one. The following excerpt illustrates such a view: "The development of the moral qualities is a more interesting problem [. . .]. A moral being is one who is capable of reflecting on his past actions and their motives—of approving of some and disapproving of others; and the fact that man is the one being who certainly deserves this designation, is the greatest of all distinctions between him and the lower animals" (Darwin, 1871, pp. 426–427). Furthermore, Darwin also proposed that the universal belief in "spiritual agencies" represented "the most complete of all the distinctions between man and the lower animals" (Darwin, 1871, p. 430).

Considerations about beliefs and intentions in ethology and in animal psychology have been tackled more recently within the field of "cognitive ethology" (e.g., Griffin, 1984; Allen & Bekoff, 1997) and with the concept of "theory of mind," proposed by Premack and Woodruff (1978). As concerns moral issues, these questions have been addressed only indirectly, for example by Lorenz (1970). The attribution of moral attitudes to animals (de Waal, 1996) has been challenged, however, notably by Kummer (1978).

It seems that the issue of the importance of the discontinuities in the mind introduced by the human specificity of language, moral qualities, and beliefs in some kinds of transcendental values ultimately refers to language understood as a system of exchanges and values (Bronckart, Parot, & Vauclair, 1987; Vauclair, 1990, 1995).

About Some Structural Differences Between Animal Communication and Human Language

It is necessary first to characterize the structure of human language with respect to the communicatory systems of animals. The well-known system of alarm calls emitted by vervet monkeys is probably a good example that illustrates some of the differences between the two organizations. Vervet monkeys have three classes of predators—leopards, snakes (pythons), and eagles—the presence of which is signaled by three different alarm calls (Strushaker, 1967). The production of each type of alarm calls evokes a different and appropriate response in conspecifics, which (1) look up and run into dense bush in response to eagle's alarms; (2) flee up to the trees in response to leopard's alarms; (3) look at the ground around them in response to python's alarms.

Even though these calls could be considered arbitrary with respect to the predators they designate, such arbitrariness is different from that of linguistic signs for at least two main reasons (see Figure 1.1). First, this arbitrariness in the vervet

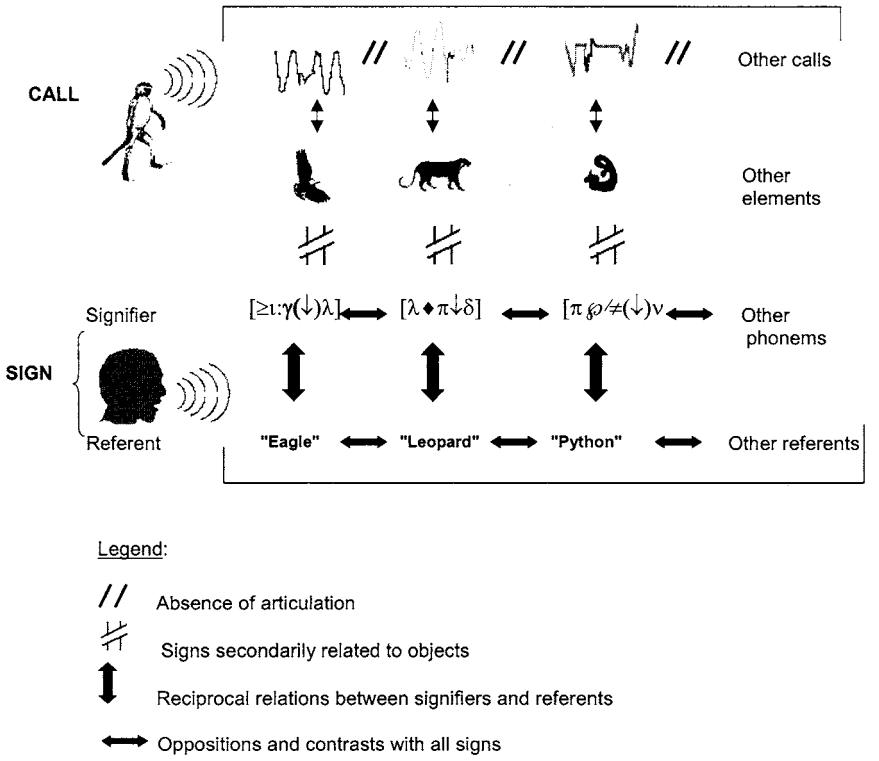

Figure 1.1
Differences between Animal Calls and Linguistic Signs

monkey does not imply the intervention of a duality of patterning between a sound, or a phonemic level, and a concept or a semantic level (Hockett, 1960; Bickerton, 1990). Second, the arbitrariness implied in the vervet's alarm system is not related to a conventionalization that ties together the level of phonemic and semantic representations. If young vervets have to learn to produce more specific calls in response to a given class of predators, they do not have to learn a conventional rule associating such or such a call to such or such a predator (Cheney & Seyfarth, 1990). Finally, each category of the vervet's alarm calls appears to be strictly linked to the predator (or category of predators) to which it refers. Thus, its specific meaning is not the result of oppositions to other categories of calls produced in the species (Figure 1.1).

Briefly, what the vervet's alarm calls might send is information about a global configuration. This proposition has also been made by Bickerton (1990), for whom animal communication is holistic because it is concerned with the communication of whole situations. For example, the units of animal communication convey whole chunks. These chunks as they are expressed, for example, in the

vervet alarm calls are roughly equivalent to "A predator just appeared!" or "Look out! A leopard's coming!" By contrast, language deals mainly with entities, that is, other creatures, objects, or ideas to which states or actions are attributed.

An additional property of the linguistic sign, the feature of displacement (e.g., Hockett, 1960), also seems to be lacking in animal communicatory systems. This feature concerns the fact that a linguistic sign can be detached or decontextualized from the element (object, event, or state) to which it relates or that its meaning is available regardless of the contextual situation in which it appears (Gärdenfors, 1996). Following this concept, a sign might become a symbol equivalent to a verbal sign when it can be used without direct connection to an experimental context. Von Glaserfeld (1977) has argued that animals' communicatory signals fail to achieve this transformation, because a mere delay (distance in time and space) does not change the one-to-one correspondence between the sign and the situation. In brief, a linguistic entity connects not only an object with a sign, but signs themselves.

To summarize, one could say that the mastery of signs in human language can be mostly characterized as an activity that consists of detaching the sounds and the words (i.e., phonemes and morphemes) from the configuration of the objects they represent and to conventionally relate these signs together, according to structures of phonemic and semantic equivalences and oppositions. These structures can be defined as "paradigmatic" because each item (sound or word) takes sense by distinction and by opposition to all other items that can commute in a given position, like linguistic units can commute in any position in a sentence (Saussure, 1966). For example, in the sentence "this animal is an eagle," the item "animal" takes sense by opposition to the other expressions that could come to the same place ("moving object," "organism," "being," "thing," "bird," etc.). Within the same logic, the item "is" takes its meaning by opposition to "has been," "will be," "looks like," etc.; and the meaning of "eagle" is specified by its opposition to "leopard," "python," "predator," or "vulture" (see Figure 1.1).

In language, the relation between referent and signifier is qualified as arbitrary, because there is no physical or analogical resemblance between the sequence of sounds and the content that is represented. In this respect, most of Washoe's gestures (Gardner & Gardner, 1969), Sarah's tokens (Premack, 1971), and the lexigrams operated by Austin, Sherman, and other language-trained chimpanzees (e.g., Savage-Rumbaugh, Rumbaugh, & McDonald, 1985) indeed entertain an arbitrary relation with the various aspects of the reality they represent. For linguists (Saussure, 1966), however, the "radical arbitrariness" that characterizes verbal units is of a higher level of difficulty than the simple relation between two realities (see also Bickerton, 1990, and Vauclair, 1990). In fact, two types of material reality need to be processed by the subject in order to comprehend or to produce a verbal sign: there is, on the one hand, the acoustic property of the sign and, on the other hand, the material property corresponding to the content expressed by the sign. Thus, a verbal sign is not simply a relation between mate-

rial elements (sounds) and the content to which they refer (objects or actions). It is, rather, the product of two representations, one built on the acoustic material and the other built on the meaning (conceptual image). The relation between the two images is said to be arbitrary because all natural languages have selected a sequence of sounds to stand for a particular concept in an arbitrary manner and through social convention. It is precisely this conventional and arbitrary relation between a signifier and its referent that is called *radical arbitrariness*. Although the construction of conceptual and acoustic images is typically an individual activity, the basic operation of language, that is, the designation or creation of signs, is nevertheless performed through social convention.

How can this analysis based on human languages help to clarify the issue of the linguistic nature of the chimpanzee's production of symbols? In order to demonstrate that an ape (or any other animal) uses symbols that are equivalent to verbal signs, one should, from the present perspective, be able to show (1) that the ape possesses an individual representation of the signifier (e.g., of a gesture) and of its content or meaning; (2) that a social convention has made the analysis of the representation possible; and (3) that the representation can be grasped by opposition to other signs. Clearly, such requirements await demonstration in the field of comparative investigations of "linguistic" abilities of nonhuman primates.

About Some Functional Differences Between Animal Communication and Human Language

It could be argued that the structural differences mentioned earlier between human language and animal communication are somewhat trivial because they compare a very sophisticated medium for conveying information and intentions (i.e., language) to a phylogenetically less advanced system (i.e., animal communication). In this respect, the comparison might appear somewhat unfair because it is likely (also still not proved) that contemporary languages represent a rather recent form of expression that could have evolved from simpler modes of social exchanges (either gesturally or acoustically based). This notwithstanding, it appears that typically human communicatory systems (including gestural and spoken language but also prelinguistic manifestations) have specific modalities that are apparently not shared by any animal communicatory system.

Following the pioneering work of Bühler (1934), two principal modalities can be distinguished in the linguistic as well as in the prelinguistic communication among humans (Bates, 1979). The primary function of language is to exchange information about the world. Such an *informative function* takes two forms: a declarative form that serves for representing states of the world (e.g., "John comes") and an interrogative form. The other function is *injunctive* (imperative) and *exclamatory* and mostly expresses itself with requests and demands (e.g., "Come!"). Developmental studies with young children have shown that the

use of declaratives (e.g., Wetherby et al., 1988; Bassano & Maillochon, 1994) becomes the dominant mode of communication between 1 and 2 years of age (about 60% of all utterances).

It happens that a major difference between humans and nonhuman primates is that the use of a signal or a learned symbol by the latter is restricted largely to its imperative function, whereas humans will use a word predominantly as a declarative. Declaratives (Bates, Camaioni, & Volterra, 1975) can be words or gestures, and they function not primarily to obtain a result in the physical world, but to direct another individual's attention (its mental state) to an object or event, as an end in itself. Thus, a human toddler might say "Plane!" apparently to mean "It's a plane!" or "Look, a plane," and so on. In such cases, the child communicates simply to share interest in something that he or she sees, that this object is a plane, and that the child has identified it and finally that he or she wants the partner to look at it.

It can be asserted with some confidence that the use of protoimperative signals is the exclusive mode of communication by animals of different phyla. When, for example, your cat vocalizes at you in the vicinity of the window and at the same time glances back and forth from the window to you, the cat is using a protoimperative signal that can be interpreted as "I want to go out." But it is very unlikely that your cat would use these same communicative signals to let you know that it has noticed something interesting in the garden.

This imperative function also appears to be the predominant (if not exclusive) mode used by "linguistically" trained apes. To illustrate this question, the case of the bonobo Kanzi studied by Savage-Rumbaugh (e.g., Savage-Rumbaugh et al., 1986) can be used. Studies reveal that (1) Kanzi had more or less spontaneously learned the symbolic function of a visual signal and (2) could (at the age of 8 years) comprehend English sentences at a level similar to that of a two-year-old child (Savage-Rumbaugh et al., 1993). But interestingly, and contrary to human children who use language to make indicative or declarative statements, 96 percent of Kanzi's productions were requests (Savage-Rumbaugh, Rumbaugh, & McDonald, 1985). Thus, the difference between Kanzi's modality of communication and the typical declarative mode observed by humans is striking. In effect, communication in the apes has essentially an imperative function (this appears to be the rule for all animal species, and this mode is sufficient to fulfill the biological requirements as, for example, to warn again predators; see above the case of vervet monkeys' alarm calls). By contrast, humans use not only linguistic signs but also prelinguistic means of communication such as gestures (e.g., pointing) for both imperative and declarative purposes (e.g., two persons sharing an interest toward a third person, object, or event: Bard & Vauclair, 1984; Vauclair, 1984).

The Future of the Study of Linguistic Skills in Apes

I have tried to point out in this section both the structural and functional differences in the spontaneous communicative signals as well as trained symbols

used by nonhuman primates as compared to human language. The conclusion that two chief achievements of human language are lacking in animals does not imply that research on this issue with nonhuman primates or any other animal species must be abandoned. It is quite the reverse, because a proper identification of the main features of a given system should help in defining a better program for further studies. Three directions for such investigations can be briefly mentioned: (1) It is likely that the limitation in the types of productions made by trained animals might be due in part to constraints inherent to the experimental environment. For example, this environment has strongly encouraged Kanzi and other trained apes to formulate mostly requests for activities or objects. Thus, an environment that would facilitate more spontaneous expressions on the subject's part could better reveal its real accomplishments (Bodamer et al., 1994). (2) It is possible that deficits in the informative modality in apes could be due to their difficulty to express attention-related demands. This constituent of the declarative mode could thus be studied along with the ability of nonhuman primates to emit emotions (e.g., exclamatory function) through the symbolic system they are exposed to. (3) Focusing on the use of declaratives in nonhuman primates (in natural communication and in the lab) and the capacity for joint attention to objects (Bruner, 1983) could help to recognize the antecedents of these possibly unique features of human language and could set a framework that allows the development of mental attribution of beliefs, knowledge, desires, and intentions to social partners (e.g., Vauclair, 1982; Tomasello, 1998). After all, gestural and spoken declaratives constitute an elaborate form of joint attention, by which a given speaker attempts to affect the listener's mind. In this same line of thinking, protodeclarative and declarative behaviors may be precursors to the development of a theory of mind (Baron-Cohen, 1992).

Another remark is in order. The fact that nonhuman primates lack language does not mean that these species cannot show peculiarities in their behavior that bring them closer to humans compared to any other animal species. A series of investigations on spatial representations recently carried out in our laboratory clearly shows this. These investigations were based on the work of Hermer and Spelke (1994, 1996), which has examined the abilities of 18- to 24-month-old human children to combine geometric with nongeometric information in order to properly reorient in space. These authors found that toddlers were limited in their spatial behaviors in that they used only the shape of the experimental environment to reorient, even when more salient nongeometric information was available. In this sense, young children behaved like rats or chicks (e.g., Cheng, 1986), whereas human adults reoriented in a more flexible way. To explain this source of flexibility, Hermer and Spelke (1996) have argued that language is necessary to combine geometric and landmark-based information. More precisely, these authors propose that the age at which children begin to successfully locate a target using geometric and nongeometric information (at about 6 to 6.5 years of age) approximately corresponds to the age at which they begin producing sentences that would uniquely specify object location and orientation, such as "near" or "to the right/left" (MacWhinney, 1995).

We have recently demonstrated (Gouteux, Thinus-Blanc, & Vauclair, 2001), however, that rhesus macaques were able to jointly use geometric and landmark-based cues when presented with the same set-up as the one used with young children. These findings tend to demonstrate that spatial processing became more flexible with evolution; and we have hypothesized that such a flexibility could have evolved in nonhuman primates independently of specifically human cognitive features such as symbolic representation and language (a different example requiring representation of spatial relations by monkeys can be found in Vauclair, Fagot, & Hopkins, 1993).

HAND COLLABORATION AND THE REPRESENTATION OF VISUO-GESTURAL MOVEMENTS

The comparison of human and nonhuman primates has too often been exclusively based on language because the latter is more or less implicitly assumed to represent the hallmark of the species *homo sapiens*. I believe that this view is reductive and neglects other important features that seem to be as important as linguistic signs for a proper characterization of the human nature. The following sections will therefore be devoted to considering two of these (related) features. The first one concerns the apparently original way (division of labor between hands) humans act on objects; the second one is related to the existence in humans of genuine visuo-gestural representations that are manifested in the use of specific techniques such as weaving. Finally, a third section will contrast the developmental pathways of human and nonhuman primates in the acquisition of manipulatory behaviors, including the use of tools, by stressing the role of the social context in these acquisitions.

Differences in Laterality and Hand Use in Primates

A domain that is rarely considered in the comparative approach of cognition between human and other primates concerns the patterns of coordination required to perform food processing and other related activities. This field is interesting because it shows that at some point in the process of hominization, forces have acted on the way the brain machinery (and thus the behavioral outputs) perform in order to fill new demands for adapted actions on the environment.

To discuss this question properly, it is necessary first to summarize the current state of knowledge concerning manual organization and hemispheric lateralization in nonhuman primates. Contrary to humans who show a strong bias for using the right hand, nonhuman primates express individual patterns of laterality but no bias toward the left or toward the right at the population level (Ward & Hopkins, 1993). However, hand laterality in these species was shown to depend on the nature of the task as well as on postural constraints related to hand usage (Fagot & Vauclair, 1991). Thus, manual activities requiring strong visuospatial demands induce a preferential use of the left hand both in gorillas

and baboons (Vauclair & Fagot, 1987, 1993). With the exception of chimpanzees, which, as a species, show a weak preference for the right hand (60%: Hopkins, 1994; for a review see Hopkins, 1996), nonhuman primates do not display, at the group or population levels, any systematic predominance of one hand over the other.

The above patterns of nonhuman primate lateralization are mostly obtained from the investigations of unimanual actions. But interspecies differences in hand use are also apparent when the overlapping manual activity in the manipulation of objects by human and ape infants is considered. An instance of overlap is counted when manipulatory events involving both right and left hands occur concurrently. In such cases, human infants exhibited greater variety and differentiation than did ape infants (Vauclair & Bard, 1983). Furthermore, this flexibility in the activity of the human infant appeared in the many instances where objects were transferred from one hand to the other during active manipulation. No case of such transfer was reported for the young apes.

Other differences between nonhuman primates and humans can be observed in the ways hands are used to handle tools. With respect to hand coordination in humans, Guiard (1987) has identified three basic models (orthogonal, parallel, or in series) describing hand coordination in right-handed subjects. The two hands of an operator of a milling machine can serve to illustrate the orthogonal assemblage. In this case, the operator moves a piece in a horizontal plane by acting on the crank with one hand (the left) according to the Y-axis, whereas the other hand (the right) acts on the crank to move the object on the X-axis. In parallel assemblages, both motors act in a synergistic fashion, essentially by adding their respective efforts (an example is provided by the weightlifter or by a child with a skipping rope). In the model of serial assemblage, the action of one hand produces a frame of reference upon which the second hand will act. Sewing activities and writing offer examples of such an assemblage. In the case of hand-sewing, for example, the left hand (of a right-handed person) manipulates the fabric relative to the body or to the table, while the other hand manipulates the needle relative to the fabric.

Interestingly, only the serial model implies differentiation in the role of each hand and thus an asymmetrical organization. It might thus be stated that this last kind of assemblage could explain lateral specialization among humans. We know that such a division of labor between hands appears early in ontogeny. For example, by 6 months of age, the human infant reaches for objects with bimanual coordination: a hand lands on the support near the object and then the other hand comes into contact and grasps it. This bimanual behavior (in right-handed subjects) is conceived of as one hand (the left) providing the spatial conditions necessary for reaching by the other hand (de Schonen, 1977).

Although the literature on ape tool use is extensive, few reports have focused on the ways hands are employed during complex manipulations (McGrew & Marchant, 1997). A survey of this literature suggests the following picture regarding hand use and hand collaboration. It appears that most tool use