

Studying Spatial Conceptualization across Cultures: Anthropology and Cognitive Science

STEPHEN C. LEVINSON

ABSTRACT *Philosophers, psychologists, and linguists have argued that spatial conception is pivotal to cognition in general, providing a general, egocentric, and universal framework for cognition as well as metaphors for conceptualizing many other domains. But in an aboriginal community in Northern Queensland, a system of cardinal directions informs not only language, but also memory for arbitrary spatial arrays and directions. This work suggests that fundamental cognitive parameters, like the system of coding spatial locations, can vary cross-culturally, in line with the language spoken by a community. This opens up the prospect of a fruitful dialogue between anthropology and the cognitive sciences on the complex interaction between cultural and universal factors in the constitution of mind.*

ANTHROPOLOGY AND COGNITIVE SCIENCE

There is little doubt that in the history of ideas the rise of the cognitive science movement will be seen as one of the main intellectual developments of the second half of this century. Its inception was blessed with brilliant spokesmen like Lashley, Chomsky, and Miller, and perhaps most importantly with a Goliath of a target—the huge but vulnerable scientism of behaviorism. The core notions were that mental processes could be thought of as operations over rich internal representations—too rich to be learned in their entirety—and that these representations and the operations on them could be studied in a rigorous way, and modelled using the new mathematical methods arising from the theory of computing. These

STEPHEN C. LEVINSON is head of the Language and Cognition Group and director at the Max Planck Institute for Psycholinguistics, Nijmegen, the Netherlands.

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ideas spread to encroach on a dozen disciplines, forming a loose coalition of fields as diverse as philosophy, neurophysiology, electronics, linguistics, psychology, evolutionary biology, vision theory, and the like. An initial member of that coalition, indeed part of the original inspiration in the 1960s, was cognitive anthropology, at that time rich in ideas, methods, and ambitions. Since then, with some notable exceptions like the ethnobiological work or the cognition-in-practice movement, anthropology has largely elected to withdraw from active participation or dialogue, partly from a distaste with the psychologism, reductionism, and scientific pretensions of the cognitive science movement. In some respects, it is true, the movement itself has slipped increasingly away from an emphasis on the role of meaning in mental life toward more mechanistic and reductionist accounts of information processing (as one of its founding fathers, Jerome Bruner [1990], has complained).

This article will suggest that, nevertheless, thoughtless rejection is not an adequate response to such an important intellectual movement. The goals of cognitive science—to illumine our mental life, to understand its inner workings, to plumb the sources of our ideas and the frameworks of our knowledge—are hardly alien to anthropology. Its presuppositions—that representations can be studied structurally, and that in certain respects the mental life of our species must be continuous with neighboring species, while at the same time it is transformed by language and external cultural representations—are, again, not obnoxious to the anthropological palate. What offends (for example, the objectivist and reductionist rhetoric) is in many respects window dressing. More fundamentally, however, the movement has opened up whole worlds of human experience—the worlds of the blind, the deaf, the mentally impaired, preverbal infants—that were as lost to us as the cultures of the pre-ethnographic age. It has shown us the intricacies of inner communications—how our eyes talk to our hands, our verbal memories to our imagery. It has shown us how truly miraculous the construction of a coherent conscious experience is from the flotsam and jetsam of fragmentary sensation. Above all, what has been unfolded for us is a glimpse of the true complexity of the workings of the mind.

In the context of this revolution in our understanding of the mind, the anthropological attitude looks truly confused: here is a discipline that centrally studies ideas and values and yet by and large subscribes to a zero theory of mind, if it bothers to think about it at all (Cosmides and Tooby 1994). But just as anthropology urgently needs a theory of mind, so the cognitive science movement needs the fresh vision that comes from seeing that human affairs can be arranged in such different ways. If the enterprise is to succeed, it will require cross-cultural evidence of a sort that only anthropology can provide. If it is to fail, it will fail quite largely on its inability to handle cultural variation and the impact of the cultural environment on

the workings of mind. And if some parallel movement more responsive to cultural variation and to the peculiar ontological status of cultural ideas is to arise, it will do so only on the prompting of anthropologists. Epistemological questions are central to the cognitive sciences, yet the core disciplines, with the exception of linguistics, have no ready access to one basic touchstone deciding between innate and acquired abilities, namely cultural variation. In short, indifference or haughty disdain is hardly a responsible reaction from a discipline like our own that has so clearly lost a coherent voice in the very period that has seen the successful growth of the cognitive science movement. At the very least, it is incumbent on us to bring the facts of cultural variation to bear on cognitive science theories that are, as it were, formulated in the dark.

If cognitive science could use a good dose of anthropological fact and perspective, so anthropological theory could use a theory of mind. In particular, anthropological positions on epistemology are often downright primitive, unreflectingly echoing the *tabula rasa* assumptions of the behaviorism of half a century ago—appearing to many commentators as an acute liability and hindrance to any serious progress toward a science of social life (see e.g., Sperber 1987; Tooby and Cosmides 1992). How can we possibly have theories of socialization and culture transmission without an adequate theory of mind? Would not such theories amount in effect to a theory of possible cultures, predicting what can and cannot be easily learned by humans through socialization, and thus delimiting the very bounds of human culture? A sophisticated theory of the interrelation between culture and mind seems a precondition to any serious theory of society.

It is time for a serious dialogue between the sciences of cognition and the sciences of culture and society. If anthropologists can show in a rigorous way that certain fundamental aspects of cognition are shaped by cultural factors, the dialogue will commence forthwith. We might study child development (see e.g., Stigler et al. 1991), we might explore the nature of memory in illiterate societies, or we might look at particular domains of human experience and compare the corresponding mental representations in different cultures. Following this last strategy, we can employ, in addition to the careful observation of everyday practice, the many methods that have been developed within the cognitive sciences to explore the nature of conceptual categories.

One interesting test ground is spatial cognition—how space is conceived of and talked about in different languages and cultures. It is a good domain for such investigations because it seems to be central to human cognition, providing the essential framework for concrete thinking about objects and events as well as for abstract thinking about many other domains (witness the proliferation of spatial metaphors in mathematics, kinship, social class, etc.). One can begin the study of spatial thinking without

necessary commitment to the presumption of the universal nature of the Kantian categories such as time, space, and cause; the fieldworker can expect to find the initial categories of any investigation reflected back in a distorting mirror. Aspects of spatial thinking are already extensively explored in anthropological writings on cosmology, symbolism, design, and land use. Spatial distinctions are also much studied throughout the sciences of cognition, from neurophysiology through linguistics to cognitive and developmental psychology. Consequently there are a wealth of hypotheses about the essential nature of human spatial cognition that can be tested against field data.¹ The overall burden of these hypotheses, to which we now turn, is that spatial cognition at first sight seems the very least likely domain in which to find cultural variation.

THEORIES OF SPATIAL COGNITION IN THE COGNITIVE SCIENCES

In cognitive science there is much talk about mental representations and an inner language of thought. The nature of these representations is assumed to be largely innate, part of our biological endowment, the assumption buttressed by arguments to the effect that organisms simply could not learn all the relevant structures given their computational and temporal limitations. These categories and their combinatorial properties can then be expected to project into language and other aspects of behavior, and this projection should be discernible in the process of child development. Cultural factors can be supposed to have only minimal influence on all of these processes. (This strong universalizing bias will be familiar to anthropologists through contact with theoretical linguists, especially of the Chomskyan persuasion; but linguists at least are faced with reconciling deeply variant language systems with such universal tenets, whereas students of vision or memory or inference have no such daily reminders of cultural difference.)

Take space as an example. Each of us has an elaborate mammalian inheritance of spatial perception and processors. The vestibular system measures angles in relation to the vertical, and velocities in every direction. The visual system isolates objects from their background, reconstructs their three-dimensional shape, gives us estimates of depth and size, and so on, utilizing specialized neural networks, with processing underway long before the signals even reach the brain. Binaural hearing helps us locate noises, and touch gives us, like vision, access to shapes and textures, but also direct access to three-dimensional properties of things. Our motor system in turn has to be geared to all this information so that we can steer our way around. Specialized neurological hardware shared with other primates can be shown to be responsible for many aspects of these different

kinds of spatial perception, so there is little room for doubt that all this forms part of our common culture-independent biological endowment.

In view of the kinds of cultural difference that will be described below, it is important to appreciate the biological underpinnings to our sense of space. Here are a few details and further references. First, there is evidence that spatial information is not only functionally separate but neurally distinct in mammals from other kinds of information. (For example, “the rat uses for navigation representations of space that involve different computations and largely different neural substrates than those used for remembering simple associations between specific objects and reward, or between specific motor acts and reward” [Leonard and McNaughton 1990:380; Schöne 1984]). Some parts of the brain, like the hippocampus, seem to be primarily dedicated to spatial memory, as detailed in O’Keefe and Nadel (1978) and Paillard (1991b) (see also Rolls 1990 on the memory for scenes). Other parts of the brain seem dedicated to correlating spatial information. Thus evidence from direct recording techniques as well as lesions show that the posterior parietal cortex is an area of the brain where the different sensory signals—visual, tactile, auditory, vestibular, proprioceptive, and so on—“create a network for transforming sensory input into signals suitable for motor control” (Stein 1992:193). On the other hand, less egocentric cognitive maps of the environment seem to be maintained in the hippocampus, where particular cells seem to record specific places (O’Keefe 1991:273; Stein 1992:211). Some important functional distinctions seem to correlate with different neural pathways: for example, knowing *what* something is seems to involve distinct pathways from knowing *where* something is (Ungerleider and Mishkin 1982). This correlates with foveal and peripheral vision, static versus dynamic visual perception, also perhaps distance versus direction coding (Paillard 1991a).

Now this varied source of inputs, together with a varied source of outputs (including gesture, language, and movement), seems to argue for a single level or inner language of spatial conception, into which the different kinds of information (visual, tactile, auditory, etc.) can be translated. One of the main tasks of such computation, the neurological work suggests, is to reconcile the different egocentric reference frames related to vision, hearing, hand movement, and so on, requiring some normalized ego center. It is naturally supposed that this “language” or representation system is also universal, presumably largely innate. The kind of essential notions involved would seem at the very least to utilize a system of three planes through the human body: one dividing front and back, one dividing upper from lower, and one dividing left from right. These planes are in fact instantiated in the inner ear by the three semicircular canals, which measure changes of location in each plane.

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The neurobiological work on space is one current of thinking in the cognitive sciences. Another is based on the long tradition of speculation, observation, and experimentation about the conceptual foundations of spatial reasoning. Immanuel Kant, for example, argued in an early paper (1991[1768]) that naive spatial reasoning is inevitably based on an egocentric and anthropomorphic basis: we find in the divisions of the body into front and back, and left and right, the fundamental axes of our framework for space. Since then much speculation and empirical work on language, child development, and cognitive psychology has suggested the essential veracity of Kant's presumption. As Miller and Johnson-Laird have put it,

The conceptual core of space probably originates, as Cassirer (1923) and others have maintained, with the body concept—with what is at, in, or on our own bodies. The first spatial relation we learn to use is ego. . . . Piaget and Inhelder (1948) claim that escape from this egocentric space requires considerable cognitive development. . . . The ability to decenter does not displace the egocentric conception of space, but it supplements it. . . . Egocentric use of the space concept places ego at the center of the universe. From this point of origin ego can lay out a three-dimensional co-ordinate system that depends on his own orientation. With respect to this landmark other objects can be located as above or below (ego), in front or in back (of ego), to the left or to the right (of ego). [1976:394–395]

The presumption of the universal basis of this egocentric and anthropomorphic conception of space can be found throughout the branches of the sciences of mind. For example, in the study of language acquisition, it is commonly held that

The child acquires English expressions for space and time by learning how to apply these expressions to the *a priori* knowledge he has about space and time. This *a priori* knowledge is separate from language itself and not so mysterious. . . . The child is born into a flat world with gravity, and he himself is endowed with eyes, ears, an upright posture, and other biological structure. These structures alone lead him to develop a perceptual space, a P-space, with very specific properties. [Clark 1973:28]

Thus, in curt overview, the picture of human spatial abilities coming to us from the sciences of cognition is one in which both the underlying neurophysiology and the conceptual superstructure is egocentric and anthropomorphic in the sense that our naive cognition about space makes primary use of the planes through the human body as the essential coordinates of spatial conception.

CULTURAL VARIATION: ABSOLUTE AND RELATIVE SYSTEMS OF SPATIAL CONCEPTION

There are plenty of clues in the anthropological and linguistic literature to suggest that this picture of uniform human spatial conception is incorrect (Levinson 1996b). But, for the most part, careful comparative investigation is lacking. Consequently, in ongoing work by the Max Planck Institute for Psycholinguistics, a sample of over a dozen non-Western

societies are being intensively investigated using a battery of elicitation tools, experimental techniques, and open-ended participant-observation. The findings are interesting because it seems that in many cultures (as suggested by at least a third of the small sample) spatial conception is organized in a fundamentally different way than expected on the basis of familiar Western languages, and indeed the observations in the Western scientific and philosophical traditions as outlined above.

Whereas the vertical dimension, based on gravitation with all its effects on our balance and stance, emerges as a universal organizing principle for spatial conception, the treatment of angles on the horizontal is clearly underdetermined by any natural force. The cognitive science prediction, as reviewed, is that the solution to finding directions on the horizontal will be to import ego's body axes, so that we can find from ego's point of view an angle "in front" of him or her, an angle "behind," and an angle to the "left" and "right." This proves to be only one solution, our own culturally familiar one. It has the consequence that horizontal directions change with ego's bodily position, and differ from ego to alter. Hence we may call this solution *relative*—angles on the horizontal are found relative to an individual's point of view.

An alternative solution is to fix the directions once and for all, like our North, South, East, and West. It matters not at all *where* the angles or directions are fixed, just so long as everyone in the community adopts the same solution.² Such *absolute* directions, as we shall call them, do not vary with bodily rotation, do not depend on point of view, and effectively remain identical for ego and alter. Compare for example a situation where Bill is standing five meters from a tree: in English I may describe him as behind, in front, or to the left or right of the tree, according to *my* position; but in a language that uses fixed angles, Bill will remain, say, West of the tree regardless of my position. (Obviously, what is West of *me* will vary with my position, although invariant to my rotation; thus such systems *may* be used egocentrically or from a particular viewpoint, but unlike relative systems they need not be.)

It turns out that many languages lack spatial descriptions like the English words and phrases *in front*, *in back*, *left*, and *right*, instead employing terms for fixed or cardinal directions. Such absolute systems are intriguing from an anthropological view for a number of reasons. First, an absolute, arbitrary fixed direction is necessarily a social artifact; unlike the vertical dimension, there is nothing directly in the human body or in the environment that will provide precise fixed angles on the horizontal. True, such systems may arise from abstraction out of seasonal movements of the sun around the solstices, or from prevailing wind directions, drainage of major rivers or overall inclinations of terrain—but they are culturally fixed

abstractions. A child must learn whatever the local system is and treat it as an arbitrary invariant for purposes of spatial reckoning.

Second, it is clear that relative systems contrast with absolute systems in their comparative strengths and weaknesses, and differential utility. Relative systems are good for the handling of arbitrary arrays of chattels from an egocentric point of view: good, for example, for instructing someone how to lay the table with forks to the left, knives to the right. Absolute systems fail here completely: there is no translation of “forks to the left” into a general rule in terms of fixed angles like north or west. On the other hand, relative systems are viewpoint dependent: if the fork is to my left, and you are opposite me, then my fork is to your right. But my knife is, say, west of my fork for both you and me. Further, “west” is a transitive, asymmetric relation good for reasoning about locations (if the cup is west of the knife, which is west of the fork, then the cup is also west of the fork), while “left” is unreliably so. In short, if you are interested in egocentric perspectives on local arrays, a relative system makes sense; but if you are interested in locations in a landscape, or local arrays without an egocentric or privileged viewpoint, then an absolute system has all the advantages. A relative system fits with a culture that promotes individual perspective, that is preoccupied with viewpoint-dependent order—as enshrined for example in domestic architecture or writing systems, symbolisms of left and right, or ceremonial arrangements of chattels. An absolute system permits abstraction away from individual perspective, allowing individuals to become mere points in a landscape (permitting, but not requiring: absolute systems allow insistent use of ego as a reference point—see the companion article by Haviland). No doubt these associations are too simplistic to fully capture the ranges of use of either kind of system, but up to a point they seem to match the characteristics of the societies that utilize them.

LANGUAGE AND COGNITION IN AN ABSOLUTE SYSTEM

Systems of absolute direction are most easily detected through linguistic distinctions encoding fixed directions. These may not at first be transparent: in many cases there is an abstraction from a landscape feature (uphill vs. downhill, or upstream vs. downstream) or meteorological tendency (windward vs. leeward, sunset vs. sunrise), with the descriptive terms retained but with fixed directions intended (not locally uphill, or not windward in *this* particular wind, not the location of sunset at this particular season, etc.). The telltale sign is where, for local arrays of objects on the horizontal plane, descriptions are couched in such larger landscape features (“the cup on the up end of the table” or “the basket to windward”). One may then expect to find instructions like “take the second turning uphill” (rather than “left”) or “move over leeward” (rather than “right”), and so on.

A linguistic system of fixed directions has cognitive implications: speakers must be able to detect the exact angles intended and agree about where “windward,” “upstream,” or “north,” and so on, lies. Indeed the cognitive implications turn out to be far-reaching. We can best explore this with an example.

The Guugu-Yimithirr speaking people of Hopevale, North Queensland, use an absolute system of spatial description to the exclusion of relative notions like “front,” “back,” “left,” and “right.” The linguistic system and its uses are nicely described in the article by Haviland in this issue, which may be read as a companion piece.³ He emphasizes the egocentric use of the system, but it is perfectly normal to use the system in a nonegocentric way, anchored to nonhuman reference points (“north of the river”) or to humans other than the speaker (“north of the protagonist”).

To explore the cognitive implications of this system a number of informal experiments were undertaken. First, we wished to know something about the sense of direction that would be required to allow a linguistic system of this kind to work. One should note too that Guugu Yimithirr speakers expect the linguistic specification of angle to be supplemented by more accurate gestural indications (see again Haviland, this issue). More will be required than merely knowing where “north,” “south,” and so on lie.⁴ For in order to specify somebody’s motion from, say, the current place of speaking toward the local town, a speaker will need to know what angle the local town lies at from the place of speaking. Thus, one’s own location north, south, east, and west of all likely reference points had better be determinable: in short, Guugu Yimithirr speakers need to constantly *dead-reckon* their current position, taking into account distance travelled and constant changes in angular bearings. This we tested by taking ten men out on bush trips to various locations on different occasions, and by asking them to point at a range of other locations differing in distance from 7 to 300 km. In over 120 observations, whether pointing to places frequently or infrequently visited, these men proved highly reliable: the average error was less than 14 degrees or 4 percent.⁵ Similar experiments on Western populations have yielded in contrast often near random pointings; British subjects for example, led 2–4 km into a wood, are quite unlikely to be able to find their way back by a novel route (Baker 1989:101). In contrast, given the very rough terrain, and thus circuitous nature of travel, together with the lack of visibility from most of the questioning points, the dead-reckoning accuracy of our Guugu Yimithirr consultants is indeed impressive. (It compares favorably to those species, like pigeons, known to employ specialized “hardware”—polarized light and magnetoreception—rather than “software”—concepts like cardinal directions—to solve this same problem).

If the linguistic system is to work, this ability to dead-reckon is as it should be. Dead-reckoning clearly requires a constant monitoring of angular

rotation and distance travelled on each leg of a journey. But all this tells us only about *thinking for speaking* (Slobin 1996);⁶ it tells us how one must think if one is to speak Guugu Yimithirr. It does not alone show that thinking *in general* about space is different in kind from, say, the way an English speaker thinks about it. We need some way to probe for how people conceive of spatial arrangements, about how they remember them or make calculations from them, when they are not speaking, but simply acting in space.

To explore these issues a number of experiments were conducted. It was observed that Guugu Yimithirr speakers talked about previous experiences in terms of cardinal directions, thus implying that locations and motions are coded for memory in absolute terms. For example, up to two months after the event, men who had participated in a land-rights meeting in a distant town could remember the disposition of their unfamiliar hotel rooms (with TV to the north of the bed, etc.), matching my records of the time. Various memory tasks were therefore devised to explore this, and we may informally report here on two, conducted on small samples (12–15) of older men (for the full details see Levinson 1997).

How can one know how people unconsciously think about space, what nonverbal concepts are employed to distinguish positions and directions, and what their properties are? Naturally, this is problematic in detail, but in contrast it is not difficult to distinguish memories coded in terms of bodily position like left and right, from those coded in terms of fixed directions like north and south. To achieve this, the simple expedient was adopted of displaying an array with the subject facing north, and then turning the subject 180 degrees around, and testing for memory and inference on arrays displayed while the subject was facing south. Two rooms connected by a door were arranged internally so that they presented the same visual appearance when looked at through the door—thus any tendency to use viewer-centered spatial coordinates should be reinforced by this environment.

In a first memory experiment, a subject facing north was asked to choose between two mirror-image cards—on one there was a large red square to the left (or west) of a blue rectangle, while on the other the red square was to the right (or east). The subject was then led across into the other room, so that he or she faced an identical array looking south, and asked (after about a minute) to identify the card he had previously chosen. Suppose in the first room the subject chooses the card with the large red square to the left (west). Would she or he, now facing the opposite direction, choose the card with the red square to the left (and thus the east, indicating a left/right or *relative* coding scheme for memory), or would she or he choose the card with the red square to the west (and thus to the right, indicating a west/east or *absolute* coding scheme)? Figure 1 should make clear how, given a choice of card A before rotation of the subject, its identification with card D after rotation, indicates the use of an egocentric or

Table 2
Memorizing Chips: Subjects by Majority of Choices.

Group	Orientation		
	Absolute	Relative	Total
Hopevale	9	1	10
Dutch	0	15	15

Hopevale versus chance: $p = 0.0107$ (binomial test, $p = 0.5$ for absolute, relative); Dutch versus chance: $p = 0.0000$ (binomial test, same assumptions); Hopevale versus Dutch: $p = 0.0000$ (Fischer's exact test).

What they show is that while the Dutch control group almost invariably coded in relative terms, a sample of (mature, male) Hopevale Guugu Yimithirr speakers tended to code in absolute terms.

A slightly more complex task, involving both recognition and inference, is illustrated in Figure 2. Here subjects were shown a "maze," described to them as a diagram of an incomplete route. After a demonstration, they were asked to remember the route displayed to them facing north. Then they were led to the other room, and now facing south, asked to choose between three cards which would complete the route. Now in fact two of the cards were identical except that they were rotated 180 degrees, while a third was a distractor. Anyone who mentally rotates the route map with himself will find natural the solution labelled "relative" in the diagram; anyone who holds the orientation of the route map constant in terms of cardinal orientation will adopt the solution labelled "absolute."

As before, the same experiment was run both on a sample of Guugu Yimithirr-speaking men and on a Dutch control group, with the results as displayed in Tables 3 and 4. Once again, the Dutch almost always chose the relative solution, while two thirds of Hopevale subjects chose the absolute solution.⁷

Table 3
Maze Completion: Individual Decisions.

Group	Solution			Total
	Absolute	Relative	Blind	
Hopevale	24	11	1	36
Dutch	3	42	0	45

Hopevale versus chance: $p = 0.0000$ (Multinomial test, assuming $p = 0.3333$ for absolute, relative, blind); Dutch versus chance: $p = 0.0000$ (multinomial test, same assumptions); Hopevale versus Dutch: $p = 0.0000$ (chi-square).

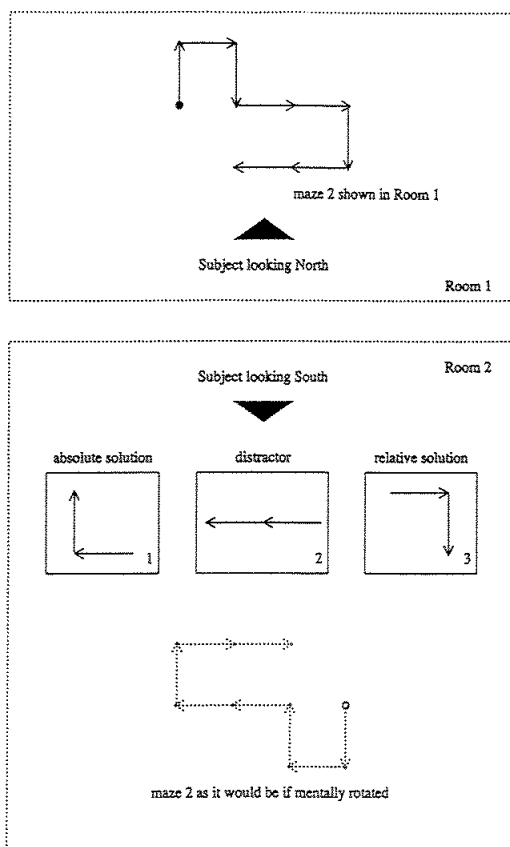


Figure 2. Recognition and Inference: The Maze Task

These results seem to show quite clearly that Guugu Yimithirr speakers tend to memorize and think about spatial arrays in terms of fixed or absolute directions, even when performing essentially nonlinguistic tasks.⁸

Together with much qualitative and anecdotal material (see e.g., Haviland 1993, this issue; Levinson 1997), the results point to a way of thinking about space that is fundamentally different from our own.

The Guugu Yimithirr way of thinking about space is fundamentally at odds with the predictions from many different branches of the cognitive sciences: the expectation has been that universally all naive human spatial conception is based on coordinates based on the human body, which thus rotate with us. Instead, it appears that whatever the biological foundations favoring this solution about how to think about angles on the horizontal, alternative cultural solutions are to be found, and that these can come to structure both verbal and nonverbal conceptualizations of spatial problems.

Table 4
Maze Completion: Subjects by Majority of Choices.

Group	Orientation		Total
	Absolute	Relative	
Hopevale	8	4	12
Dutch	0	15	15

Hopevale versus chance: $p = 0.1938$ (binomial test, $p = 0.5$ for absolute, relative); Dutch versus chance: $p = 0.0000$ (binomial test, same assumptions); Hopevale versus Dutch; $p = 0.0002$ (Fischer's exact test).

Since this investigation conducted in 1992, we have been able to show similar biases in memory and inference in other cultures; for example, using more sophisticated techniques and larger samples we have shown that speakers of a Mayan language that favors use of cardinal-direction-like absolute coordinates reliably employ absolute coordinates in a wide range of tasks (Brown and Levinson 1993; Levinson 1996a; see also Levinson and Brown 1994 for exploration of the anthropological dimensions of the phenomenon).

SOME CONCLUSIONS

There is more than one way of thinking and talking about space. One major cleavage is the opposition between absolute and relative ways of spatial reckoning.⁹ These differ in many fundamental ways: relative systems are viewpoint-dependent, and thus unreliable for inference; absolute systems are viewpoint-independent, and good for inference; relative systems lend themselves to certain activities—for example, laying the table, or reading *no* as distinct from *on*, or describing the route down a system of corridors; absolute systems lend themselves to other activities—for example, finding one's way about in the wilderness, or describing routes where there are no roads or paths, or describing arrays that have no privileged angle of viewing.

The importance of culture is self-evident here. A system of fixed orientations is a social fact in the Durkheimian sense: it is a system that is arbitrary, might be otherwise, but whose existence constrains individuals. It can be learned only through communication. To use it requires constant background computations of a specialized sort that members of other communities may not indulge in at all. It would seem to be as good an example of "linguistic relativity" as one might hope for: a linguistic (and more broadly communicative) system may require one to think in a certain distinctive way. Of course, it is unlikely that there are indefinitely

many, fundamentally different ways of thinking about space, but there are at least two and no doubt more.

Such systems are not as predicted by specialists in the various branches of cognitive science. For the expectation was, no doubt in line with our own Western languages, that the egocentric and anthropomorphic bias built into our neurology and anatomy (as in the inner ear) would directly reflect in linguistic and conceptual distinctions of a parallel sort. Here we see a curious tendency in the cognitive sciences to fail to fully exploit the computational metaphor: the mind is thought about as a computational device with overemphasis on the hardware; linguists, for example, often presume that we may be able to obtain all the observable linguistic variation by means of “parameter setting,” as if what was involved was setting a few dip switches, rather than thinking of distinct languages as running quite different software on the same physical device. Demonstrating that the brain, the computing device, does not alone determine the architecture of cognition, is an important task. We can exploit linguistic and cultural variation to show just that. Studies of spatial thinking across cultures have much to offer here.

I have sketched the beginnings of a dialogue between ideas in the cognitive sciences and the study of everyday thought and practice in other cultures, focused on issues of spatial thinking. I have emphasized how experimental methods borrowed from psychology might be applied even in field conditions to answer questions about styles of thinking, which cannot be easily addressed simply by observing how people talk and act. That is not to deny that careful observation and case study will help to confirm the picture, a point made elegantly in the companion paper by Haviland in this issue. There will not be many of us who would prefer the lean facts reported here over the rich cultural detail he describes. The value of experimental methods are various: they centrally address a very limited hypothesis, and put it to the test with a reasonable range of individuals and tasks (in a way that anthropological interpretations are rarely hazarded), and they allow one to probe where commonsense observation may deliver no clear answer. But in this context they have an additional value: they are the coin of the other realm, and help to establish that what we know through detailed informal case study can be verified or cashed out in terms that any cognitive scientist must accept as evidence. A full-scale dialogue should be conducted on a fairer footing, where not only the nature of what counts as data is mutually respected, but where theoretical presuppositions on both sides are examined for the flaws that each can see in the other’s unexamined line of argument. In that direction, the cognitive sciences have much to learn from us. But the doors need to be opened.

In the long run we need much more sophisticated models of the complex interaction between the biological and cultural contributions to mind

than are currently to be found in either the anthropological or the cognitive sciences. There are currently many interesting developments throughout the behavioral sciences that argue for a coevolution of social and mental abilities (Byrne and Whiten 1988; Durham 1991; Goody 1995; Tooby and Cosmides 1992). What we now need are detailed models that simultaneously explain in what ways the mind is preadapted to expect cultural input, and in what ways cultures are constrained to meet those expectations by limitations on human learning. This is a crucial intersection point for the sciences of the mind, the branches of anthropology, and the theory of evolution. One would hope that psychological anthropology would make central contributions to progress here.

NOTES

1. For a review of the background and the possibilities for field exploration see Levinson 1993.
2. In this respect fixing cardinal directions is an arbitrary coordination problem, as explored in Schelling 1960 and Lewis 1969. Of course the rising and setting of heavenly bodies, locations on the far horizon, the lie of mountains, the fall of rivers and the like will provide useful reference points, and are utilized in many systems. For a review see Levinson 1996a, 1996b, 1997.
3. The basic linguistic and ethnographic work at Hopevale has been undertaken especially by Haviland (1979). I am enormously grateful to him and Lourdes de León for much collaboration and discussion over the years, most recently in the field in July 1992. For further background see Haviland 1993, Levinson 1997 and references therein.
4. Guugu Yimithirr speakers find the location of north and south quadrants, and so on, a trivial, commonsensical matter, whether out in the open on the reserve or inside an unfamiliar building without windows in a distant town. Since the root for, for example, "north" denotes a 90-degree arc, accuracy by pointing is in any case hard to assess (there is no conventional linguistic expression denoting the bisection of the arc).
5. The details of this and the subsequent experiments, together with much associated information and caveat, may be found in Levinson 1997.
6. Actually it tells us a little more: Slobin's *thinking for speaking* denotes a special kind of on-line thinking required just during the process of speech encoding—getting our thoughts into the shape required by a particular language for expression. But dead-reckoning will be a constant background cognitive task required even when not thinking for speaking, in order to have available the information to encode when the time for speaking occurs.
7. Readers will note that in Table 4, the Guugu Yimithirr consultants' tendency toward absolute codings of spatial arrays is here not statistically significant (no doubt due to the sample size)—that is, they might have been randomly switching between absolute and relative strategies (what they are not doing is randomly selecting between possible responses, as shown by the tests in Table 3). But if so, that behavior is already significantly different from the behavior of Dutch subjects, who do not appear to have the absolute strategy available.
8. To minimize the chance that *thinking for speaking* in Guugu Yimithirr was in play, the instructions were given in English. All Hopevale residents speak English, although the subjects for these experiments were all fluent speakers of Guugu Yimithirr who would seem normally to speak Guugu Yimithirr, or mixed Guugu Yimithirr and English, by preference. The current sociolinguistic situation is complex and fluid, with many residents preferring English for many purposes. Obviously bilingualism raises many pertinent further questions, which cannot, unfortunately, be adequately dealt with here.

9. The different spatial distinctions made in language are in fact interestingly complex. For an attempt to unravel some of the distinctions and build the foundations of a typology, see Levinson 1996.

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