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PRIMER FOR THE FIELD INVESTIGATION OF SPATIAL DESCRIPTION AND CONCEPTION

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0. Aims[1]

This pamphlet aims to stimulate the interest of field working anthropologists, linguists and psychologists in issues of spatial conception, and to provide some rough and ready framework and methods for investigation, as tried and tested in the field by researchers affiliated with the Cognitive Anthropology Research Group. The discussion has been kept superficial with minimal theoretical intrusion, and readers who find these matters engrossing should write to the Group for working papers that exemplify the issues and the problems in detailed case studies. Some of these papers, together with introductory texts, are listed in the bibliography at the end; while more detailed references are placed in the footnotes. This pamphlet will be continuously updatedas we accumulate more field experience and ourselves understand the issues more clearly.[2]

1. Why space?

Why be concerned with the study of spatial conception? One reason is that it seems central to human thinking. This is shown on the one hand by the way that spatial thinking intrudes into thinking about almost all other domains: when an intellectual problem can be spatialized, it can be conceived clearly. Hence the special historical

[1] This paper has been produced rapidly in response to an immediate demand for more orienting materials by participants at the workshop on spatial description in Papuan and Austronesian languages, held in Nijmegen Sept 30-October 1, 1991. Later versions will hopefully be less full of flaws and omissions - your suggestions would be most welcome. Meanwhile I have drawn on the collective experience and knowledge of all members of the Research Group, not always with separate acknowledgement - their work will be found in the Bibliography. My thanks to Penelope Brown, John B. Haviland, Lourdes de Léon, Gunter Senft and Jürg Wassmann for corrections and additions.

[2] Reference may also be usefully made to other papers with a similar aim, e.g. 'Institute Project E: Reference', Mimeo, Max Planck Institute for Psycholinguistics, Nijmegen; D. Slobin, (1967) *A field manual for cross-cultural study of the acquisition of communicative competence*, Mimeo, University of California, Berkeley; G. Senft, 'Everything we always wanted to know about space - but did not bother to ask', paper to the workshop mentioned in footnote 1.

place of geometry in the Western intellectual tradition. Hence also the intrusion of spatial metaphors in thinking about time (cf. *before the altar* vs. *before tomorrow*), about kinship (*distant relatives, closest kin*) and social structure (*low class*, etc.), about music and sound (*high notes, flat notes*), about mathematics (*high and low numbers, graphs and curves,* etc.), about emotions (*high, depressed, lonely*), about just about anything (*the ascent of man, the peak of a career, after his illness he went downhill, the horizons of knowledge, his circle of friends, the proper place for respect*). Such metaphorical extensions to other domains proVide clues to the importance of spatial thinking.[3] Developmental psychologists have found too that during the development of the child the acquisition of spatial knowledge plays a key part in forming a foundation for later cognitive development.[4] Anthropologists have noted how humans impose geometrical order on their environment, marking off 'culture' from the randomness of 'nature'.[5] Archaeologists have traced the relation between the evolution of *homo sapiens* and the rise of abstract notions of space and shape as revealed e.g. in stone tools and their distribution.[6]

The centrality of spatial cognition[7] is also shown by the way in which such transfers of non-spatial problems into spatial ones is the basis of modern (and indeed ancient) 'knowledge technology', and hence arguably of the historical rise of the West.[8] A 'knowledge technology' is a technique for manipulating information, for externalizing cognition. The most striking example is pen and paper, and especially of course the alphabet (or other writing system) that renders linear sounds into two-dimensional shapes. But diagrams,[9] matrices, abaci, knotted mnemonics

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[3] For an informal popular account, see Lakoff & Johnson 1980. On the relation between space and time conception, see Traugott 'On the expression of spatio-temporal relations in language', In J. Greenberg, (1978) (ed.) *Universals of human language*, Vol. 3,369-400.

[4] Piaget & Inhelder, (1956). For references to modern critiques, see J. G. Bremner, 'Object localization in infancy', in Potegal (1982).

[5] Cf. E. Leach, (1976), *Culture and communication*, Cambridge University Press, p. 51.

[6] See T. Wynn, (1989), *The evolution of spatial competence*, University of Illinois Press.

[7] The terms *conception* and *cognition* are not (at least by intention) being used here in any 'loaded' way: conception has to do with the formation of abstract, organizing concepts, cognition with the process of thinking and knowing generally. In particular, no association between the term *cognition* and 'innate schema and rule' (somewhat encouraged by the Cognitive Science metaphor of Mind as machine) is intended. On the other hand, of course, it's impossible (however desirable for a relativist 'cognitive anthropology') to slough off entirely the conceptual baggage of two millennia of Westernintellectual tradition, wherein 'cognition' is opposed to 'emotion', is associated with 'knowing that' rather than 'knowing how', and where questions of epistemology are central (as they are to this paper).

[8] See Goody, J. (1977), *The domestication of the savage mind*, Cambridge University Press. Of course a very special spatial technology was involved in Western expansion, namely the marine compass and the marine chart; see C. Ronan & J. Needham (1986), *The shorter science and civilization in China*, Vol 3, Ch. 4.

[9] See e.g. E. J. Dijksterhuis, (1986), *The mechanization of the world picture*, Princeton University Press, pp. 193ff, on the fourteenth century discovery of the graph.

(like the ancient Inca *quipu* or the Iatmul *kirugu*)[10] or tallies, charts, maps, architectural and engineering plans, visual records of land-tenure, are all examples of such spatialized knowledge technologies, which make essential use of a two- or three-dimensional representation of another domain. There are further reasons to be interested in spatial cognition at this particular moment in intellectual history. Generalizing at the level of (at least Anglo- American) intellectual 'fads', we can say that thinking about human nature during the first half of the twentieth century was characterized by fairly extreme empiricism, the view that most significant knowledge is learned by experience; during the second half of the century, it has been characterized by fairly extreme rationalism, the view that most significant aspects of human cognition are innate. Sapir, Whorf, de Saussure, Bloomfield, Wittgenstein, Watson, Skinner and so on (although holding widely variant views in many respects) are characteristic thinkers of the first half of the century; Chomsky, Miller, Johnson-Laird, Marr,Minsky, Fodor, Sperber and so on, are typical of the second half, which has beenmarked by the rise of the 'Cognitive Sciences', a loose confederation of theoretical linguists, anthropologists, cognitive psychologists, computer scientists, neurologists and supporting philosophers.[11] The dominance of rationalism is built on powerful arguments about the unlearnability of certain cognitive structures, e.g. syntactic patterns in language. There is also a growing appreciation of the specialized nature of human 'hardware', and neuro-psychological evidence that the brain is not just a general computing machine, but highly developed for certain tasks (like vision), and underdeveloped for others (like memorizing random sequences).

In an era dominated by rationalist theory and speculation, observations about cultural and linguistic difference tend naturally to be minimized or ignored. Disciplines like cultural anthropology that deal with cultural differences are also to some degree rendered mute by the apparently inconsistent desires to emphasize difference and yet to insist on common humanity. This gives license for cognitive scientists to make over-hasty generalizations from familiar cultures and languages to the intrinsic structure of human thought. One area where this has happened is the study of spatial conception, where the semantics of Indo-European prepositions have been presumed to give us more or less direct access to the structure of innate mental categories. Yet researchers who work on the details of different languages, like developmental psychologists and descriptive linguists, know this cannot be the case; there is far more variety than the current theories allow for. What seems to be missing in general (i.e. not only in the field of spatial conception) from the Cognitive Science paradigm is proper appreciation of one of the most striking specialisms of human cognition, namely its culture-acquiring capacity.

Spatial cognition has been one of the favourite traditional battlegrounds for the rival epistemologies in philosophy and psychology: spatial concepts seem at once

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[10] See Conklin, W. 'The information system of middle horizon quipus' in A. Aveni & G. Urton (1982) *Archaeoastronomy and ethnoastronomy in the American tropics*, New York: Academy of Sciences; and J. Wassmann, (1990) 'Nyaura concepts of space and time' in *Sepik research today*, Basel.

[11] For an excellent popular introduction to the Cognitive Science movement see H. Gardner, 1987, *The mind's new science*. New York: Basic Books.

too abstract to induce from experience, and yet immanent in the physical world we have to learn our way in.[12] It remains a good area in which to rethink the whole relation between the biological and the cultural endowment in human thinking. On the one hand we know that there must be deep structural constraints from our anatomy, neuro-physiology and innate cognition in this area. Vision, motor co-ordination, vertical orientation and so on are achieved partly by specialized hardware'.[13] On the other hand, we now have enough information about cultural and linguistic difference to show that generalizations about how humans conceive of, talk about and operate in space are not going to be easily made.[14] Field-working anthropologists and linguists have a real role to play here by describing systems of language, thought and action in the spatial domain from very different cultural traditions, since despite the long history of philosophical debate, this information has never been thoroughly collected or properly collated. This primer is meant to suggest questions to address, distinctions to be sensitive to, and methods of collecting relevant data in this domain.

2. What is space?

The question 'What is space?' has been a source of endless puzzlement to philosophers in the Western tradition.[15] The Pythagoreans in Ancient Greece thought that space could be equated with air - there was no such thing as empty space. Descartes supported this view of space with the argument that, since only material things have extension, space must be an ethereal 'thing'. Later thinkers took the more abstract view that space was nothing at all, but merely the relations between things. This view, championed by Leibniz aiming his remarks at Newton (who seems to have held a sophisticated space-is-'stuff' view), was opposed again

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[12] For a detailed history of the battles between nativist vs. empiricist theories of epistemology in spatial conception see G. Hatfield (1990), *The natural and the normative: theories of spatial perception from Kant to Helmholtz*, Cambridge, Mass: MIT Press.

[13] Also in all likelihood by specialized 'software', i.e. information processing routines, that have an innate basis but no simple physiological locus. The student of space will find an enormous amount of relevant fact, theory and fiction in the theory of vision. Good starting points are the (instant) classic by David Marr, (1982); the collection by Pinker, (1985), and the textbook by Humphreys & Bruce, (1989).

[14] One highly controversial attempt to relate cultural variation in spatial cognition to 'stages' of Piagetian development can be found in C. R. Hallpike, (1979), *The foundations of primitive thought*, Oxford: Clarendon Press, Chapter 7. The generalizations seem directly falsified by e.g. the data in Haviland (1986), Levinson & Brown (1991); see also Dasen (1984) on Hallpike's misuse of his (Dasen's) data.

[15] We can do no more than allude to this tradition. See e.g. J. C. Smart, (1968) *Problems of space and time*, Macmillan. Perhaps we should all follow Isaac Newton's Precept: "I do not define time, space, place and motion, as being well known to all"; he himself ignored it, however, immediately proceeding to explicate the concepts in 'the Scholium to the Definitions', *Mathematical principles of natural philosophy*.

by Kant, who argued that space could not be reduced to the relations between objects, but is a mental frame of reference independent of objects. Since then, discussions about the fundamental nature of space have played an integral part in the development of Western science (with Einsteinian theories about the relation of space and time) and mathematics (with the development of geometries of multiple dimensions). All of this must have been at least partially stimulated by the curious fact that the familiar Western languages have abstract nouns like English *space* and *place* that immediately suggest various conundrums.[16]

Given these developed explicit modes of talking about space (as for example represented by the infinite Newtonian space extended out along three orthogonal co-ordinates from some arbitrary *origo* or reference point), there is no problem being precise about what a spatial relation is: it is any relation between an origo and a referent that is completely specified by giving co-ordinates in that Newtonian infinite 'box'. But this of course is not how normal individuals think about space, nor how normal human languages encode spatial relations (or not all of them anyway).[17] On such 'etic' definitions, all predicates that involve location, motion or transfer are partially at least spatial predicates - e.g English *wind (around), blow (away), eat, drink, give, gather.*

To find something more akin to a natural semantic or conceptual field, one must 'listen to the language', and indeed attend to the culture in general. For example, English presents us with a set of prepositions, notably *in, at, on, behind, to, from, between, above, below* and a set of complex prepositional phrases like *in front of, to the left of, from the side of, next to*. There are verbs of motion like *come* and *go*, with corresponding doublets like *bring* and *take*, with the tight structural oppositions characteristic of semantic fields. Similarly, there are demonstrative adverbs *here* vs. *there* and pronouns *this* vs. *that*. What makes all these sub-systems belong together? They are all resources that will be employed in answers to *Where?, Where from?* or *Where to*? questions. As far as we can guess, all languages have specialized *Where*? question forms, so this suggests a natural domain while providing a useful heuristic for its boundaries.[18]

There is no reason to think that answers to *Where*-questions in 'exotic' languages will utilize anything like the English subsystems just mentioned. Deictic

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[16] For example Zeno's various paradoxes of place and motion, e.g. 'everything is in a place; therefore a place is in a place, and there is an infinite series of nested places in every place'. See R. M. Sainsbury, (1988), *Paradoxes*. Cambridge University Press.

[17] See Miller & Johnson-Laird (1976) for a summary here.

[18] I have not been able to find any empirical foundation for this assertion; see though R. Ultan, 'Some general characteristics of interrogative systems', in J. Greenberg (ed.) (1978), *Universals of human language*, Vol. 4: 211-48, Stanford Univ. Press. Despite current linguistic treatments, there is no one-to-one correspondence between types of sentence constituent and types of WH-question words; sometimes there are constituents (e.g. English prepositions) that lack corresponding WH-words (no English *whep meaning 'which preposition'), while many WH-words are overdifferentiated (e.g. questioning English adverbial phrases requires specification for time, place, manner - when, where, how). That where questions are (putatively) universal therefore demonstrates the importance of spatial information irrespective of the grammar. See Weinreich, 'On the semantic structure of language' in J. Greenberg (ed.) (1966), *Universals of language*, MIT Press, p. 152f.

oppositions (like that between *this* and *that*) will almost certainly occur, but their semantic basis may be very different from that of their English counterparts. Fieldworkers should be prepared to encounter systematic grammaticalized reference to landscape features, visibility (or audibility) of referent, cardinal points, systems for sub-dividing spaces on analogy to human, animal, house or plant parts, etc. Nor should fieldworkers be dismayed if the boundaries of the domain begin to look ever wider. Questions of shape, for example, are almost always involved in spatial distinctions: English on is opposed to in partly in that on presupposes a planar (two-dimensional) reference point, while in presupposes a three-dimensional container.[19] Some languages have highly developed shape discriminations encoded into nominal classifiers, basic locative predicates or adpositions.[20] For example, a basic distinction is whether objects can be seen to have oriented shapes; in English this is the most complex part of the spatial system, where *by the side of the table* can mean in front of it (because a table does not have an intrinsic front), while *by the side of the desk* means at one of the edges other than its front or back (because those are designated facets).

Thus the student of space is soon involved in the conception of objects generally, and by the parallel chain of reasoning, soon concerned not only with motion description but with the conception of event structure generally. And so far, we have only considered the notion of space as we have access to it linguistically. But concepts of space can also be studied directly, ethologically as it were, by the observation of the physical use of space, whether on the micro-scale as in human movement and gesture or the macro-scale as embodied in architecture and land-use (see section 5.).[21] It is because the subject naturally widens in this way that it has the importance it does; but the first thing the fieldworker has to come to grips with is the underlying conceptual structure of the central parts of the spatial domain, as reflected in language and action.[22]

3. Conceptual parameters underlying spatial descriptions

3.1. *Location*

Until recently it was thought in cognitive science circles, as outlined in 1., that the underlying conceptual intuitive organization of space for all humans was not very

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[19] This is a ghastly oversimplification: see Herskovits (1986).

[20] Take Tzeltal as an example: a large set of verbal roots encode precise shape and disposition; these are then morphologically derived into over 500 numeral classifiers (see the classic study by Berlin 1968) and locative predicates (see Brown 1991).

[21] But as far as I can see, access to alien concepts of space will always have to pass through the filter of language, hence the linguistic bias in this tract.

[22] The extent to which a language and culture does not isolate out an abstract notion of space from the systems of use in which it is embedded is itself one of the important variables in the cross-cultural study of this domain - see e.g. hints in Levinson (1991a), Haviland (1991a:54).

remote from the kind of conceptual distinctions enshrined in English prepositions. For example, we could analyze the conceptual content of x being *in* y as 'part of x is included in a three dimensional region y'; the content of x being *on* y as 'x is in included in the immediate region of the surface of y, and y supports x'; and x being *at* y as 'x is included in the region of y'.[23]

But we now know that we cannot project from English or the familiar European languages directly to the innate 'language of mind'. It has become evident that there are alternative, radically different ways of organizing spatial conception. Whether these form a very limited set of alternatives, or whether we are in for yet more surprises, only further research will tell.

Following Descartes, it would seem that on first principles we must think about the location of a referent in relation to some given origo or reference point. More psychologically, we can think of these as **Figure** and **Ground**, as the item of interest (the Figure) located against the background of the reference point or object (the Ground).[24] There may be various natural psychological constraints, e.g. the Figure is usually smaller, less fixed, than the Ground.[25] Even this, though, is too much to require universally of motion expressions, where origo or Ground specifications may not only be omitted, but not even be presupposed (as in *The ship steamed West*). Very often the Ground is the **deictic centre**, typically the speaker, so that we think about some object as, say, far from, or close to me.

There then arises the problem of how the relation of Figure to Ground is to be specified. The problem essentially consists of limiting the **search-domain**, the region - somehow related to the Ground - in which the Figure can be found. For some purposes it may be sufficient simply to indicate relative proximity of the Figure to the Ground, thus locating the referent or Figure as within (*The station is near the cathedral*) or beyond (*The station is outside the town centre*) some concentric circle around the Ground. In English, deictic demonstratives like *this* and *that*, and deictic adverbs like *here* vs. *there*, partially operate on such a conceptual basis, with the speaker as the Ground. There is a fundamental difference though between a

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[23] This is a simplified version of the analysis given by Miller & Johnson-Laird (1976:384ff), which itself builds on a number of earlier studies. That analysis is constructed out of about a dozen primitives, like REGION, (spatial) INCLUSION, SURFACE, SUPPORT, DISTANCE, etc. (see p. 391-3). For more complexities, see that work and Herskovits (1986).

[24] I have here followed the use of these terms as proposed by Talmy (1983) because of their conceptual simplicity. The Gestalt analogy if taken too far becomes misleading. I would myself advocate another set of terms: **referent** (the thing to be referred to), **relatum** (the 'landmark' object), the **relation** (between referent and relatum) as specified by the spatial predicate and/or adposition - as in:

[The cat]$_{\text{referent}}$ [is near]$_{\text{relation}}$ [the couch]$_{\text{relatum}}$.

The relation normally serves to specify and delimit a **search-domain**, projected off the relatum, such that the referent can be found within it - e.g. is *near* in the above sentence tells us that the cat will be found within a circular space (of small radius relative to the scale of the relatum) around the couch. See Levinson (1991a).

[25] E.g. it is odd to say "The cathedral is behind my bike" instead of "My bike is in front of the cathedral", and even stranger to say "The door is around the key" instead of "the key is in the door". A basic reference here is Talmy (1983), who develops a theory of psychological/linguistic constraints on spatial expressions, especially as encoded in grammaticalized elements.

concentric system focussed around the speaker (this-near-me, that-far-from-me), and a multiple-centred system focussed around speaker (this-near-me), addressee (that-near-you) and perhaps other participants (that-near-them). A system of multiple centers with different degrees of proximity to each can yield a useful set of delimited search-domains, but generally speaking concentric circles around the Ground do not provide the kind of delimited search-domain adequate for location-specifications. What is lacking of course is any specification of **angle**, within the 360 degrees of arc around the Ground. That is no doubt why many deictic terms are normally supplemented by **gesture**, which is one of the best possible solutions to the problem of angle-specification since gesture is an analogue system (offering indefinite subdivisions of arc) while any linguistic solution will be digital (offer- only a small set of broad angles or points). Although a gestural system offers excellent design features for face-to-face communication, it will fail absolutely wherevisual contact cannot be established; but beyond that, it is a solution to a communication problem, not a solution to the conceptual problem, namely, how an individual should conceive of angles, remember them, and find objects or destinations utilizing them.[26]

So how do humans conceive angular distinctions? One basic strategy - but curiously not the only one - is to operate with an abstract notion of space, laid out by three co-ordinates, one for each dimension. The design problem then is how to fix these co-ordinates in such a way that humans can perceive and determine them for purposes of action (e.g. finding their way) and linguistic description (e.g. telling someone else where something is). There turn out to be a lot of different answers to this design problem which different languages and cultures exploit. The least variable element in these solutions is to fix one co-ordinate vertically, as convincingly suggested perhaps by the gravitational force which is reflected in our upright posture.[27] That leaves the essential problem as the need to establish angles on the horizontal dimension.

At this point solutions divide into two families, which following Isaac Newton we can call 'absolute' and 'relative'.[28] 'Absolute' solutions set up fixed angles that never change, while 'relative' solutions find a way of assigning an angle from some facet of the Ground to the Figure. Our familiar European system belongs to this last class, and here the solution is to take the prototype Ground to be ourselves - that

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[26] This is not to suggest that one could not remember the precise direction of a gesture (Guugu Yimidhirr speakers have to do that, see below), but rather that the memory would require an external frame of reference that specifies angles. This Kantian theme can't be pursued here, but see Levinson, *in prep* 'Immanuel Kant among the Tenejapans'.

[27] Even here though it can be moot whether terms glossing 'up' and 'down' actually have vertical prototypes in those mountain cultures where these have most frequent application to the mountainside. See Levinson & Brown (1991). H. Steinhauer ('Spatial notions, with reference to some Indonesian languages', paper delivered to the workshop mentioned in fn. 1) shows that in Blagar the 'up'/'down' distinction is fundamental to location-description on the (near or actual) horizontal. See Shepard & Hurwitz (1985) for psychological comment here.

[28] The reader is warned that there is another sense sometimes given to these terms in the philosophy of space, where 'absolute space' describes the view that space is ethereal stuff, while 'relative space' is the Leibnizian view that space equates with relations.

is to make the deictic uses central. Then we can use the asymmetrical nature of the front/back plane of our bodies to define one of the horizontal co-ordinates, letting the orthogonal left/right plane define the other. Now we can specify the location of an object not only as near or far from ourselves, but also as lying in a specified angle or quadrant projected off our bodies (*the man in front of me/to my left/behind me* etc).[29]

What happens in such a system, with its angles projected off our bodies, when the Ground or reference point is not a human? We analogically map fronts, backs and sides onto objects, so that we can now say *I left my car in front of the cathedral*, or *You'll find the book beside the phone*. The mapping is sometimes absolute (*the front of the cathedral* is fixed once and for all), sometimes deictically relative (*behind the table* means on the side opposite the speaker). Moreover, the mapping is sometimes mirror image: *at the left of the cupboard* means at *my* left of the cupboard even though *at the front of the cupboard* means at *its* front. But regardless of the details about how such designated facets are assigned to particular Ground objects, they then provide a way of projecting an angle outwards towards the Figure. So we are provided with the means to specify the location of almost any object with respect to any other Ground object, including ourselves.[30]

We have to say 'almost' because some objects, like balls or even trees, may resist the non-deictic assignment of facets.[31] In that case, we may as before use a non-deictic Figure and non-deictic Ground, but take the specification of *angle* from the deictic human frame. So for example, we say *The boy in front of the tree*, meaning the boy (Figure) on the side of the tree (Ground) towards my front (deictic angle). This seems to be based on what Clark (1973) calls the **canonical encounter**: I encounter the tree just like an interlocutor who faces towards me, so its 'front' is assigned analogously. But this assignment is, in cross-cultural perspective, arbitrary; we could as well imagine the canonical situation as travel in single file, with you ahead of me. In that case, by analogy, the 'front' of the tree is what in English we would call its *back*. This system is used, e.g. in Hausa.[32]

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[29] The basic reference here is Clark (1973), but it is also all in Kant (1768), *Von dem ersten Grunde des Unterschiedes der Gegenden im Raume*. Many ideas here were also prefigured by Bühler (1990 [1934]).

[30] For more details see Lyons (1977), Fillmore (1975), Miller & Johnson-Laird (1976), Herskovits (1986).

[31] Psychologists talk in terms of 'featured' and 'non-featured' objects, the latter offering no intrinsic orientation. Note that orientations can be assigned on different principles, typically on analogy to the human body (*the front of the statue*), on the basis of primary mode of access (*the front of a cupboard or building*), or on typical direction of motion (*the front of a car or train*). This shows that the notion 'featuredness' is not immanent in the object, since a ball in motion now has a 'front' as in *John ran in front of the ball in order to stop it*. The 'features' are in the eyes of the beholder (or at the very least lie beyond the object in the 'schema' of the entire situation).

[32] C. Hill, (1982). 'Up/down, front/back, left/right: a contrastive study of Hausa and English.' In Weissenborn & Klein, pp. 13-42. There are hints of such a system in some Malayo-Polynesian languages, where one talks of the future as 'the rear' (see R. Blust, 'Semantic change and the conceptualization of spatial relationships in Austronesian languages', MS, contribution to the workshop noted in footnote 1).

Not all relative systems establish horizontal angles by primary reference to the human body. We could for example see everything on analogy to a quadruped, so finding not only fronts and backs, but flanks, horns and tails.[33] Even if we use the human body as metaphor, we could avoid making the egocentric deictic usages primary, and avoid designating angles primarily on just the front/back, left/right planes. If we have assigned legs and tails and horns to inanimate objects, why, we can project out angles 'legwards' or 'tailwards' or 'hornwise', thus specifying finer angles radiating out in many directions from the Ground object. Many Mesoamerican, Oceanic and African languages would seem to use body parts that work this way in locative descriptions.[34] One should note that the assignment of named facets to an object may not be based on shape - indeed in these systems function and canonical orientation may be the most important criteria: e.g. the 'teeth' of a knife names its sharp edge, the 'foot' of an axe may label its handle even though it normally rests on its 'head' when not in use.

Let's turn now to the other family of systems, the 'absolute' ones. These establish angles that are fixed, irrespective of properties of the Ground or Figure object. Cardinal point systems are perhaps the easiest to grasp. Once we have designated North, that's it once and for all. Then we can dispense with all the complexities of assigning oriented facets to Ground objects.[35] We don't need them because we can specify where the Figure is relative to the Ground by giving an absolute angle, say North-West. Some languages use such elaborated systems to the exclusion of any of the 'relative' systems just outlined; e.g. Guugu Yimidhirr (an Australian language) employs a system of cardinal edges (oriented somewhat differently from our compass points) to the exclusion of any angles projected from properties of Ground objects. Thus, apart from a locative case, there are almost no locative 'prepositional'-like concepts encoded in the language at all.[36] More often, no doubt, languages exhibit some mix of systems.

'Absolute' systems have an elegance and simplicity in stark contrast to the *ad hoc* attempts to project angles off Ground objects that characterize 'relative'

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[33] Such seems to be the case for the Nilotic languages. See Heine (1989).

[34] See e.g. Friedrich (1969), MacLaury (1989). For Oceanic languages see Bowden 1991, for African languages see Heine (1989). Not all body-part systems though involve such projected regions - see the discussion of Tzeltal below.

[35] A curiosity is that many cardinal point terms are in fact etymologically derivative from terms for oriented facets. For example, the Indo-European terms generally derive from conceiving oneself as facing east: then 'in front' = east, 'left' = north, 'right' = south, and 'behind' = west. C. Brown (1983) argues for a universal tendency for the sources of cardinal directions to be 'front', 'back', 'up' and 'down'. R. Blust provides further evidence of this from Austronesian ('Semantic change in the conceptualization of spatial relationships in Austronesian languages', paper contributed to the workshop mentioned in fn 1.). My own guess is that the 'front', 'back' terms (the ones from oriented facets) are not in fact universal sources at all, however general.

[36] See J. Haviland, (1979), 'Guugu Yimidhirr: sketch grammar' in R. M. W. Dixon & B. Blake (eds.) *Handbook of Australian Languages*, Vol 1:25-180, Australian National University Press. See also elaborations and qualifications in Haviland (1986), Levinson (1986). For another even more thorough-going 'absolute' system see N. Evans, in prep., *A grammar of Kayardild*, Melbourne University MS.

systems. Their single design flaw is that they require some preternatural ability to determine the agreed fixed angles, some remarkable sense of absolute orientation. Without a compass, how do the Guugu Yimidhirr speakers maintain the exact knowledge of where their cardinal edges lie? We simply do not know; they are not star gazers, their territory presents no simple angular clues, and in any case they navigate off beaten tracks often in dense scrub. A mental solar-compass, with seasonal corrections for azimuth, is the most likely fix, supplemented with local knowledge about seasonal winds and the like. Dead-reckoning purely by angular velocity (that is, knowing where you are by virtue of always knowing how many degrees you turned to the left or right) would alone lead to accumulated error and can not be the sole system of navigation employed by any animal.[37]

Most cultures that employ 'absolute' reckoning systems find a simpler but more fallible solution. They designate an angle by reference to some distant or overall feature of the landscape or environment. For example, the Tzeltal-speaking Mayan Indians of Tenejapa live in a series of parallel valleys in southern Mexico that fall steeply from South to North. 'Uphill' then comes to designate not only an incline, but a fixed angle on the horizontal, namely South, and 'downhill' designates North as well as describing a fall in the land.[38] The orthogonal or 'traverse' comes then to mean East and West (not verbally distinguished). Their neighbouring Tzotzil-speaking Zinacantecos live in an area where the land falls steeply away to the West, so they have rotated the system 90 degrees.[39] Members of both communities when travelling outside their valleys can use the system absolutely, without recourse to the landscape, but in the case of the Tenejapans anyway that is clearly what normally provides the 'fix'.

Systems that obtain the 'fix' from local landscape features are fallible outside a local territory. For example, the widespread Austronesian system of 'towards the mountains' vs. 'seawards', when utilized on a small island will yield constantly changing angles as one circumambulates the island.[40] This is notoriously the case on Bali where what seems to be a cardinal direction 'north' when talking on the

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[37] See B. McNaughton, L. Chen, E. Markus, "Dead reckoning", landmark learning, and the sense of direction: a neurophysiological and computational hypothesis'. *Journal of Cognitive Neuroscience*, 3 (2):191-202.

[38] Some writers (e.g. Shepard & Hurwitz 1985) have thought there might be some 'natural' association between North and 'up'. But even medieval maps of the Northern hemisphere had East at the 'top', hence our word *orientation* (cf. Brown 1983 who thought the association was an early modern diffusion from the West).

[39] This is not meant to suggest the priority of the Tenejapan system - it would require a lot of work in comparative Mayan to establish the orientation of the relevant proto-forms in this and other branches of the language family. There is evidence that ancient Mayan glyphs for 'zenith' and 'nadir' secondarily referred to north and south respectively; if so the Tenejapans have revolved the system 180 degrees in line with the local landscape; see. B. Stross, (1991) 'Classic Maya directional glyphs' *J. of Linguistic Anthropology*, 1(1):97-114.

[40] B. Nothofer, 'Some notes on the four cardinal points in Sundanese and Javanese', paper to the workshop mentioned in footnote 1.

south side of the island becomes 'south' when talking on the northern side (since it has primary reference to the central mountains).[41]

For that reason terms that belong to 'absolute' systems should not be too quickly equated with Cardinal Points. Another reason for caution is that our familiar four-term system (North, South, East, West) would seem to be not particularly widespread. Sometimes, as in some Austronesian languages, one may find two pairs of terms (seawards/mountainwards; west monsoon/east monsoon) which are by no means guaranteed to be orthogonal to one another - the angle designated 'inland' may vary over a small region, while the prevailing seasonal winds may give absolute fixes over a vast area.[42] Sometimes, as in the case of Tzeltal, one or other of the orthogonal dimensions may be bi-directional, yielding a three-term system. Even a proper 4-term cardinal point system may have an unusual interpretation; in Guugu Yimidhirr the terms label 'edges', and thus give us labelled 90 degree quadrants not labelled points; in Walbiri, the term glossing 'West' means a Westerly deviation off the North-South line, so it could designate a point, say, only 25 degrees West of North.[43] Notice too that in principle, if real points are chosen, there is no limit to the number of them; island peoples for example might employ an absolute system of points fixed by reference to other islands, wherever they happen to lie on the horizon. Certainly the navigators of Puluwat use such a system, combined with a set of absolute points fixed by the rising and setting points of stars on the horizon.[44] These define a set of thirty-two compass points, somewhat unevenly distributed around the 360 dégrees of our compass. Other Oceanic navigators used directions of named seasonal winds, to fix from 32 points (Cook Islands) to three 120 degree 'quadrants' (Fiji)[45] and indeed 'wind roses' are the origin of our European compass roses. Tzotzil-speakers of Zinacantan use such a system of multiple points with different angles in between, here based on the local towns and socially important landmarks and regions in a 60 mile or greater radius of their territory.[46]

One should note that 'absolute' systems lend themselves to a series of distinct kinds of usage. On one way of thinking, one needs two points to fix a line that can then be projected to the angle. One point is the object to be referred to, the Figure. The other we have been calling the Ground. The Ground may be equated with the

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[41] This was described by Gregory Bateson, but I can no longer find the reference. See also S. Adelaar, 'Terms for cardinal points in Malagasy and West Indonesian languages', paper to the workshop mentioned in footnote 1.

[42] See F. Ozanne-Rivierre, 'L'expression linguistique de l'orientation dans l'espace: quelques exemples oceaniens', *Cahiers du LACITO*, 2, 129-55; also Adelaar, Nothofer, op. cit.

[43] M. Laughren, 'Directional terminology in Warlpiri', Working papers in Language and Linguistics, Tasmanian College of Advanced Education, Launceston, No. 8, December 1978.

[44] Thomas Gladwin, (1970). *East is a big bird.* Harvard University Press.

[45] D. Lewis (1972). *We, the navigators.* Honolulu: Hawaii University Press, pp. 73ff.

[46] L. de Leon (1991b). Nowadays even Mexico City a thousand kilometers away participates in this system as a directional point (the Zinacantecos have at least since Aztec times been long range traders).

speaker or some other participant, in which case the usage is deictic (as in *The ship is North of me*). Or it may be some other object or person, in which case the usage is non-deictic (as in *The ship is North of the island*). But there is another way of thinking: sometimes when describing motions or alignments, there is no implicit or explicit Ground at all; for then one is talking of an absolute vector (as in *The ship steamed North*; *The mountain range runs North*). Such systems are also likely to acquire frozen usages whereby say *North* comes to designate some culturally important place regardless of its location with respect to the speech event. Thus the fieldworker must be prepared for strikingly different uses of the same system.

How else could one conceive of locations? One way would be to ignore altogether the possibility of constructing an abstract space with designated angles between Figure and Ground, and just plump for a series of addresses (as in *John is in London* or *Sue is at Woolworths*). Place names work this way of course. Could a natural conceptual system for space work almost entirely this way? An infinite array of addresses would tax both memory and lexicon. But could we have a generative system, i.e. a compositional system of place-names, so that the locations can be designated by building up the names from a limited set of meanings?[47]

Tzeltal, again, provides a partial example of such a system. Suppose we can map onto any object a division into named parts or regions, such names drawn from a finite set. Then since in terrestrial conditions objects are normally in contact with other objects, we can specify the location of one object as at or in the designated region of another object.[48] To achieve this, we must have some system for mentally 'dismembering' the reference object into its constitutive parts in a systematic way.[49] In Tzeltal this is done by analogically mapping a human or animal body onto the object. Then using the one all-purpose preposition in the language (meaning 'to, at, in, from' etc.) the Figure can be located as within the region of the, say, leg-part of the Ground. The Ground may be a large object, like a house or yard or mountain, and its partition into 'feet', 'ears', 'mouths' etc. successfully serves to locate the Figure. The key characteristic of such a system is that the Figure and the designated portion of the Ground must be actually in contact or actually contiguous: the Figure is described as 'at' a part of the Ground - no projections into a three-dimensional void are involved.

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[47] Cf Dixon (1972), *The Dyirbal language of North Queensland*, Cambridge University Press, p. 57: "The Dyirbalngan have a multiplicity of place names - for every bend in a river and dip in a ridge - often in terms of the type of tree that grows there, the rock formation, etc. It is frequently difficult to distinguish between an institutionalized place name, and simple reference to a particular object at some locality."

[48] 48. Note incidentally that the so-called 'topological prepositions' of e.g. English (*in, at, on*) rely on such simple adjacent co-presence of Figure and Ground, as opposed to the 'projective' prepositions (like *in front of*) that indicate the location of the referent in a region projected off a Ground object at a certain angle. Incidentally, mere adjacency may not be sufficient reason to select an object as Ground, e.g. it may be too small or mobile to meet Talmy's (1983) constraints.

[49] *Vision theorists claim we must do this for visual object recognition, and have suggested various* algorithms; e.g. Marr (1982) posits a mapping of generalized cones onto objects.

Such systems may be common, and they might alone be sufficient for all location-specifications, but we do not know. Tzeltal, and its closely-related neighbour Tzotzil, suggest that such systems might develop into ones where the same terms come to have projective usages. Thus in Tzeltal a sentence glossing 'the cup is at the flank of the pot' designates contiguity between the cup and that part of a pot that can be isolated as its 'flank'; but in Tzotzil, the cup might lie in a region projected some way off the pot (as in English *by the side of*). Such meaning changes may be typical of grammmaticalization processes in the spatial domain, whereby a metaphor (here one based on body-parts) is extended to denote first a part and then a region, simultaneously becoming the source of a closed class of grammatical morphemes.[50]

And there are no doubt yet further linguistic and cultural solutions to the problem of how to specify the relation between Figure and Ground, solutions which *a priori* speculation alone fails to reveal to us. As a final important caveat one should note that we need systems of spatial conception for quite different tasks: for analyzing our visual field, for coordinating our motor system, for remembering locations and navigating to them, and finally for communication about location. It is important to see that these systems may not be congruent. For example, it is conceivable that a communication system might in effect partially circumvent the problems of abstract spatial description by developing other means of referent identification, by specifying *how* a thing appears instead of *where* it is. Some languages (e.g. the Mayan ones) certainly have elaborated systems for describing shape and disposition rather than location *per se*, so that locative phrases necessarily carry a great deal of shape/disposition information to aid referent identification. But clearly a linguistic solution to the problem of specifying a referent (which may e.g. favour precise shape- over location-specification) carries no necessary implication for the parallel cognitive systems of e.g. route-finding or navigation, where spatial 'mapping' must remain predominant. Judging from what is known about mammalian orientation and navigation systems,[51] it may well be that multiple cognitive systems for space are run in parallel, each cross-checking on the other.[52] Particular cultural systems may then select, develop and specialize on the basis of a subset of these systems.

It will have been noted that systems that specify a location directly in terms of an orientational or partonymic property of the Ground object, presuppose some kind of classification of object-shapes, that is some kind of *naive geometry*. It has

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[50] See e.g. Svorou (1986), Heine (1989) or Bowden, (1991:Ch.2) for ideas here. The suggestion is that as a human body-part comes to be generalized, first to parts of other objects, then to associated regions, so the grammaticalization proceeds from noun to genitive modifier to adposition to bound affix.

[51] A good lay introduction is T. H. Waterman, (1989), *Animal navigation*. New York: Scientific American Library.

[52] All the different senses, with their distinct neurology, clearly participate in spatial cognition, even if the visual sense is predominantly important for humans. In addition to the traditional five senses, there is also the inertial and gravitational information provided by the vestibular system, and the control and memory system for kinesthesis (motion). All this information must somehow be coordinated and related to the various kinds of mental 'map' and co-ordinate system involved in utilizing an ecology.

been proposed that naive human geometry is always essentially topological rather than Euclidean, i.e. that the underlying notions do not involve concepts like 'parallel' or 'orthogonal' or 'longer than' and the like. However, this itself turns out to be a language- and culture-specific variable - some languages, for example, clearly encode precise Euclidean notions throughout their locative system.[53]

The following figure sketches the distinctions we have been able to see so far.

[53] For the claim that natural languages encode only topological features see Talmy (1983); for a counter-example see Levinson (1991a). Talmy's claim is restricted to the closed-class 'grammatical' elements of the language, but even here is quite clearly falsified by e.g. the English preposition *opposite* which encodes an orthogonal, let alone by Kayardild demonstratives that encode cardinal point quadrants (see Nick Evans, in prep., *A Grammar of Kayardild*, University of Melbourne.) Nevertheless, Talmy's claim is, interestingly, relatively true for English and relatively false for say Tzeltal, and therefore a useful point of cross-linguistic comparison. It might prove interesting to study the relation of such linguistic differences to the geometry of ornament and architecture.

RELATIVE ANGLES: systems with some subset of:

(a) *deictic and anthropomorphic centering* ('in front (of me)', etc., plus *projection onto objects* and other persons ('in front of the tree'):
different projection systems -
(i) aligned projection (e.g. Hausa 'back of tree'= Engl. 'in front')
(ii) confronting projection (e.g. English 'in front')

(b) *'intrinsically' oriented objects*, with (or without) regions projected off oriented facets; facets conceivedon analogy to:
(i) anthropomorphic body-parts ('head' (= up), 'left', 'right' etc.
(ii) quadrupedal body-parts 'tail', 'horn' etc.
(iii) house-parts, 'ridge', 'pillar', etc.
Facets assigned on the basis of:
(i) shape;
(ii) canonical orientation (e.g. 'head' of fallen bottle); actual orientation ('top (side)')
(iii) function (e.g. 'teeth' of knife)

ABSOLUTE ANGLES: systems with some subset of:

(a) finite *angular divisions*: quadrants, 'tridrants' etc.
(b) *n-independent axes*: e.g. inland/sea, monsoon X/Y
(c) *n-points*: e.g. windpoints, horizon points, etc.
Various usages:
(i) with deictic Ground
(ii) with non-deictic Ground
(iii) vector (no Ground)
(iv) sociocentric (frozen reference)

LANDMARKS & PLACE NAMES: some system for generating unique *location-specifications*

(a) general description
(b) partonymic division of objects/regions

Figure 1. *Distinctive Kinds of Location Conception*[54]

3.2. *Motion*

Motion can be conceived of as traversing through time a line between point A and point B. In that case, just like the English word *between* presupposes two reference points or Ground objects, so *The ball rolled away from me towards the tree* might be held to describe the Figure (the ball) as moving from one reference point, the

[54] Actually, the usages indicated under 'absolute angles' may be more various still; e.g. the absolute angle may on occasions be deictically determined by reference to the speaker's frame! See Levinson & Brown, 1991.

source (the speaker), towards another, the goal (the tree). The sentence *The ball rolled away* omits both source and goal, yet presupposes the source, but does not so clearly presuppose any goal. Further, *The wind was coming from the north* does not have anything to do with a location of origin (conceived of as a place) or a point of arrival; it rather describes a pure vector, i.e. a direction and (here presupposed) a velocity. In any system that fixes horizontal angles absolutely, as described above, verbs of motion do not necessarily presuppose points and places at all. Thus although there may be (ignoring the associated velocity) a mathematical equivalence between a vector and a set of places in a co-ordinate system, a natural language expression like *heading north* is general over an infinite set of paths through space - the vector is not anchored in (a co-ordinate) space at all.

If we think about motion in terms of potentially unanchored vectors, then the conceptual problem is how to fix the angle of direction. Assuming that gravity universally suggests 'up' and 'down' as natural directions, the problem remains (as in location-specification) how to fix angles on the horizontal dimensions. One solution as before is to utilize absolute fixed angles (whether conceived of as 'north', 'windward', 'uphill', 'towards the monsoon' or whatever). Another is to anchor the motion-specification by specifying some points or places traversed. Specifying one point will not of course suffice - but it may already be sufficient for some descriptive purposes: *come* and *go* describe (very roughly) radial motion in any angle towards and away from the place of speaking. If we add a further point, as in *She is coming up behind you*, we get an angle, along the line from me to you, and so on, e.g. *He came through Amsterdam on his way to Moscow* fixes an Eastern direction of motion.

Such ways of thinking may be important in conceptual systems which are generally based on absolute angles of location and motion. In other systems, like our own, another way of thinking about motion is central, and that is to focus on Goal and Source and other places regardless of angle. Here a motion is more obviously an anchored pathway, which we can think of as a sequence of places with associated times of traversal.[55] So if we let p_n be such a place/time pair, a path P consists of an ordered sequence $<p_i, p_{j..}>$ of successive points of time with the associated locations at each point. We need in addition to designate some very special places, e.g. the place of speaking, the beginning of the motion - the Source, and (for intentional agents in motion) an *intended* Goal. We may also need notions like the Focal Place, the place we are thinking about.

Then we can specify special kinds of trajectory, e.g.:

(a) where the first place p_1 is the location of the speaker at the time of speaking; i.e. the Source is deictic, as in the verb *go*;
(b) where some later (often the last) place in the sequence, p_n, is the location of the speaker at the time of speaking; i.e. one of the traversal points is deictic, as in *come*;
(c) where the last place in the sequence is the Goal, as in *arrive*;
(d) where some place other than the first and last is the Focal Place, as in *pass through*.

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[55] This account is based on Haviland (1991a:50ff), which in turn exploits model-theoretic work by Verkuyl & Zwarts.

(e) where the Goal (or Source or Focus)) has certain topological or geometrical properties, as in *enter* (or *exit*, or *go through* (e.g. a tunnel)).

Many languages have sets of motion verbs that can be analyzed in terms of a more fully elaborated semantic system of this kind (see e.g. Haviland 1991a on Tzotzil).[56] These verbs in turn often form the conceptual basis for intuitive understandings of other domains. Motion can be thought of as a directed arc, an 'arrow'; so of course can time - and thus it is natural that motion conception provides the primary metaphor for temporal conception.[57] Aspectual auxiliaries and tenses are often derived from motion verbs (as in the English periphrastic future *I'm going to do it*).

One final point to note is that there appears to be cultural variability in the degree to which location- and motion-specification overlap conceptually and linguistically. Talmy (1983, 1985) claims that natural languages tend to collapse the two, so that e.g. the single notion 'across' suffices for both *He went across the river*, and for *The bridge lies across the river*. This is certainly not invariably the case; e.g. Tzeltal encodes these two notions differently, and in general keeps location and motion description conceptually separate.[58]

3.3 *The larger picture: space, place, mental maps and the cosmos*

Earlier we asked "what is space" and provided some operational definitions. But it is interesting to ask to what extent an abstract notion of space is immanent in different cultural forms, from language to maps. The notion of 'place' is perhaps simpler than the notion of 'space' (Aristotle tried to reduce 'space' to the sum total of all 'places' occupied by bodies), yet there are certainly languages that directly encode no such abstract concept.[59]

One may be able to find some abstract notions of space in the nature of mental maps. These seem to be conceivable in different ways, e.g. as a mental journey through three-dimensional space, or as a bird's eye view of terrain, a

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[56] See also Haviland 1986 for a similar treatment of adessive and abessive nominal cases in an Australian language.

[57] The three dimensions of location specification do not map so directly into the single dimension of time (e.g. we don't so readily say *above Thursday* or even *near Thursday*); but single angles on the horizontal location can also be fertile sources of temporal metaphors as in *before* and *after*. Since such angles in Tzeltal are derived from the vertical tilt of the land, there one can in effect say 'up(hill) of the festival' meaning 'after the festival'! But superfluity of dimensions does not seem to be a serious impediment to the utilization of the spatial metaphor - which runs counter to the adage that metaphorical domains are usually simpler than the domains they model.

[58] See P. Brown & S. Levinson (1990) 'Recentering in Mayan spatial description', MS., Brown (1991), and Levinson (1991a).

[59] e.g. Tzeltal; there is a term *y-awil* ('it's place') for 'proper storage place' or 'place reserved for', but not an encoded notion of the place occupied by an object. In Blagar there is a term *bil*, that denotes 'place' but also 'garden', 'situation', 'weather', 'season' and 'time' (H. Steinhauer, 'Spatial notions, with reference to some Indonesian languages', paper delivered to the workshop mentioned in fn. 1).

two-dimensional image.[60] Either way, the space could be thought of as itself oriented with respect to absolute angles (as in our conventional paper maps) or merely as sets of bundles of distances and relative angles between three or more landmarks (as in some early medieval charts). These have different computational properties: each time you add a landmark in the latter system, but not the former, the information increases exponentially.[61] Alternatively, the space may be thought of on analogy to some familiar shape, e.g. a human body[62], a snake or a house[63].

Most if not all cultures offer some overall spatial scheme, some model of the cosmos, instantiated in myth, ritual or art, and therefore discussed below under non-linguistic expressions of spatial conceptions. Here we merely note that these overall spatial schemas would be worth examining for their underlying spatial properties. It would also be worth making a systematic comparison of such schemes. Many of these schemes are quite literally ethnocentric, so that one's own territory lies at the centre of the world. But are they all, excepting our post-Copernican world? Some are square, some circular, some bounded by known natural barriers; some are horizontal, some slope downward. Many have layered levels, with worlds below, or the earth may be conceived as floating upon the deep. At the very least some interesting geometric notions lurk among these Frazerian butterflies, which are therefore certainly worth collecting.

3.4 *A note on language and conception*

Readers may have already noticed that we are relying heavily on linguistic distinctions to give us insight into conceptual distinctions; yet at the same time, we have pointed out that one cannot leap from linguistic distinctions to the 'language of thought'. What kind of relation between language and conception is envisaged?- The question is, needless to say, fraught. Since the demise of strong claims about linguistic relativity,[64] the subject is often either circumvented, or it is assumed

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[60] See C. Linde & W. Labov, (1975), 'Spatial networks as a site for the study of language and thought'. *Language* 51, 924-939. They found that 97% of a large sample of New Yorkers described their apartments in terms of a tour rather than an abstract layout, a tour which almost always had a certain form (start at the front door, describe branching routes by recurrent leaps back to the branching node, etc.).

[61] See B. McNaughton, L. Chen, E. Markus, "'Dead reckoning", landmark learning, and the sense of direction: a neurophysiological and computational hypothesis'. *Journal of Cognitive Neuroscience*, 3 (2):191-202.

[62] As suggested by the ancient Delphic *omphalos* 'navel of the world', or by the Yupno visualization of their valley as the prone figure of a god (Wassmann 1991).

[63] See C. Hugh-Jones, (1979:241ff) for detailed descriptions of the cosmological associations of an Amazonian people. Also Hanks (1990).

[64] See e.g. E. Rosch, 'Linguistic relativity' in P. Johnson-Laird and P. Wason, (1977), *Thinking*, Cambridge Univ. Press; J. Lucy, (1985), 'Whorf's view of the linguistic mediation of thought' in E. Mertz & R. J. Parmentier (eds.) *Semiotic Mediation*, Academic Press, 73-97; J. Gumperz & S. Levinson, 'Rethinking linguistic relativity', in press, *Current anthropology*.

without demonstration that the differences between the semantic structure of languages are relatively small, allowing translation into a universal conceptual level, the 'language of thought'.[65] One of the reasons for studying a domain like space is that it may throw light on this difficult, but not unstudiable, subject.

It is quite clear for example that an absolute system of location-specification has entirely different cognitive consequences than one based on a relative system. An absolute system requires a user, first, to be absolutely oriented at all times. This in turn may require constant background computations of a special sort, using inertial navigation, landmark sightings, observations about winds, etc. Secondly, it will not be sufficient for a user of such a system just to know how he himself is oriented; one will also need to know what the absolute angles are between all significant points of reference, landmarks and locations (otherwise I will not be able to describe Bill as walking North from A to B, etc., as these systems require). Thirdly, one's own angular relations to all those reference points must be constantly updated as one moves. Fourthly, every scene or event that might need to be recollected for information processing or communication must be memorized with the absolute angles of all significant objects exactly specified (otherwise I won't be able to say 'John followed Bill to the north, but Bill hid north of the tree', which will be the normal way of describing Bill hiding behind the tree).[66] Thus the use of a linguistic system of absolute spatial description unconditionally requires all these complex and highly specialized computations.

A system of relative spatial description like our own requires none of these computations; we only have to perceive and memorize the relative distances and angles between objects and reference points. To see the difference consider what would happen if I, a relative-system user, invite my counterpart user of an absolute system to dinner in one of those revolving restaurants fashionable in Western inner-city towers. As far as I am concerned, as I eat my meal, all the fixtures and furnishings of the restaurant stay in a constant spatial relation to one another (the butter is still to my left, my guest remains opposite me); for my guest all the angular relations of objects will be constantly changing (the butter will be now to his north and I to his west; then soon the butter will be to his east, and I to his north, etc.).

The example makes clear that in order to use a particular linguistic system of spatial description one is forced to make the requisite computations - the cognitive consequences can be far-reaching indeed. Semantic structure may not be equivalent to conceptual structure, but it can certainly require supporting cognitive

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[65] "The language of thought may be very [much] like a natural language. It may be that the resources of the inner code are very directly represented in the resources of the codes we use for communication... [That is] why natural languages are so easy to learn." J. Fodor, (1975), *The language of thought*, New York: Crowell, p. 156. See also J. Fodor, (1983), *Modularity of mind*, Cambridge, Mass.: MIT Press.

[66] What if one mentally entertains a possible but unrealized scenario? John Haviland and myself had long speculated that users of such systems entertain directed mental images. Nick Evans recently gave us some evidence: a speaker of Kayardild (a language using cardinal directions almost to the exclusion of other location/motion specification) was praising a spear - it was the kind of spear that would penetrate a queenfish to the second barb, a turtle's fin to the fourth, a man's chest to the tenth, but for a dugong, why 'the west end comes out of its throat'!

systems. This is, if one likes, a kind of strong linguistic determinism of thought.[67] When I and my guest think about where the butter is (even if we were to sit in the same place) we simply do not have the same thought. The thoughts are translatable, to the extent that they are,[68] only with considerable effort (at least on my side) and terminological invention. There is no necessary implication or even likelihood that languages and conceptual systems vary without limit; but equally we do not yet know what the limits are.

For this sort of reason we have given especial emphasis to linguistic evidence concerning spatial conception, especially as any other kind of evidence will have to be linguistically mediated. But the interest of the linguistic distinctions is precisely their non-linguistic implications and correlates; for example we expect a system of gesture to be quite differently organized amongst people who use absolute spatial systems than amongst those who use relative systems.[69] Moreover exactly parallel kinds of arguments can no doubt be made, from particular architectural or agricultural or representational practices to certain kinds of spatial computation.

4. Coding of spatial relations in language

Many of the distinctions in conceptual system made in the prior section are more or less directly reflected in the linguistic systems of various languages, which is largely why they have been noticed by analysts. In the same way, the fact that the familiar European languages and their historical predecessors happen to exhibit sentential connectives that map reasonably well onto the logical ones, is what suggested the basis of modern logic in the first place. Many languages (e.g. Australian languages like Guugu Yimidhirr) have no self-evident counterparts to conjunction, disjunction and conditionals; instead the logical relations are expressed only indirectly and through overlapping means.[70] This is what we can also expect to find in the spatial domain; we can use the semantic distinctions made in the various languages of the world as heuristics for setting up underlying conceptual distinctions. But any one language is likely to draw upon a subset of these distinctions, and possibly use quite different underlying conceptual systems in different parts of its grammatical system.

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[67] Why not the other way around - a conceptual determinism of language? Only because it is the communal possession of a shared linguistic system that coerces our private conceptual systems into shared directions.

[68] His 'North' is likely in fact not to be my north at all; it may be an angle of a certain width oriented somewhere northerly. With compasses, maps and other paraphenalia we can hopefully construct a bridging metalanguage, but that metalanguage is not any innate 'language of thought', even though it may be made possible by such a thing.

[69] See e.g. Haviland (1986), Levinson (1986, 1987). See also A. Kendon, (1988), *Sign languages of Aboriginal Australia*, Cambridge University Press, especially 240ff, 320ff.

[70] See e.g. Cole *et al.* (1971); or J. Hamill, (1990). *Ethnologic*. Urbana: Univ. of Illinois Press.

Perhaps there are principles that govern what kind of conceptual distinctions will be drawn upon to structure what kind of linguistic oppositions, but if so these are yet to be discovered.[71] Thus the following is nothing more than a checklist of possible encodings of specific distinctions in specific portions of the grammar, based on limited experience.

4.1. *Encoding of deixis*

The deictic distinctions of degrees of proximity to speaker, and/or to other participants, are most obviously demonstrated in deictic demonstratives (like *this/that*), deictic determiners (like *this boy*) and deictic adverbs (like *here*). For all we know, all languages have at least a pair of deictic demonstrative pronouns (although as mentioned the basis of the opposition may be quite different, either proximal/distal from speaker or proximal-to-speaker/proximal-to-addressee). Deictic determiners may be in collocation with or affixed to nouns, and some languages (like Kwakwala) require the encoding of such information on all nominals; or they may be cross-referenced with the nouns by case-marking and distributed elsewhere in the sentence (as in some Australian languages). However marked, there may be other spatial information encoded beyond the proximity of the referent, e.g. its visibility (e.g. in Kwakwala, a N.W. Coast Amerindian language), its directness of apprehension (e.g. in Yucatec Mayan), even its cardinal direction (e.g. in Kayardild, an Australian language). Interestingly, (as in Tamil) deictic adverbs and demonstratives often form a series with question forms (*cf.* (archaic) English *hither, thither, whither*?).[72]

There is a great deal more proximal/distal deixis in the general vocabulary than normally enters linguistic descriptions; consider e.g. the English deictic adjectives in the phrases *the local pub*, *the far mountain*, *the nearest station*, or the noun *the neighbours*. Some analysts (e.g. Lyons 1977) analyze the definite article as a deictic neutral on the proximal/distal dimension. Other semantic theorists find covert deictic parameters within the semantics of nearly all lexemes; but it is a theoretical matter as to whether the deictic relativity of much interpretation is to be handled within the semantics or the pragmatics.[73]

Among the motion verbs there are typically found deictic verbs like English *come* and *go*, which (arguably) prototypically denote movement to speaker, and movement away from speaker, respectively. Sometimes the location of the addressee may be goal of the motion (*I'm coming*!) or the normal home base of speaker or addressee. Where such verbs occur in a large series, other spatial concepts may be

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[71] For an attempt to outline such principles see Talmy (1983); for doubts about their universality, see Levinson (1991a.)

[72] Indefinites commonly overlap with question-words (e.g. 'someone' and 'who' are expressed by the same word in many Australian languages) because both are variables; we often therefore get a series 'which one?', 'someone', 'that one', as in Tamil.

[73] See e.g. J. Barwise & J. Perry, (1983), *Situations and attitudes*, MIT Press.; the pragmatic point of view is put in Levinson, 'Notes on situation semantics' MS.

encoded, like ascending and descending, or going up-river/down-river or heading in a particular cardinal direction. Spatial notions of various detailed kinds are likely to be built into verbal roots of carrying (e.g. English *bring/take*), exchanging (*buy, sell*), entering/exiting etc.; they are also likely to occur as verbal affixes or verbal modifiers.[74] Deictic verbs of motion may themselves be partially or wholly grammaticalized as auxiliaries, thus bringing spatial dimensions automatically into the description of events.[75]

In short deictic (and other associated spatial) information can be encoded just about anywhere in the linguistic (and indeed gestural) system: in nominal and verbal roots, and nominal and verbal inflection and modification.[76]

4.2. *Encoding of relative location or motion*

Location of a Figure relative to a (not necessarily deictic) Ground requires some way (a) of designating a referent as the Ground object, and (b) of specifying a search-domain with respect to the Ground object. These two functions can be packaged together in locative/motion case-markings affixed to the noun phrase describing the Ground, and also in adpositions affixed or collocated with the Ground NP.

Case systems of any elaboration are likely to encode spatial information of various kinds, as in the frequent opposition between Locative, Allative[77] and Ablative cases. Some languages, like Finnish, have many cases with primarily spatial interpretations: first there are three 'internal' cases marking relations to a 'container': corresponding roughly to the English prepositions *in* (Inessive), *out of* (Elative), *into* (Illative); three 'external' cases marking relations to surfaces, corresponding to *on* (Adessive), *from* (Ablative), *to* (Allative); in addition two corresponding to *through* (Prolative), *with* (Comitative), plus three cases (Essive,

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[74] E.g. Highland Mayan languages have a special series of 'directional' adverbs derived from motion verbs, which encode deictic and absolute directions.

[75] See Haviland (1991a).

[76] There are many surveys available so we shall say no more here; see Levinson (1983:79ff) and references therein; Jarvella & Klein (1982), Anderson & Keenan (1985), Fillmore (1975). For some 'exotic' systems see e.g. Weissenborn & Klein (1982). For attempts to link deictic development to cultural complexity, see J. P. Denny, 'Locating the universals in lexical systems for spatial deixis', Chicago Linguistic Society, Parasession on the Lexicon, 71-84; and R. Perkins 'Covariation of culture and grammar' in M. Hammond, E. Moravcsik & J. Wirth, *Studies in syntactic typology*, Amsterdam: Benjamins, 359-78.

[77] The Dative case familiar from the classical European languages marks grammatical relations like indirect object, as well as subsuming Allative (motion towards) notions. The literature generally fails to distinguish semantic functions from surface case marking, which is confusing. If we identify the semantic notions IO (indirect object), TO (motion towards), FROM (motion from), AT (location at), INST (instrumental) then we can say that Dative (D) case marking subsumes IO, Allative (All) subsumes TO, Ablative (Ab) FROM; in any particular language D may also subsume All. See E. Blansitt, 1988, 'Datives and allatives', in M. Hammond, E. Moravcsik & J. Wirth, *Studies in syntactic typology*, Amsterdam: Benjamins, 173-92.

Partitive, Translative) which either mark grammatical relations or notions parallel to Adessive, Ablative, Allative. Hungarian adds a further distinction (vertical relation to surface vs. proximity) through the 'external' set, yielding three more cases.[78] Spatial cases may sometimes compound, as in Tamil where ablative case-suffixes are affixed to locative ones (*mature-le-runtu* 'Madurai-LOCATIVE-ABLATIVE, i.e. from Madurai').

Case systems are often supplemented (or supplanted, as in English) by post- or pre-positions, yielding adverbial or adjectival phrases of place. The semantic notions encoded in such adpositions may be quite complex, as in English *across*, which presupposes some kind of longitudinal strip as Ground, and a bisecting orthogonal longitudinal Figure (as in *the bridge across the river*). Various attempts have been made to generalize about the kinds of geometric concepts involved in natural language expressions of this sort (see e.g. Talmy 1983), but we need a great deal more information before this can be done with any security.

Complex prepositional (or postpositional) phrases are often constructed from core spatial prepositions (or case endings) plus nominals of various kinds. These nominals are often drawn from terms for human body parts (as in English *to the back of*), but they may also be drawn from animal body parts,[79] house-parts and the like. The motivation is often to project an oriented facet on the Ground, from which in turn an angle can be described in order to delimit the search-domain in which the Figure can be found. But this is not the only possible semantic interpretation of such constructions; sometimes (as mentioned in the prior section) they may merely divide up the Ground into sub-regions and locate the Figure as in contact with that region. In either case the Ground will often be in the syntactic role of 'possessor' of the part-term (e.g. Tzeltal *ta s-jol witz*, Preposition POSSESSIVE-head mountain 'at its head the mountain, i.e. on the top of the mountain').[80]

Unfortunately, the semantics of such phrases are rarely described accurately in grammars; the meanings are in fact likely to deviate quite markedly from the English (or other familiar language) glosses that are provided. This can be easily appreciated by seeing how idiosyncratic and complex the interpretation of the various English phrases are (see e.g. Herskovits 1986). We have already seen, for example, how the interpretation of a facet (like 'front') or body-part (like 'back' or 'flank') depends in part on whether an object can be thought of as intrinsically possessing such an attribute; if not, then an angle may be imposed from the point of view of the observer (*The rabbit behind the flower-pot*). But the radical differences of interpretation of adpositional phrases across languages can best be appreciated

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[78] J. Anderson (1971), *The grammar of case*, Cambridge Univ. Press, pp. 4-5.

[79] Heine (1989) notes that there is no known African system built exclusively on animal (as opposed to human) body-parts. Since animal parts will often have the same names as human parts, the evidence for which model is involved may be indirect - e.g. the term for 'back' may express the concept ON, the term for 'anus' may express the concept BACK. Both human and animal models may often compete in the same system.

[80] For some generalizations about the association of possessive and locative constructions see E. Clark (1978).

by careful comparison: phrases that at first sight gloss the same, often turn out to have fundamentally different semantic organization (see Bowerman 1989).

Adpositional phrases are likely to participate in at least two kinds of syntactic construction: as optional adverbial clauses of place, and as subcategorized arguments of certain verbs (cf. English *put* which requires a prepositional phrase specifying location). It may be that this distinction can be used to isolate 'core' adpositions (the subcategorizing ones) from those less central to the linguistic (and maybe conceptual) system.

In English, relative location information is almost entirely packaged in the prepositional phrase, with a vacuous locative verb *be* fulfilling the need for a (tense-bearing) predicate. But many languages have a set of contrasting locative verbs.[81] Thus whereas in English we indiscriminately use locative *be* in *The book/cup is on the table* or *The key is in the lock*, or *The picture is on the wall* in German we must say *Das Buch liegt auf dem Tisch, Die Tasse steht auf dem Tisch, Das Bild hängt an der Wand* and *Der Schlüssel steckt in dem Schloss*, the distinctions encoding geometric properties of the Figure (whether the object is flat or has a canonical base, etc.) or of the Ground (whether it is a container, a vertical surface, etc.) or of the relation between them. Some languages carry such distinctions to the extreme: thus Tzeltal forces a choice between over one hundred commonly used locative predicates, each of which encodes especially properties of the Figure object (shape, disposition, angle, etc.) or occasionally of the Ground or the relation between Figure and Ground. This then takes the burden of location description off the adpositional phrase - in Tzeltal there is a vacuous preposition corresponding to the English vacuous locative verb.[82]

4.3. *Absolute systems*

Cardinal point terms in English are somewhat odd nominals (not always requiring articles, cf. *from north to south*), functioning also as adjectives (*the north shore*) and as adverbs (*the ship sailed north*). Perhaps they should be analyzed as a distinct form class or part of speech. That is certainly true e.g. of the various Australian cardinal directional terms, which belong to a quasi-nominal category which take only the locative, ablative and addessive case markings, often in irregular forms.[83] Although cardinal points terms have very various etymology (e.g. 'east' in Finnish derives from

[81] This seems to be a neglected aspect of research on spatial description. E. Clark (1978), at a higher level of generalization, shows how locative verbs also participate in other constructions, especially the existential and possessive ones.

[82] The system is described in Brown (1991), and Levinson (1991a).

[83] R. Dixon (1980), *Languages of Australia*, Cambridge University Press, p 282-3.

a verb meaning 'come forth'), they are likely to end up as a distinct minor word class.[84]

The fieldworker should clearly be suspicious of frequently occurring adverbials that literally translate as 'up'/'down', 'upstream'/'downstream', 'the X wind', 'windward'/'leeward', 'seaward'/'landward', 'back'/'front', names of natural landmarks like mountains, islands, etc. These may well name fixed angles of reference, operating somewhat like cardinal points.

There is no reason why absolute angles may not be marked throughout the linguistic system, in demonstratives, nominal affixes and the like. The most thorough-goingcase of this kind known to us is Kayardild, an Australian language spoken on a small offshore island, where cardinal directions are encoded in determiners, and as roots inflect or derive for allative, ablative, provenance (origin), continuity ('ever northward'), remoteness, boundary, side, parts of the sea, etc. They can also form the roots for verbs meaning e.g. 'turn north', 'look north', 'move north'.[85] Not only Australian languages but also Austronesian and Papuan languages seem quite frequently to encode such information in demonstratives and verbs.[86]

4.4. *Place names and descriptions*

There is, it has been argued (see Lyons 1977:215ff), a fundamental semantic difference between proper names and descriptions: the latter have a sense or intension, the former lack it (it is pointless to ask what *London* means, as opposed to what it refers to). The semantic difference may often have syntactic correlates, as with the co-occurence restriction on determiners in English proper names. However, since many place names are descriptive (e.g. *Long Beach*) and within any given territory may be uniquely so, it may not be easy to make the distinction.[87]

As mentioned, a generative system of place-names offers an alternative to a relational or angular method of location-specification, and uniquely identifying

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[84] See C. Brown (1983). This article, interesting and thorough though it is, lacks critical data e.g. on the Australian systems. The author is therefore led erroneously to suggest that, with some possible Amerindian exceptions, such systems might be generally borrowed from Western sources and are in any case of recent origin.

[85] N. Evans, *in prep.*, *A grammar of Kayardild*, Melbourne University MS.

[86] The 'absolute' angles are often associated with 'up'/'down' or 'seaward'/'mountainward'. See H. Steinhauer (1991), 'Demonstratives in the Blagar language of Dolap' in T. Dutton (ed.) *Papers in Papuan Linguistics*, 1:177-221 (Pacific Linguistics A-73); V. Heeschen, 'Spatial deixis in Papuan languages', in Weissenborn & Klein (1982:81-110). R. van den Berg ('Spatial reference in two Sulawesi languages', contribution to the workshop mentioned in fn. 1) shows how complex the choice of 'up'/'down' motion verbs are in relation to cardinal directions on the one hand, and non-straight line, non-horizontal routes, on the other.

[87] And if one follows H. Clark & D. Wilkes-Gibbes (1986, 'Referring as a collaborative task', *Cognition*), there is an essential element of arbitrary, but collaborative, 'baptism' in any kind of reference.

location-descriptors are one such system. For example, in a Tamil revenue village with a large agricultural hinterland, every field has a specific (originally descriptive) name; in principle this yields a checkerboard of named units for spatial description (also incidentally for farmer-identification!). Alternatively, there may be a system for carving up larger named spaces by some generative principles. The fieldworker should be attuned to this possibility, because the presence of such a system may form an integral part of the resources of spatial description in the language, allowing reduction of resources elsewhere. Place-names also often form a conceptual underpinning of social organization, being associated with clans, exogamous units, alliances etc.[88]

A final feature always worth noting in the field is what need *not* be specified linguistically - that is how much is left to the pragmatics. Every system of linguistic-oppositions exploits a system of pragmatic inference: thus there is no need for a word meaning 'not at', because any use of the word *near* will pragmatically imply (implicate) 'not at'. That's because there's an expectation that a speaker would use the most informative expression compatible with the facts, and so would use *at* if it applied. A full investigation of any spatial terms should thus include a consideration of what is pragmatically implied rather than linguistically encoded.[89]

5. Spatial conception revealed in schema and action

Human action and interaction take place in space, a space highly modified by human artefacts and impact on the environment. Cultures specialize in particular shapes, and cross-cultural psychologists even suggest that peoples are differentially susceptible to various spatial illusions according to their socialization in a 'carpentered world' of right-angles (as in Western architectural structures) or a 'bent and moulded world' of circles and spheres (as e.g. in many African houses and corrals).[90] Architecture, aesthetics, land use, water control, the structure of trails and highways are all grist for the mill of the student of space. Economies and

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[88] See M. Takaki, 'Regional names in Kalinga: certain social dimensions of place names' and K. Basso 'Western Apache place name hierarchies' (and the many references therein) in E. Tooker & H. Conklin (1984), *Naming systems*, Washington: American Ethnological Society. The Apache naming system is a good example of the use of descriptive labels as proper names (e.g. *t'iis naadn'áá 'a* cottonwood tree stands alone here and there' designating a certain solitary tree, and by extension a local encampment; *op. cit.* p.91). There is of course an enormous literature on European toponymy, e.g. *Concise Oxford Dictionary of English Place Names*, but with little attention to factors of interest here.

[89] See Levinson (1991b) for some further hints here.

[90] These results were first obtained by W. H. Rivers, the founding father of psychological anthropology, in the Torres Strait Islands at the turn of the century. The standard reference is M. Segall, D. Campbell & M. Herskovits (1966), *The influence of culture on visual perception*. Indianapolis: Bobbs-Merrill. For more recent collective opinion see J. Deregowski (1989) and Lawrence & Low (1990).

centralized polities depend on trade routes and communications, while the fundaments of agriculture involve rights to divisions of land. The social construction of space proceeds on a scale from the minute to the immense.[91]

In societies with any significant division of labour, one turns naturally to the experts for explication of the local systems of spatial use. Architects and builders, irrigation experts, land-tenure judges, navigators and long range traders, are all specialists who are likely to use special methods for reckoning, measuring and determining spatial parameters. Even a subsistence farmer, who must calculate how much seed of different crops to save from the harvest in order to realize next year's planting plan, will have various rules of thumb that amount to a kind of geometry.[92] Farmers operating in the 'hydraulic civilizations' of Asia must also calculate water volume in laying out irrigation ditches and deciding which plots to irrigate. It seems that despite the massive amount of research on economic activity little is actually known about most such indigenous practices.

Navigators, hunters, ocean fishers, trackers and traders must operate with complex mental maps, and with various systems of dead-reckoning to locate current position on the map. They are the spatial experts *par excellence*. Some exemplary studies, e.g. of navigation in Oceania, show how complex and accurate such indigenous systems can be. For example, the Carolinian star-compass with 32 fixed points can be just as accurate as a small marine compass.[93] And the sea-lane system, connected to star-courses, had sophisticated mathematical properties which were conceived of as a directed graph connecting islands.[94] When such expert knowledge is being passed on, or where two experts are discussing the merits of different routes, maps may be externalized as drawings or arrangements of sticks,

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[91] Consider e.g. the construction of S. E. Asian kingdoms on the model of the mandala (Tambiah, 1985: Ch. 7) or Inca cities on radial lines (*ceque* system) connected to astronomical observations, kinship, ancestor worship, irrigation and much else (A. Aveni, 1990, *Empires of time*, London: Tauris, Ch. 8).

[92] A Tenejapan farmer for example calculates on the basis of a fixed (approximate metre long) measuring stick between maize seeds; at five seeds to each planting hole, he can mentally lay out a quadrant for his rectangular fields, and quickly assess the consequences of growing peanuts versus maize. As he gets old he must divide his land among his sons, giving to each rectangles of equal size from each of the ecological zones (highland, lowland) his field are dispersed between; geometric fairness will be insisted upon.

[93] See K. Oakley, 'Inference, navigation and cognitive maps' in P. Johnson-Laird and P. Wason (1977), *Thinking*.

[94] See P. Hage & F. Harary (1991) *Exchange in Oceania*, Oxford University Pres, Ch. 3. Incidentally, the same system of nodes and directed arcs is mapped on the human body, yielding massage pressure points (p. 216ff).

etc.[95] Even where there is no tradition of such representations, it is interesting to see whether informants can produce them on request.[96]

Less practical spatial models are cosmologies, mental models of the entire universe, where spirits good and evil, dead ancestors and unborn souls, moral and spiritual qualities, together with terrestrial and celestial phenomena are conceived of as all having their proper place in some large three-dimensional scheme. The founding fathers of anthropology were fascinated by this phenomenon, which was as typical of medieval and early modern Europe as modern 'primitive' cultures.[97] Durkheim for example recounts how the Zuni divide space into seven regions (four cardinal points, the centre, the nadir, the zenith), and then assign to each the winds, the seasons, the natural species, the colours, social functions like war, peace, agriculture, medicine, magic, and not least the clans, three each to each region except the perfect central clan.[98] Such holistic spatial models of the social and physical world, encyclopedic encapsulations of traditional knowledge, may be expressed in myth, ritual, art and architecture, as well as expert exegesis.[99] Models of this kind must be built on an underlying conceptualization of space, of course, and are thus potentially of considerable interest to the student of cognition. For example, the widespread use of a left-right opposition as the base for multitudinous symbolic oppositions, has long been noted and much studied.[100] Such systems depend of course on a relative, egocentric rather than absolute system of spatial conception - Tenejapans, without such a left/right angular division of space, have to find something else to hang their social symbolism on.[101]

Overall cosmologies of this kind may provide the system behind the differential evaluation of spaces within home, village, town and nation. All societies have sacred spaces, good and bad, safe and dangerous regions. The home may be seen as homology for the larger world, with pure and dirty regions, places for men

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[95] See e.g. the star-maps of the Caroline Islands as described by Gladwin (1970), *East is a big bird*. Harvard University Press.

[96] See e.g. Gossen, G. H. (1974) *Chamulas in the world of the sun*. Cambridge, Mass: Harvard University Press. Also, Wassmann 1991.

[97] See e.g. E. M. W. Tillyard (1963) *The Elizabethan world picture*, Penguin.

[98] E. Durkheim & M. Mauss (1903 [1963:43ff]) *Primitive classification*. London: Cohen & West. Their account is based on Cushing's observations published in 1897.

[99] For a modern exemplary study, see C. Hugh-Jones (1979:Ch.7).

[100] See R. Hertz (1906) 'La prééminence de la main droite: une étude sur la polarité religieuse', available in translation as R. Hertz (1960) *Death and the right hand*, London, Cohen & West. For a more modern study see e.g. L. C. Faron (1962), 'Symbolic values and the integration of society among the Mapuche of Chile', *American Anthropologist* 64(6):1151-64.

[101] Incidentally, from a conceptual point of view it may be quite interesting to understand ideas about the spatial location of the spirit world - is it localized, e.g. in the dangerous bush or jungle, or omnipresent like a fourth dimension, or a dimension entered through dreams (see e.g. Littlejohn 1960)?

and women, humans and animals.[102] In some societies the social system is expressed and realized spatially in thorough-going ways. For example, in a South Indian village, major caste divisions are located in distinct hamlets, lesser divisions in specified wards. Each home is organized from inner, pure rooms where only caste-members may enter, to outer rooms where caste-equals may sit together, to the yard where lower castes may enter. Ritual pollution involves exclusion from pure zones, so menstruating women must take up temporary abode in the yard. Ingestion of substances must be carefully controlled lest impurity enter the body. Untouchables traditionally had to keep at specified distances from higher castes, e.g. 20 metres from a Brahman. The compass points are associated with auspiciousness and its reverse, life and death.[103] The vertical dimension also is invested with social symbolism, low caste persons having to keep their heads below the level of high caste persons. Rank is expressed in height, purity in aloof distance, and control of access. Social distinctions are thus brought exactly into line with spatial distinctions: you are where you are.[104]

In all societies, such distinctions are not merely marked but also realized in the conduct of social interaction, where postural and gestural use of space iconically represents social relationships. The study of proxemics and kinesics are technical areas of study because of the difficulty of transcribing spatial disposition, and they lie beyond the scope of this brief introduction. But one should note that the human body, with its highly expressive facial muscles, its articulate and fluid hands, and oral-auditory specialization for speech, has obviously evolved for expressive interaction at a relatively close distance. Some of our spatial acuities and sharp interest in shapes may owe as much to this as any more practical evolutionary pressures like hunting or tool-making.

6. Methods

How should one set about investigating spatial conception in the field? Substantial answers have already been suggested in sections 4. and 5.: one should look on the one hand to the conceptual organization encoded in the relevant linguistic structures, and one should study behaviour that is directly focussed on spatial issues. But some traditional methods are likely to leave a great many further questions unanswered, while others may be completely impractical in field conditions. Here we sketch how starting from the language, one may try to broaden one's understanding of how space is conceived and computations about it are handled. Structured elicitation is best done monolingually with an informant who has grasped the

[102] See e.g. Littlejohn (1960), Hugh-Jones (1979), Tambiah (1985:176ff).

[103] A general South Asian theme; see e.g. Tambiah (1985:178).

[104] This description is based on my own field experience and work by Brenda Beck (1972, *Peasant society in Kongu*, Vancouver, Univ. of Brit. Columbia Press.) but is typical of South Indian systems.

metalinguistic character of such sessions. Using the 'Where is the X?' elicitation-frame, one may run through a set of objects (Xs) in the visual field, trying to vary the scale and distance of X in order to provoke the use of different kinds of Ground (deictic, or landmark or prominent object or bounded space). Similarly, one can roll a ball and use 'Whither?' questions. One soon has a set of linguistic forms in syntactic and morphological alternation (like *this X* vs *that X*) which clearly involve spatial oppositions. The methods of structural semantics, based on the presumption that classes of items in formal opposition are also in semantic opposition, are the normal recourse here (see e.g. Cruse 1986). One then tests hypotheses about the nature of the semantic oppositions by systematically varying the relative positions (and the disposition, orientation, size and shape) of Figure and Ground. In this sort of way one should be able to find whether a distal demonstrative like *that* refers to something far from speaker or close to addressee, or whether a preposition like *on* presupposes a horizontal surface (no, since a fly can be crawling *on* a wall).

It is essential before the session to have gathered sufficient 'props'; objects of various shapes and kinds to act variously as Figures and Grounds. Some of the objects should have clear canonical orientations (like indigenous vessels or other artifacts), but others should lack them (like a ball, a short cylindrical stick). Since colour, shape, texture, disposition (e.g. angle vis-a-vis the horizontal) can all prove relevant, quite a collection of exemplars will be needed. It is also very useful to bring into the field models of humans, animals, houses, boats and other vehicles as relevant to the local situation, because it is easier to manipulate such models than the real objects (although it is conceivable that in some cultures such models may be treated in a special way). Plasticene or flexible modelling clay (or just some local dough or mud) can also be very useful to test the limits of certain shape restrictions (e.g. what kind of container is required for something to be conceived as within it). (We even found a 'paint' program on a field lap-top computer a useful resource: one can e.g. progressively deform a circle into an ovoid while eliciting shape classifiers that distinguish such shapes.) Some props should be chosen for questions about motion, e.g. a ball, model humans, animals or vehicles, so that while moving an object one can ask 'Where is X going?' and the like. Where human body-parts and body positions are mapped analogically onto the world (as in many Meso-American languages) it may be useful to take an artist's wooden maquette as a stimulus object.[105]

It is enormously helpful to videotape some such elicitation sessions, because the exact spatial relation between Figure and Ground can usually not be recovered from a tape recording alone, and one's field notes rarely prove adequate later on. The new compact video formats ('Compact Super-VHS' and 'High-Video-8') offer double the resolution at about 1/3 extra price over the older formats (VHS and Video-8). Cameras of these standards offer digital mono- or stereo-sound, of potentially better quality than analogue tape recordings; to make good use of this a plug-in external mike with a long shielded cable is highly recommended (this

[105] Used with some success by John Haviland in his study of Tzotzil. He, and subsequently Penelope Brown studying Tzeltal, used a maquette as the basis for a descriptive game of a kind described below: one subject had photos of the maquette in certain bodily positions, and the other had to place the actual maquette into the described position.

avoids camera noise, and brings the microphone close to the informant while allowing the camera to be placed at a discrete distance). A tripod (or separate cameraman) is necessary of course, or the elicitor will be behind the camera and unable to manipulate the objects. A good quality rechargeable battery will last up to 90 minutes in a warm climate, making it practical (though still difficult) to utilize such cameras beyond the range of electric current. Videotapes can be played back to further informants for comment and quibble (for this a light-weight LCD screen is necessary or a separate miniature player like the Sony Videowalkman[106]), or indeed can form the stimulus for informal experiments.[107]

Still photographs of the relationships between the relevant objects can also be very useful, provided they are keyed to the appropriate notes; if they can be developed and used again in the field as stimulus objects, they provide a way to compare descriptions from numerous informants (but see caveats below).[108] Some stimulus photographs can be prepared before going into the field, showing objects of different kinds and shapes in different spatial relations to one another (on top of, underneath, to the left or right, far or near etc.). But it is then a good idea to choose objects that will be familiar to informants, like locally grown vegetables or goods that are imported (e.g. batteries or tins or matches or common tools).

If we have managed to videotape such informant sessions we will have a good record of both the relevant linguistic expressions and their extensions (the situation which they describe) for later transcription and analysis. We will also have a preliminary mental analysis, and a great many puzzles: some puzzles will arise because the informants' explanations do not fit with their demonstrated usage, others because one simply cannot see the basis of some distinction, yet others because contradictory usages seem to be employed. Sometimes one will incorrectly think one already has a good analysis. To solve the puzzles and put what appear to be good analyses to the test, one must have access to other kinds of data, especially kinds that are in some sense more 'natural', less based on the confrontation of ethnographer and informant, and the kind of *ad hoc* working 'solutions' that may be invented in that situation.

The best corrective is of course real-life naturally-occurring spatial descriptions. But one may have to wait a long time to acquire a reasonable sample of these, and they will not test the limits of the descriptive system (but see suggestions below). An intermediate method is therefore to stimulate interaction over spatial issues. One technique used in the study of Western languages has been for the investigator to pose as an anonymous passer-by in need of route-directions, saying e.g. "Excuse me, can you tell me how to get to X" and then to record the

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[106] A separate video-player allows the copying of precious tapes; but at the time of writing these players do not support the super-video standards.

[107] A range of Sony Hi-8 cameras have proved reasonably reliable in fairly tough field conditions; touch field conditions; some problems arise though in cold humid conditions despite a humidity sensor system. A good external microphone with say 10 metres of shielded cable is a worthwhile accessory.

[108] The recent proliferation of colour processing equipment throughout the third world may make this practical, provided 35mm 100 or 200 ASA colour print film is used.

answers, choosing a range of different destinations on different occasions. This technique naturally does not easily generalize to field conditions: not only can the investigator rarely 'pass' as an anonymous native, the questions rarely make sense in small communities where everyone knows the relevant routes already and local people may find it quite difficult to grasp the problem at all.[109] More successful may be for the ethnographer, prepared with snapshots of local people, to ask for descriptions about where each lives, a kind of curiosity that may seem natural; the task can then be repeated with a number of informants. But in any such techniques the investigator is not only obtrusive, but the responses of local people are likely to be specially adjusted to the perceived difficulty that the investigator has with local terrain and local idiom.

The inadequacies of this kind of method on the one hand, and the difficulty of getting sufficient focussed natural data on the other, have led us to try to prompt interaction between two or more native speakers. One technique, pioneered by Lourdes de Léon, involves introducing 'games' of skill in precise space and shape description.[110] There are many different designs possible, but the simplest involves two individuals with two identical sets of stimulus materials. One of the individuals (the 'director') has these stimulus materials in a particular order or configuration, while the other (the 'matcher') has them disordered and must bring them into the identical configuration on the basis of a verbal description by the director.

The two individuals must be so arranged that they cannot see each other's materials. The easiest way to achieve this is to sit informants back to back. Such an arrangement however brings in the complexities of one participant trying to take into account the inverse orientation of the other. Notice, for example, that if I describe to you in English (or any other relative system of spatial description) how to set a table, with the fork on the left and the knife on the right, and in your orientation back-to-back with me you follow my instructions, we will have what are for us the same configurations, but rotated 180 degrees. But if we now operate with an absolute cardinal-point type system, and I describe the knife as (say) to the East of the fork, we will now end up with the truly identical non-rotated configuration, which if rotated will be incorrect! To avoid these problems, the two individuals should be seated side by side, with a cloth or wooden screen between them (the back-to-back design, though, may make an interesting contrast). Description under different conditions can be investigated. We have tried the following for example:
(i) by arranging the screen so that participants can see each other but not the stimulus materials, one may try to obtain gestural deixis;
(i) by making the game a 'race' one may try to force rapid economic descriptions;
(iii) by repeating the same game three times one may see how a pair of players further economize on descriptions;

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[109] In a Tzeltal-speaking community where labourers from neighbouring Tzotzil-speaking areas are sometimes employed, we asked two informants to role play such a foreign labourer asking for route directions; the informants obliged (one speaking Tzotzil) but the route directions were just as presumptive of local knowledge as the ones normally offered to us when in difficulty.

[110] The 'games' owe inspiration to the design of more formal experiments involving the description of shapes by H. Clark & D. Wilkes-Gibbes (1986, 'Referring as a collaborative task', *Cognition*), themselves part of a long psychological tradition.

(iv) one may encourage or discourage the 'matcher' to query the 'director's' descriptions;
(v) one may encourage or (attempt to) discourage the participation of onlookers (whose corrections or improvements on descriptions can be most revealing).[111]

As stimulus materials de Léon and other members of the Group have successfully used sets of photographs of multiple objects in different orientations and positions. On a first run, photographs of familiar objects from the local environment are most likely to be interpretable, to prompt developed vocabulary and to engage informants. On subsequent runs, 'exotic' unknown objects (like Western children's pop-beads or blocks) may push the descriptive resources of the language to the limit. In order to avoid the use of non-shape and non-spatial expressions, black and white photographs might theoretically be best, but the hand processing involved nowadays makes this relatively impractical. A set of between nine and sixteen photographs should be chosen so that each contrasts with a number of others on just one variable (say, inversion of one object, or mirror-image arrangement, or slight displacement). Two sets are then printed and each identical pair have the same number written on the back. Then the only essential record that needs to be kept is (a) the tape recording of the session, (b) the order of the photographs followed by the director (i.e. the sequence of the identifying numbers on the back), (c) the identifying number of each photo paired by the matcher with each description (and thus the noting of any mismatches). The tape can then be transcribed with reference to the photos that were being described, and mismatches analyzed for their linguistic sources.

But there are problems with the use of photographs. First, informants unfamiliar with photographs may simply not see them as representations of a three-dimensional reality.[112] Secondly, even if they do, the language of description may refer either to the represented three-dimensional world or to the actual two-dimensional photograph: one may therefore not be able to determine what an informant means by, say, 'on top' - it may refer to the 'top' of the photograph on a convention where the photo is laid flat with the vertical dimension away from the speaker, or it may refer to the perceived vertical arrangement in the three-dimensional scene that was photographed.

A solution to this is to use actual three-dimensional stimuli, but this requires the use of at least a still camera to record the director's assemblage and the matcher's attempted replication. A video-camera provides a great deal of further information, by recording the whole process of building up the replica assemblage. The stimuli themselves can be any local materials, providing they can be found in near-identical pairs: sticks cut into special shapes, notched or broken; stones, leaves,

[111] This is not the place to describe the findings arising from these 'games', for which see L. de Léon (1991a) and P. Brown (1991). But to give some brief examples: de Léon finds that when economic descriptions are forced, the great compactness made possible by Tzotzil numeral classifiers and positional adjectives comes to the fore; that Tzotzil speakers cannot make the 180 degree mental rotation needed to play these 'games' back to back while still utilizing the absolute angles made available by landmarks the visual field, while Brown's Tzeltal data does not reveal much use of such landmarks even in the side-by-side setup.

[112] See J. Deregowski (1989).

vessels etc. of same shape and size. In all these games, as the analyst gets a better understanding of the nature of the local spatial system, the stimulus materials can be 'tuned' to probe further into areas where the language is specially developed or especially under-developed. Two identical grids of say 16 squares (each say 6 inches square) are drawn on the ground with a stick or chalk, in such a way that they can be separated by a screen, with an informant sitting side by side before each grid. The objects are then arranged by the investigator in the director's grid, and the director is asked to tell the matcher exactly how his own objects are arranged so the matcher can replicate the configuration. The task could be standardized by first asking the director to match the objects in a still photograph, but this requires holding the stimulus materials constant of course, and not adjusting them e.g. for children. A videotape of this kind of game can be extremely revealing of spatial discriminations, as it records the process whereby the matcher attempts to make the objects fit the description, and then halts, finding vaguenesses or ambiguities that require reciprocal questioning, the answers to which require dismantling and rebuilding the partial assemblage.[113]

Some attempt should obviously be made to get a representative sample of 'players'. Especially important may be to contrast the usage of older, more traditional, less travelled subjects with younger, typically more educated and acculturated ones. Variations in sex, age, group status, natal provenance, etc. may all yield highly varied descriptive techniques and responses. Above all, it should be remembered that because such 'games' involve a local dyad, the relationship between the two 'players' will be governed by local mores. For example, two individuals in an affinal relation may refuse to play, or they may conduct the exercise with minimal verbal description and maximal embarrassment, while at the other extreme two persons (say cross-cousins) in a joking relation may exploit the possibilities for innuendo or 'playing dumb'.[114] The fieldworker has to be sensitive to such possibilities, not pressing too hard against reluctance to play, and hoping by sheer replications to overcome any peculiarities of a small, happenstance sample. Collaborative playing of the 'game' by committee (which is likely to happen anyway in field conditions) may avoid difficulties with particular dyads, while introducing many other variables.

There are many other games that can be devised, according to the subject of interest, and adjusted to local linguistic and cultural practices.[115] One we have tried involves blindfolding one informant ('the seeker') and getting another

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[113] For information about results from Tzeltal speakers playing this kind of 'game', see Brown (1991). We are grateful to Herb Clark for suggestions about how to proceed here.

[114] See e.g. the peculiar results obtained by Cole et al. (1971:264) because their native 'experimenter' was the son of a chief.

[115] de Léon (1991c) describes some other collaborative tasks that can be embedded in the same essential screened set-up; for example, the 'director' may have an assemblage of a child's construction toy like Tinker Toy which has to be matched by the 'matcher'. Allowing the director to 'correct' the assembly at the end without a screen can also be revealing. The task can be tuned to interesting properties of the language in question, e.g. Tinker Toy is ideal for a language rich in 'insertion' or 'fitting' predicates. For languages with absolute reference systems, assemblages of toy houses, corrals, animals etc. may provoke reference to the relevant landmarks or fixed angles.

informant ('the director') who stands still to guide him or her around a delimited space by purely verbal commands, picking up sweets en route! The whole episode is best videotaped. This is especially interesting in languages that lack left/right descriptions, since angular orientation must be described in some other way. However, being blind-folded can obviously be seen as being demeaning, and the method must be used with caution. For inducing deictic usage, one might try a variant of this task along the following lines. An array of many (50 or 100) sheets of paper or, say, leaves are placed on a flat piece of ground. A key object, e.g. a coin, is placed under one of these, in such a way that the 'director' knows where it is, but the 'seeker' does not. The 'director' stands at the edge of the array and must economically guide the seeker to the hidden coin. The economy and precision could be enhanced by requiring the seeker to guess the coin's location after each command, the fewer the leaves or sheets turned over the higher the reward.

Whether such games are accepted enthusiastically as 'fun' by members of the local community of course depends on contingent factors; they may be acceptable to children and not to adults, or they may seem like games of skill that children are shy to play but which adults are keen to try. But on the basis of our Group experience they are certainly worth persevering with, as they provide extensive spatial descriptions in a precisely recordable context of use. We shall attempt to make available a 'kit' of stimuli, and interested readers should write to the Group for further details.

Any induced interaction, however readily native speakers co-operate in it, still has peculiar boundary conditions. What is to stop the evolution of a new Wittgensteinian language-game, now played by local people for the benefit of a stranger? Such doubts can only be put to rest by the study of naturally-occurring verbal interaction. The problem here, as mentioned, is that relevant linguistic expressions may be few and far between. One exception though is the set of deictic expressions, which tend to occur with reasonable frequency. Assuming a good comprehension of the language, it is possible to take systematic notes by focussing on just a few expressions. Bill Hanks has shown how profitably this kind of case study can be done.[116] By living for a long period with an extended family, he came to have a good ethnographic understanding of the various divisions of domestic spaces: personal areas of rooms, distinct rooms with different degrees of public access, different yards, invisible 'fault-lines' between divided or to-be-divided plots of land, and so on. By assigning each such space an identification code, he could economically note how e.g. a demonstrative spoken in space A would be used to refer to objects in space B. As a result we probably have a better understanding of how such proximal/distaldistinctions actually work in Yucatec Mayan than we have for any of the heavily studied European languages!

Participant observation of this sort also allows theunobtrusive testing of the investigator's hypotheses; questions about present locations or distant locations (like the home-base of someone one has just been introduced to) can be asked from time to time in a natural way. If one suspects that accurate absolute angles are involved, a small compass should be constantly referred to, and indeed compass directions or directions of other landmarks should be noted for all recorded interaction (again

[116] W. F. Hanks (1990).

videotape makes this easy). One should never miss the opportunity to test an informant's orientation and spatial sense when by chance he or she is out of the local territory, as the absence of local landmarks may make clear the underlying basis of orientation.[117]

Some of our most interesting material comes from videotaped conversation where people were exchanging narratives, e.g. stories about historical events that they witnessed long ago. Such events have to be retold by reinvoking the spaces in which they happened, and since they correspond to real spaces, the stories can be related to the actual terrain, by later visiting it, or at least studying the relevant maps. For hunters or pastoralists or sailors who make significant journeys, the story plus knowledge about the actual route followed can be fascinating data. Australian Aboriginals whom we have worked with, for example, can remember events from half a century ago complete with accurate cardinal-point orientations for every alignment of and motion in the terrain.[118] Videotape of the interaction is more or less necessary, as oriented gestures may be deeply integral to the understanding of the narrative. Later, these gestures can be painstakingly studied with specialized equipment, so that the kinds of spatial information packed into the morphology of the gesture can be unpacked.[119]

It is worth noting that journeys often play a role in myth, cosmology, folk history and ritual, so that such performances may also be well worth attention. Tzeltal guardians of the various saints make recurrent trips around the mountain shrines where they are held to reside, while shamans curing patients recite place-names on a mental circuit of local territory.[120]

Apart from the collection of such narratives or performances, the best chance of acquiring recordings of natural interaction with rich spatial reference is to be on the look out for events where collaborative work is involved on some large scale non-routine construction or operation. For example, the construction of a house or corral, the felling of a large tree, the laying in of a new irrigation ditch, the building of a road, or the slaughter and division of a large animal, usually requires both communal effort and some kind of overt advice giving and direction involving spatial matters. Even better is to catch the 'briefing' prior to such events, e.g. the despatch of hired outside labourers to work in specific fields. Videotapes of such events can yield valuable examples of natural spatial description, but it will also prove invariably difficult to get an adequate sound-track in the general hub-hub of simultaneous, often noisy, actions. The best hope is to have a well coordinated separate sound person, with a radio mike or a mike on a long cable, who can move

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[117] For example when investigating the Tenejapan 'uphill/downhill' orientation system, it was especially interesting to see how informants operated it outside of their steep valleys in a local town (where it was quite clearly used like a fixed cardinal point system).

[118] See Haviland (1986, 1987) for case studies.

[119] See e.g. Haviland (1991b). The requisite equipment is a video player that can play variable slow motion without losing the sound-track; it is helpful too to be able to superimpose time-code on the image so that speech and gesture can be precisely aligned.

[120] A. Becquelin, paper to a workshop on Mayan spatial conception, Berlin 1990.

close to the operation of most interest at the time, allowing the cameraman to stand some way off.

One kind of interaction is especially worth careful observation, and that is implicit or explicit socialization and language acquisition. The stages of understanding of spatial distinctions through which a child progresses may be more deeply revealing of the relationship between cultural and biological endowment in this domain than any other source of data. For example, if it could be shown that children pass through the Piagetian phases of spatial reasoning, then it would follow that our Western relative system of spatial thinking is conceptual bedrock, and the 'exotic' absolute non-egocentric systems are highly developed superstructures later acquired on top of this. This in fact does not seem to be the case, and this is a discovery of the first importance.[121]

There are two basic methods of studying language or conceptual acquisition: either one follows single children for a couple of years through the actual process, building up 'diaries' or recording case-histories of individuals; or one studies cohorts of children of different ages, and extrapolates to the development between the ages. The fieldworker is likely to be forced into the second method, and thus compelled to collect comparable data from samples of reasonable size.[122] The need for comparability can be met by using 'games' like those discussed above to induce interaction, or by more formal experimental methods. Since there is a great deal of accumulated experience in the cross-cultural study of language acquisition, we refer the reader to Slobin (1985).

Finally, we should consider the practicality of formal experiments in the field. A well designed psychological experiment attempts to control for all extrinsic variables, so that the results cannot be attributed to peculiar properties of the sample or situation. Field conditions where there is no privacy, no simple way of recruiting subjects, where 'test' situations are strange and contrary to local values and motivations, and where the language in which the task must be explained is anything but transparent, make it difficult to achieve results that will meet with professional approval in psychological circles. Their intrusive and strange character may also harm the relationship between fieldworker and subjects.

Nevertheless, simple experiments may well be worth trying. Sorting experiments have proved relatively robust in field conditions,[123] and these may be of considerable interest to the study of shape-discrimination. One simple kind of stimulus is the triad-test where informants are asked of successive sets of three objects which two 'go together' as most alike. Another kind of design has been used in the field by Lucy (1987), who has used picture stimuli to investigate the effects of the grammatical encoding of number, in a way that could easily be adapted to the study of the effects of specific kinds of encoding of space and shape. A sequence of line drawings of a familiar scene can be used, each differing only in, say, the

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[121] See de Léon (1991b).

[122] For methods in the longitudinal study of the acquisition of spatial concepts in non-European languages see e.g. Choi & Bowerman (in press), and Slobin (1985).

[123] See e.g. Lucy (1989), J. Wassmann & P. Dasen (1991), 'Hot and cold: classification and sorting among the Yupno of Papua New Guinea', MS.

location or arrangement of some objects. Subjects are then asked to describe what they see. In another variant, the picture is removed before description, and the subject asked to recall what was drawn. The same experiment is then administered to a similar sample in another contrastive language (say English), to see what the effects of the grammatical encoding of spatial distinctions may be, first, on attention (what is described) and, second, on memory (what is recalled). Twelve subjects in each culture may be sufficient to give at least preliminary results.[124]

The application of the classical Piagetian spatial tasks has also been tried in the field by cross-cultural psychologists,[125] but the difficulties are numerous because of the unfamiliarity of the test materials and the testing situation. Nevertheless, Piaget's stimulus sets can be used as a constant source of inspiration for rather different purposes. For example, one prime question arises about the mental 'coding' of scenes in absolute spatial systems: are these memorized in terms of the absolute angles that each object in the scene exhibits, or are they memorized just as we memorize them as a set of relative angles, together with just one cardinal angle, from which all the other cardinal angles can be reconstructed? The following experiment, carried out on samples from a population of 'absolute' system users and another of 'relative' system users, might decide. First, a model of house, corral, trees, etc. is arranged so that the subject looks across it, to a model man on the other side. The subject describes the scene. Two days later he is asked to describe the scene he previously described, but now from the point of view of the model man (a control group should also repeat the prior task). Hypothesis: this should be easy for the 'absolute' system user (since the same description, which is not anchored to the observer's point of view, still applies), difficult for the 'relative' system user (whose new description should be slower and more hesitant). Second, a slightly different model is shown and described as before.from the point of view of the observer. Then in front of the observer the model is rotated 180 degrees, holding the location of the model man and the subject's observation point constant. The observer is immediately asked to describe the scene from the point of view of the model man. Hypothesis: this should be easy for the 'relative' system user (whose prior description still applies since the scene has been rotated, and appears the same to the model man as it previously did to the observer), hard for the 'absolute' system user who must construct a new description. If the hypothesis fails (there are none of the expected performance differences between and, especially, within populations), then the mental 'coding' for both kinds of system must be essentially similar after all.[126]

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[124] For a defence of such small samples, against attack from the psychometric school, see Dasen (1984:114ff).

[125] See e.g. Dasen (1974) 'The influence of ecology, culture and European contact on cognitive development in Australian aborigines' in J.W. Berry & P.R. Dasen, *Culture and cognition: reading in cross-cultural psychology.* London: Methuen.

[126] The design of course needs detailed working out. Although there are always difficulties comparing performance across samples from different linguistic/cultural groups, here these difficulties are largely bypassed by the comparison of relative performance *within* each culture on the two tasks. This allows e.g. the details of the stimuli to be superficially different, as appropriate to each culture. The basic idea for an experiment along these lines is due to Pim Levelt.

Only experimental methods are likely to answer questions of this sort. For a wealth of further specific suggestions about field experimental methods, dangers implicit in them and much field-lore see Cole, Gay, Glick & Sharp (1971).

7. Conclusions

As we have sketched, there are many aspects of spatial conception and description: how things are conceived or described within one's physical reach, one's visual or perceptual field, or beyond that, as maps or 'runs' through territory - and then again, beyond that, how familiar terrain fits into the cosmos, both physical and metaphysical. There are questions about the segmentation of the universe, from the analysis of objects into parts, to the analysis of spaces and places into regions. There are questions about how humans privilege certain regions, e.g. the region of reach, the visual field, and the spaces important to specific social organizations (sacred terrain, domestic spaces of restricted access, etc.). There are questions about naive geometry and topology, the underlying spatial calculus used to classify objects and relations and serve the purposes of route finding and navigation.

But behind this vast range of questions from indigenous metaphysics to architectural forms and land use, there are some central questions that should never be lost sight of. These central issues are the underlying conceptual core of the local system. Assuming we can establish the existence of a straightforward vertical dimension of orientation, the next question is how are angles on the horizontal dimension established? Are they established egocentrically and anthropomorphically? Or are they established by reference to external fixed angles? Or by some other means? If the system has an egocentric prototype, how can the reference point be shifted to inanimate Grounds? Where objects serve as Grounds how are regions projected off them, if indeed they are? If various systems are used, which takes priority for which purposes? Are there experts who use quite different systems? In which order are such sub-systems acquired by children? These are the sorts of question central to the study of spatial cognition, and thus to the general question of nativist vs. empiricist epistemology that has vexed this area of study for two thousand years. Speculations in this area have lacked some essential fundamental data - knowledge about cross-cultural variation - which only sustained field research will be able to supply.

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