# Immanuel Kant among the Tenejapans: Anthropology as Empirical Philosophy

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## KANT'S EARLY VIEWS ON SPACE

The great 18th-century philosopher Immanuel Kant held a complex sequence of views about the fundamental nature of space. At first he seems to have hoped to reconcile Newton's views about space as an 'absolute' (a sort of 'ethereal stuff'), independent of and prior to any of the objects in it, with Leibniz's celebrated 'relativist' view of space where space is nothing but the system of relations between things (or rather 'monads'). Twenty years later in 1768 he published a pamphlet (*Von dem ersten Grunde des Unterschiedes der Gegenden im Raume, On the First Ground of the Distinction of Regions in Space*) that seemed to establish the Newtonian view and to force the rejection of Leibniz's views; it is the ideas sketched there that are the focus of this article. Later, though, he came to reject the Newtonian view as well, claiming that space is neither a set of relations between things nor an 'ethereal stuff', but a subjec-

tive framework we impose on the objective world, and it is these later mature views that are most closely associated with him today.[1]

The 1768 pamphlet is short and readable. First, it makes the point that we conceive of regions of space as three dimensions projected out from our bodies along the orthogonal planes *above/below, before/behind,* and (the focus of discussion) *right/left.*

In physical space, on account of its three dimensions, we can conceive three planes which intersect one another at right angles. Since through the senses we know what is outside us only in so far as it stands in relation to ourselves, it is not surprising that we find in the relationship of these intersecting planes to our body the first ground from which to derive the concept of regions in space. . . .

One of these vertical planes divides the body into two outwardly similar parts and supplies the ground for the distinction between *right* and *left;* the other, which is perpendicular to it, makes it possible for us to have the concept *before* and *behind.* In a written page, for instance, we have first to note the difference between front and back and to distinguish the top from the bottom of the writing; only then can we proceed to determine the position of the characters from right to left or conversely. [Kant 1991(1768):28–29]

One might think that one could dispense with right/left by substituting maps of the stars or of the terrain. But Kant points out that these devices in turn rest upon an orientation of the map in my hands, and a relation between my sides and the regions projected from them. Otherwise, what is there to stop us from interpreting the sheet contralaterally, with the symbol on the left of the map referring to a landmark in the region on my right side?

Similarly, our geographical knowledge, even our commonest knowledge of the position of places, would be of no aid to us if we could not, by reference to the sides of our bodies, assign to regions the things so ordered and the whole system of mutually relative positions. [1991(1768):29]

Nor can one even appeal to the apparent absolute nature of cardinal points, for the compass only assigns North, and we must fix the rest of the points by directed rotation, for example by the clockwise order N-E-S-W. But a moment's reflection reveals that the notions of handedness and clockwiseness are one and the same.[2]

Kant then turns to consider how the left/right distinction is instantiated in nature by natural species that spiral to the left or to the right but not both, and indeed by the two sides of our bodies that exhibit a left/right symmetry but in 'mirror-image' of each other.

Since the different feeling of right and left side is of such necessity to the judgement of regions, Nature has directly connected it with the mechanical arrangement of the human body, whereby one side, the right, has indubitable advantage in dexterity and perhaps also in strength. [1991 (1768):30]

Such left/right asymmetries, or rather our perception of them, seemed to Kant to be philosophically fundamental: indeed, they struck him as knock-down proof against Leibniz's view that space could be reduced to the sum of the relationships between things— that is, the view that space amounts merely to a network of *positions*.[3] Here is his reasoning. A left hand and a right hand have identical internal measurements in all respects, so they cannot be distinguished in a Leibnizian way in terms of the relations between their *internal* parts. And yet they clearly are distinct: "the surface that bounds the one cannot possibly bound the other" (as shown by trying to put a left-hand glove on a right hand).

But Leibniz might appeal to the different relation of each hand to the body or indeed to any *external* reference points. To close off this line of argument, Kant appealed to the following thought experiment. Consider the case in which the entire universe consisted of only one hand (an early moment in the Creation perhaps)—there are therefore no external objects to which it could be differentially related. Moreover, the relational angles and distances between fingers and thumb and palm would be identical whether the primordial hand were a left or right one. And yet the primordial hand *would* have to be either a left hand or a right hand—a hand that was somehow indeterminate between left and right simply would not have the shape of a human hand. (Besides, it would not fit the rest of Adam when the good Lord got around to finishing him off.)

The Leibnizian concept of space simply fails to capture the essential difference between such mirror-image objects. Instead, Kant argued, we have to conceive of an absolute framework, *conceptually external* to the hand, in whose coordinates the leftedness or rightedness can be distinguished. Hence, something like an intuitive Newtonian space, prior to and independent of objects and their sensations, must be "a fundamental concept which makes all such sensations possible" (1991[1768]:32).

Kant's argument relies crucially on the nature of these left/right 'inversions' or 'mirror-image objects' like our two hands or feet or ears. Kant called such objects *incongruent counterparts*—in modern

terminology they are known as *enantiomorphs*.[4] He had charac-
teristically grasped their geometry, as identical to the inversion
about the plane of a mirror, and constructible by drawing perpen-
diculars from points on an object in front of that plane just as far
behind the plane as the points of the object are in front; thus "the
counterpart of the counterpart of an object is necessarily congru-
ent with the object" (1991[1768]:31). However, it seems that enan-
tiomorphs were philosophically puzzling to Kant himself, since he
used them to argue for different views at different times; but
regardless of that, they remain puzzling to this day. Do they really
argue for an absolute view of space? Wittgenstein dismissed the
argument in one sentence: "A right-hand glove could be put on the
left hand, if it could be turned around in four-dimensional space."[5]
Do incongruous counterparts *really* differ in *shape*? If you take two
planar incongruous counterparts and then slip one of them round
a Möbius strip, they end up congruous—so can there be anything
very deep in the incongruity?[6] And, anyway, if the universe con-
sisted of only one left hand, would its left-handedness be an
intrinsic property of it at all?[7]

We shall not pursue these issues here, at least not in a philosophi-
cal way—they belong not only to the history of philosophy, but also
to current running debates in philosophy and geometry, as made
available in the compilation by van Cleve and Frederick (1991).
What concerns us here is the set of conceptual linkages that Kant
seems to have established. He has argued that the distinction
between the left and right sides of our bodies is connected to the
ability to distinguish mirror-image counterparts like our two hands
(or each member of a pair of gloves), or clockwise and anticlock-
wise spirals, or east versus west, because all of these distinctions rely
on an absolute subjective notion of space: "absolute space is not an
object of an outer sensation, but a fundamental concept which first
makes all such sensations possible" (1991[1768]:32). It is this
association between the very tangible reality of incongruous coun-
terparts like left and right hands or spirals running clockwise versus
counterclockwise, on the one hand, and the very abstract nature
of an overall spatial schema, on the other, that we wish to explore.
If you could not distinguish a plane through the body dividing your
world into a left-hand side and a right-hand side and you could not
distinguish enantiomorphs, that would be because you lacked an
absolute framework of reference within which two identically pro-

portioned objects could be seen to be opposed. That is to say, the perception and differentiation of incongruous counterparts carries with it other, more abstract, conceptual baggage.

Philosophers are fond of thought experiments of the kind: suppose we could find a tribe who could not tell apart incongruous counterparts—would they then, following Kant's association, be essentially Leibnizian? Would they lack an overall scheme of abstract spatial reference, or at least would it be different in kind? And if they did have one, would it lack an opposition between clockwise/anticlockwise, like that intrinsic to our rotational system of cardinal points and, instead, consist essentially of a network of positions?

## HERTZ'S SOCIOLOGICAL UNIVERSAL OF LEFT/RIGHT DISTINCTIONS

Being (like all anthropologists) empirical philosophers, we ought to search for such a case. However, first sociological principles might make us dubious that we would have much luck. Consider, for example, the argument in the classic paper by Robert Hertz (1960[1909]), "La Prééminence de la Main Droite: Étude sur la Polarité Religieuse," which together with Durkheim's late works, and Mauss's essays, constitutes some of the core intellectual capital of sociological thought. Hertz argues that the slight physiological favoring of the right hand (in the majority, right-handed population)[8] provides a potent natural metaphor for a host of social dualisms, especially the oppositions between sacred and profane, between good and evil, between birth and death:

> The relation uniting the right to the east or south and the left to the north or west is even more constant and direct, to the extent that in many languages the same words denote the sides of the body and the cardinal points. The axis which divides the world into two halves, the one radiant and the other dark, also cuts through the human body and divides it between the empire of light and that of darkness. Right and left extend beyond the limits of our body to embrace the universe. [1960(1909):102]

Hertz notes how thoroughly the symbolism of left and right pervade social values in the cultures of the world—the association, for example, of the 'strong' sex with the strong side (whether in Maori or Aboriginal associations); of the right hand with the sky and life, and the left with the earth, hell, and death (whether in

representations of Christ in the Last Judgment, or the conventional associations of Plains Indian sign language); of the right hand with food, the left with excretion (whether in Egypt, Malaysia, or India). In sacred rites, the right foot enters the temple first, the right hand makes the offering, and one circumambulates clockwise, right shoulder inward to the deity (1960[1909]:104). "Sacred power, source of life, truth, beauty, virtue, the rising sun, the male sex, and—I can add—the right side; all these terms are interchangeable, as are their contraries" (1960[1909]:103). Hertz noted too how the slight physiological favoring of the right hand is reinforced, for example, by binding the left arm of children to teach them not to use it (1960[1909]:92). Evans-Pritchard later recorded how the Nuer, who identify the right spear-arm with masculine identity, sometimes actually cause the left arm to wither by constricting the blood flow with metal torques.[9] Hertz concludes that "if organic asymmetry had not existed, it would have had to be invented" (1960[1909]:98). There is no doubt that he thought the dichotomy universal and that claim has been developed in later anthropological theorizing (Needham 1973).[10]

**So if a 'tribe' exists that finds symmetry and congruity and even identity between left and right, it would seem to violate not only philosophical but sociological preconception.** Nevertheless, we think we have a good approximation to such a 'tribe'—the Tenejapan speakers of the Mayan language Tzeltal, in southern Mexico. Tenejapan conceptions of space are currently under investigation, using a mixture of traditional ethnographic and linguistic techniques and informal experimentation (Brown 1991, 1993, in press; Brown and Levinson 1993a, 1993b; Levinson 1990, 1991, 1992a, in press).

Tenejapans show a remarkable indifference to incongruous counterparts. It is true that they have names for the left hand and the right hand, and also a term for hand/arm in general. But they do not generalize the distinction to spatial regions—there is no linguistic expression glossing as 'to the left' or 'on the left-hand side' or the like, and there is no elaborate system of value associations with the left and the right—indeed, none at all to our knowledge. We have watched ritual circumambulations of a saint that have gone anticlockwise and then clockwise, retracing the steps.[11] We shall describe shortly the evidence we have that speaks to these Kantian themes. The evidence points in two directions:

(1) Kant was wrong to think that the structure of spatial regions founded on the human frame, and in particular the distinctions based on left and right, are in some sense essential human intuitions; (2) Kant may have been right to think that the left/right opposition, the perception of enantiomorphs, clockwiseness, east-west dichotomies, and so forth, are all somehow intimately connected to an overall system of spatial conception.

## EXCURSUS I: THE PECULIARITY OF MIRROR-IMAGE OBJECTS

Kant's incongruous counterparts raise an important question: *what's in a shape?* Is each member of a pair of shoes the same shape or not? We judge not. As we shall see, the Tenejapans would disagree. Can the very notion of *shape* be culturally relative? This thought requires a digression on the nature of enantiomorphs.

Enantiomorphs can (although not without danger) be thought about as rotations. We are not very good at mental rotations. Consider the following facts. When my interlocutor and I stand face-to-face, if his left hand is to the north of his body, my left hand is to the south of my body (and so his right hand is to the south and mine to the north of our respective bodies). We shake our right hands diagonally across the space between us. This is what Clark (1973) has called 'the canonical encounter'. When I stand face-to-face with my own haggard reflection in the hall mirror, if my right hand is to the north, so is that of my mirror image. We shake hands orthogonally. This is all rather confusing. People often think mirrors reverse left and right, whereas what is special about them is that they do not. It is the 'canonical encounter' that reverses left and right so that my conversational counterpart has a left hand 'mirroring' (opposite) my right. The confusion is amplified in English, wherein we talk of *the left side* of the desk as if the speaker was a desk and the real desk was its reflection in a mirror (so my left is its left), not an object encountered with its own left (despite the desk's possession of its own back and front)! Why should we fail to do the mental rotation for desks and succeed for people? Actually, *to the left of Bill* is ambiguous between 'to my left of Bill' and 'to his left', but we manage all those difficulties fine. Perhaps desks fail to rotate because they do not have hands; apes do have hands, and we judge *to the left of Washoe* ambiguous. However, we

can manage rotations for objects without hands, as shown by the complex rules of the river with *port* and *starboard,* luckily bereft of the same ambiguities and luckily comprehensible to all old salts.[12]

These linguistic inconsistencies perhaps show mental confusion. In any case, psychologists can show that rotations of this sort seem to take considerable mental effort.[13]

But it is only two-dimensional enantiomorphs that can really be flipped over in three-dimensional space; three-dimensional enantiomorphs require four-dimensional rotation. So you might think that, because we live in a boring three-dimensional world, we would necessarily think of three-dimensional enantiomorphs as quite distinct in shape. But it is not as simple as that; we deal in two-dimensional retinal images, and besides real three-dimensional enantiomorphs are pretty restricted in our world. Let us consider these points a little further.

Three-dimensional enantiomorphs occur in nature, with rare exceptions, only as the attached parts of bilaterally symmetrical objects. Consequently, object-recognition will not be aided by being able, for example, to distinguish the left versus right forelimb of an antelope—they will carry no separate identificatory information. On the other hand, separated three-dimensional enantiomorphs are vanishingly rare (e.g., snails of the same (or contrasting) species with reverse spiral shells). All in all, it is hard to imagine how an evolutionary advantage might accrue to an animal good at distinguishing three-dimensional enantiomorphs. They are either attached parts of one object, or they hardly exist in the natural world at all.

Instead, it is easy to see how just such an evolutionary advantage might accrue to a higher animal that *actively suppressed* the difference between mirror-image objects. The reason is that two-dimensional enantiomorphic visual arrays abound as contrasting views of the self-same object. Thus, a predator (such as an early hominid) in search of horse meat had better be able to recognize the silhouette of a horse facing (say) north as the image of the very same object when it is facing south. The silhouettes are enantiomorphic in two dimensions; the hunter knows the one can be transformed into the other by rotation in a third dimension. Similarly, a landmark that describes a left/right diagonal (for example, a leaning tree) will appear as a right/left diagonal from the other side. Since we live in a three-dimensional world that

subtends two-dimensional patterns on our retinas, two opposing views of an asymmetrical object are likely to be enantiomorphic. This will be true when we are looking at objects that are bilaterally symmetrical in one plane, but asymmetrical in another—like virtually all animals.

Thus, the needs of visual object-recognition, coupled with the importance of bilaterally symmetrical objects in the ecological world of vertebrates, would militate against taking left/right asymmetries to be objects in the world rather than mere effects of rotation.[14] And there is considerable psychological evidence for a mechanism of 'mirror-image generalization', to be discussed below. It is only in the distinctly peculiar world of *cultural* objects that enantiomorphism or nonidentity under rotation starts to become all-important. A Ford Sierra designed to drive on British roads is not the same object as one designed to drive on German ones; a Chinese stone lion on one side of a monumental stairway, with its head inclined to the left, is designed to balance its counterpart with its head inclined to the right. A left-hand glove, rapier, or pair of scissors, is not the same as its right-handed counterpart. But, above all, there is writing. A page of writing is not the same object as its mirror-image; **b** and **d** (and **p** and **q**) are two-dimensional enantiomorphs—so are the words **bib** and **did.** As Kant remarked, the relation of the letters on the page may remain constant, "but the very same writing becomes unrecognizable when seen in such a way that everything which formerly was from left to right is reversed and is viewed from right to left" (1991[1768]:29).

Cultural objects are often enantiomorphic while lacking their manufactured mirror-image counterparts—that, in many cases, is the whole point. The whole cultural world may be constructed right-oriented, and the left-oriented objects banished (as with Nuer left-arms, quasi-amputated). Not only might special left-handed automobiles defeat the first rule of the road (stay on the right), but when we lay the table with fork to left and knife to right, that constitutes civilization.[15] This was perhaps the heart of Hertz's thesis: we constitute culture by imposing asymmetry on bilateral symmetry. Thus, a Hindu bride walks clockwise around her groom in marital and subsequent ritual—to walk anticlockwise would be to doom him; she will do it only once, around his funeral pyre. Not all of this is functionless symbolism, as shown by the rules of the road. In our own world, the importance of the *clockwise equals 'on'*

*or 'open'* rule for knobs, taps, and door handles may contribute critically to the safety of complex machines.

But wait a minute! If the acuity for right-left asymmetry in visual perception is *cultural* rather than *natural,* then there should be cultural variation (i.e., cultures indifferent to reflections around the vertical axis) and there should be developmentally late, culture-specific appreciation of left-right inversions. We began this section with the question: are two incongruous counterparts the same shape or not? The hypothesis we are now advancing is: *it all depends on the culture!*

How could we show this? One way is by looking further into writing systems, for a grapheme is, by definition, distinctive in shape from its counterparts and an allograph, by definition, non-distinctive in shape. Unfortunately, there has been little attention to enantiomorphism in writing systems. But it is well known that early scripts often vacillated between left-right versus right-left reading order.

> The direction of signs in writing varies greatly in the oldest Greek inscriptions, as it runs either from right to left or from left to right, continuing in boustrophedon fashion, alternately changing direction from line to line. Only gradually did the classical method of writing from left to right assert itself in the Greek system. [Gelb 1952:178]

In *boustrophedon,* each letter on one line is the two-dimensional enantiomorph of the letter on the next line (Gelb 1952, illustrations p. 179). Thus, the entire alphabet had mirror-image allographs.

In the one (brief) study of enantiomorphism in writing systems that we know, Stephens (1980) shows that in a sample of 56 (mostly archaic) writing systems, 45 avoid the use of mirror-image letters (like **b** and **d**) to make a graphemic difference;[16] of the 37 languages where the data is clear, 22 are indifferent to left-right inversion (i.e., **b** and **d** would be allographs, the same letter in such systems), and 11 are even indifferent to which way up you write the grapheme (**p** and **b**, for example, would count as the same letter in such systems).[17] All in all, it would seem that well over half of the premodern writing systems of the world had mirror-image allographs reflected about the vertical dimension; that is, a predominant proportion of those cultures treated left-right inversions or enantiomorphs as *the same distinctive shape.* Modern systems are, no doubt, more one-

sided because the demands of the printing process will enforce an arbitrary standardization and reduction of allographs.[18]

Perhaps especially relevant to the present study is the case of Mayan hieroglyphics. Their values are invariant in either enantio-morph (or left-right flip); indeed, the satellite 'affixes' could also be upside down with same value although this made a difference in value with main signs (Justeson 1989:28). This is in accord with the psychological observation that left-right mirror images are much less salient than vertical flips. Blocks of glyphs were organized into columns; each block or group of a main glyph surrounded by 'affixes' might typically be read in the order: left, top, center (main), bottom, right (Houston 1989:33). Beyond that, left-right, top-down order predominated but not exclusively:

> The normal reading order within a text is from left to right in pairs of columns; if a text has more than one pair of columns, the first pair is read to the bottom, followed by the second pair. . . . Three column texts sometimes read across all three columns, and texts could be placed in L-shaped areas, single columns, circles, or other arrangements. Nevertheless, the left-right reading order in both texts and glyph blocks predominates, *except in mirror-image formats, in which the entire text is reversed.* [Schele and Miller 1986:325, emphasis added]

Most writing systems are essentially two-dimensional. But there are three-dimensional spatial encodings of language, namely in sign languages, which are, as it were, the only languages with three-dimensional 'graphemes'. As far as we can ascertain, in these systems the signer may use either hand; that is, signs do not take a different meaning when made with a left as opposed to a right hand.[19]

The developmental psychological evidence is also certainly in line with the claim that sensitivity to enantiomorphic distinctive-ness in writing systems is learned by children only through in-creased exposure to writing systems that make such demands. In our own culture, it is not straightforward for children to see the difference between left/right inversions: children up to five years of age may fail to discriminate a card with a **d** from a card with a **b** even when the stimuli are both directly in front of them, but the vertical reflection **p** versus **b** is markedly easier.[20] Nativists may want to see this left-right confusion as a natural 'stage' in human matu-ration (e.g., before a left-right visual scanning system has matured); but (1) there is evidence that this ability to distinguish left-right enantiomorphs is directly connected to schooling (with which its

growth coincides), and (2) users of a right-to-left writing system, like Hebrew, acquire different patterns of eye movements.[21]

The evidence from writing systems alone is quite suggestive. Whether a culture considers a left hand and a right hand, or a **p** and a **q,** as the same shape or a different shape is indeed a matter of culture: distinctiveness between enantiomorphs is just like distinctiveness between phonetic features, something we can learn to attend to, or learn to be blind to.

## EXCURSUS II: THE PHYSIOLOGICAL AND PSYCHOLOGICAL BASIS OF LEFT/RIGHT DISCRIMINATION

There is a large academic industry engaged in trying to understand the underlying physiological and psychological basis for left/right discrimination. This is not the place (nor are we the authors) to review this literature, which is marked by controversy and inconclusiveness. Nevertheless, it is important for the current enterprise to have some understanding of the substrate influences on cultural practices, and we attempt to answer the more obvious queries from a lay point of view on the basis of a number of recent reviews of the literature.[22] The reader should note, though, that although there is much recent information on the structural asymmetries in human brains and bodies, there is still sufficient uncertainty to allow the greatest range of interpretations with respect to virtually all the most important questions. And most of the interpretations are views that have been recycled from a century or more ago: "for all the theoretical and empirical progress of recent years, . . . we still seem to be plowing the same old ground" (Harris 1983:238). Worse, the views may themselves be part of our Hertzian cultural emphasis on the asymmetry of left and right. As psychologists Corballis and Beale (1976:193) remark, "with the discovery of cerebral lateralization, we are perhaps again witnessing the growth of a left-right symbolism, the spread of a metaphor." Still, here goes.

*Is handedness genetically coded?* Strictly speaking, probably not. For example, monozygotic twins are just as likely to differ on handedness as any two persons from the general population. For all the simple species that we have data on (e.g., snails with right-spiralling shells), asymmetries of adult form are not coded directly genetically, but are caused by asymmetries in the cytoplasm (the ovular surrounds). Nor is there any genetic coding in the cells of a left

hand that make it a left hand. In general, there is no evidence that genes can tell left from right![23] But what about the asymmetry of our internal organs (especially the heart) and the dominance of the left hemisphere of the brain? One plausible explanation (which goes back beyond Broca to Gratiolet in the mid–19th century [Harris 1983:183ff]) is a cytoplasmic gradient that favors early development of the left side; hence, the location of the heart, the dominance of the left hemisphere, and the corresponding dominance of the right hand (left-handers arising randomly not by virtue of genetic coding for leftness, but as the result of the cancellation of the left-biased gradient).[24] Nevertheless, given this cytoplasmic gradient, left-dominance has a natural maturational course of development in the child, with handedness established at age six, lateralization (still fully equipotential at age two) fixed by about age 8, and a 'left/right' sense developing in Western children from ages 5 to 10. The bodily asymmetry then provides a natural basis for a socially exploitable distinction.

*Is the ability to discriminate enantiomorphs 'natural'?* No. The evidence seems to be that the difference between mirror-image objects is actively suppressed, if not at the immediate perceptual level, then at the level of 'coding' for memory and recall. This makes good sense, because we are bilaterally symmetrical organisms who live in a significant world governed by parity and symmetry, and it may be related to lateralization (with dual coding in opposite hemispheres). The evidence for this 'mirror-image generalization' includes experimentation, experimental surgery on animals, and pathologies (see Corballis and Beale 1976 for review). Amongst the latter are a number of cases where patients having lost the use of a right hand spontaneously produced mirror-image writing with the left. Since Ireland's report of such a patient in 1881, it has been supposed that mirror-image reversals might systematically occur during the interhemispheric transfer of 'coded' images.

If, immediately after perception, images are 'coded' in both enantiomorphic forms, one would expect systematic discrimination to involve some lengthy training. As mentioned, children learning to read have difficulty with such mirror-images as **b** and **d.** They show a marked leap in performance on enantiomorphic discrimination during the first year of schooling (where this is later than in the West, improvement is later), and there is little doubt that this is related to learning to read and write. Animals are

generally also bad at discriminating enantiomorphs; when they are able to do it, like pigeons pecking at distinct diagonals, they seem to use a correlation with bodily orientation (they cock their heads). Children too can learn to discriminate enantiomorphs as early as age 4, if and only if they can set up a bodily association (e.g., pressing a left button when a stick figure is pointing to the left).[25]

*Is the ability to respond differentially to left versus right 'natural'?* Probably yes. Some animals seem to be able to do this relatively well: rats can be induced to turn left at T junctions, and so on. In general, there is "no evidence that animals find it particularly difficult to learn the simplest kind of left-right response differentiation" (Corballis and Beale 1976:40).[26] This is a little interesting given the absence of consistent lateralization in most nonhuman species, including apes (see Yerkes 1943).[27] Naming is a different matter—it shows all the signs of a late-acquired skill. Western children show a slow developmental progression of abilities in verbal left-right response: only by about age 5 (coinciding with schooling) can children correctly name their own left/right body parts. It takes another three years for them to correctly name others' body parts (i.e., to make the rotation for a facing interlocutor) and a further two years before they can talk of X as 'to the right of' Y vis-à-vis ego (where three relations are involved).[28]

*What is the cultural component in left/right differentiation?* The cultural component would appear to be a series of systematic linkages that then make possible a whole system of left/right associations.[29] First, by developing a strong left/right response differential (insisting, for example, on shaking hands with the right, making the sign of the cross with the right, reading and writing from left to right, writing with the right hand, holding tools, weapons, and bats in the right hand), cultures aid children to distinguish the sides of their own body (they can recall which hand is labeled 'right' by asking which hand is used for writing). Cultural traditions then link left/right response differences to the perception of enantiomorphs: we learn to discriminate **b** and **d** by learning to trace the letters and write them (and perhaps by learning that the circle comes first in the **d** in our left-right pattern of eye movements). We now know a left-hand bend in the road from a right one, and we are able to oppose a figure to the left of a ground object with one to the right of it. Cultures may also give us labels for 'left' and 'right', which may aid discrimination and recall, and complex rules

for their use (e.g., from the point of view of another person). We then have a whole system of spatial organization and description developed out of the slight asymmetry of our handedness (Piaget 1928). In short, without the cultural linkages, there is only the slight anatomical asymmetry of handedness and the ability to respond in a handed way based on that. The potential for enantiomorphic discrimination is undeveloped and unconnected.

There are a great number of relevant studies in cognitive and developmental psychology. Unfortunately, in our opinion, experimental and theoretical work on enantiomorphic discrimination, left/right discrimination, and response is so vitiated by conceptual muddle that it is hard to draw any firm conclusions from it as a collective body of evidence. To give but one example: Piaget (1928), in early work, was interested in the growth of left/right discrimination and labeling behavior in Western children as part of a general development away from egocentrism. Much work has been built on this. Some of it demonstrates that the investigators are almost as confused as the infants.[30] The kinds of distinctions that need to be made in analysis and experimental design are actually quite complex and include at least those distinctions collected in Table 1. (Some of these are drawn from Corballis and Beale 1976.) Thus armed, we may proceed to consider the various kinds of conceptual distinctions and the conceptual gap associated with 'left' and 'right' in Tenejapa.

## LEFT/RIGHT IN TENEJAPA

Here we lay out what we know about Tenejapan concepts of 'left' and 'right', insofar as they have such concepts. We should note that our research has focused on the systems that effectively *replace* those concepts, so that we have failed to pay enough attention to exactly what there was as residue. But first, some ethnographic background to set the scene.

### ETHNOGRAPHIC BACKGROUND

Tenejapa is a Mayan Indian community situated in the highlands of Chiapas in southeastern Mexico; there are perhaps 15,000 Tzeltal Indians living there. They form a distinct ethnic unit, although there are many other ethnic groups in Chiapas that speak the same language, and others that speak the closely related lan-

TABLE 1

ANALYTICAL DISTINCTIONS IN THE STUDY OF LEFT/RIGHT DISCRIMINATION AND RESPONSE

1. Mirror-image discrimination
    1.1 Perception of enantiomorphs (e.g., seeing a 45° diagonal as distinct
        from its mirror-image)
    1.2 Memory of those percepts
    1.3 Discrimination (e.g., of pairs) versus identification (e.g., of one)
    1.4 Labeling/coding of asymmetries:
        consistently (e.g., calling your left your 'right')
        correctly (calling your left hand your 'left')
2. Left/right response differentiation
    2.1 Stimuli types
        2.1.1 With systematic cues (e.g. turn left on red)
        2.1.2 With iconic cues (e.g., arrows)
        2.1.3 With arbitrary stimulus (e.g., salute when you see a Colonel)
        2.1.4 With 'left'/'right' linguistic labels as stimuli (see 3.)
    2.2 Response types
        2.2.1 Own body parts (e.g., raise left hand)
        2.2.2 Motion (e.g., go to the left)
        2.2.3 Location (e.g., push button to the left)
        2.2.4 Linguistic label (e.g., say 'left')—see 3.
3. Linguistic system of 'left/right' labels and its use
    3.1 Body-part labels
        3.1.1 Ego's parts (Piaget's stage 1)
        3.1.2 Alter's parts (Piaget's stage 2)
            (a) In side-by-side position
            (b) In 'confrontation' position
            (c) In 'single file' position
        3.1.3 Object parts
            (a) Intrinsic (e.g., 'the left of the cow/desk')
            (b) Nonintrinsic (e.g., 'the left of the table')
    3.2 Labels for spatial regions
        3.2.1 Regions on ego's sides
        3.2.2 Regions on alter's sides
        3.2.3 Regions projected from oriented objects (e.g., 'to the left of the cow')
    3.3 Deictic angles projected on the relationship between two objects (Piaget's stage 3)
        (e.g., 'the cat is to the left of the tree' where ego imposes a 'left side' on the tree)

guage Tzotzil. Until 1951, when the National Indian Institute arrived in the local town, the Indians of Tenejapa were insulated from the influences of metropolitan Mexico by an apartheid system that forbad them to be in town after dark or to walk on the sidewalks in the day.[31]

Under such conditions, Tenejapans were illiterate, largely monolingual in their indigenous language Tzeltal, and few ven-

tured into town. Today, the situation is under rapid change, with roads under construction, electrification, influence of religious reformers, and local schooling in Spanish. Tenejapan women, and also men over 40 or so in the remoter areas, are still likely to be effectively monolingual and to have grown up in a world constructed along traditional lines.

Traditional houses have a square floor plan, with no windows and one door centrally placed. The door itself opens neither to the left nor the right, being split into two vertical half-doors, both opening inward. (Modern houses are mostly rectangular but normally retain the split doors located centrally in the longer side.) By virtue of the location of the fire, which might be a little off-center, or of the bench for food preparation formed by lashing a board to stakes, there may be a side of the house clearly belonging to the household women, and another belonging to the men and visitors. But there seems to be no pattern in the assignment: either area may be to the left or right of the entrance. In short, domestic architecture encourages a symmetry, or, if need be, an arbitrary allocation of space. Nor is orientation of any ritual significance—houses can face in any direction, and unlike in some other Highland Chiapas cultures, there are no obligatory directions for sleeping (e.g., in the opposite direction to that in which the dead are laid to rest).[32] When people die, they are buried under the floor of the house. Traditionally, they were buried in a vertical crouching position; whereas, now they tend to be laid out lengthwise, but in any direction except that with the head 'downhill', toward the north. In general, symmetry pervades material culture; for example, traditional vessels do not have one handle, but either none, two, or sometimes three, equally placed around the top.

Other aspects of daily life tend to show the same pattern of symmetrical design or arbitrary asymmetry. In traditional weaving patterns, symmetry is enforced by mirror-image reflection around a vertical line, and, in general, dress is symmetrical, bags being slung on the back by a tump-line over the forehead, or indifferently over left or right shoulder.[33] Babies are slung on the back in a shawl tied over one shoulder, but which shoulder seems to be a matter of convenience.[34] Body posture tends again to be neat and symmetrical (slouching or leaning not being typical), as indeed do gestures, generally not expansive, that are often double-handed. Men,

however, in ritual or civil office may greet each other by touching limply their right hands.

In the ritual system, cardinal point orientation does not seem to play any important symbolic role as far as we know. Although major Christian churches are oriented east (the Catholic church in Tenejapa center having been built by Spanish monks), individual household shrines and local community churches may face in other directions. Since houses have no favored orientation, and household shrines are placed inside opposite the door, it follows that the orientation of the shrine follows the orientation of the building, which is a matter of convenience. Ritual processions may go both clockwise and anticlockwise around a town or focal area, and although in major festivals a specified route is followed, there is no particular reason to believe that there is any attention paid to clockwiseness.[35]

There is no Hertzian symbolic system of oppositions associated with right and left. The Tzeltal word for 'correct', 'real' is *batz'il,* for 'straight' is *tojol,* unrelated to *wa'el* 'right' (unlike in neighboring Zinacantan Tzotzil); the word for 'bad' is *chopol,* for 'dirty' *papas,* unrelated to *xin* 'left'. The body of officials we would call the president's right-hand men are called *yok sk'ab kunerol* 'the president's legs and arms'. And so on.

### CONCEPTS OF LEFT AND RIGHT

We come now to consider the perceptual, conceptual and linguistic aspects of left/right differentiation in Tenejapa. In Tenejapan Tzeltal, there are words for 'left hand' and 'right hand'. Berlin, Kaufman, and Maffi (1990) give the following entries:

*xin,* Noun, 'left-hand side'
*xin k'ab(al),* Nominal Compound, 'left hand'
*wa'el,* Noun, 'right-hand side'
*wa'el k'ab(al),* Nominal Compound, 'right hand'

However, our informants do not accept that these terms designate the left (or correspondingly the right) side of the body. Their explications are somewhat complex. Although *xin* and *wa'el* are clearly nominals, they normally occur in collocation with just two body-part terms, *-k'ab* 'arm/hand' and *-akan* 'leg/foot' of either humans or animals (the front legs of quadrupeds are designated 'arms').[36] Now such body-part terms are inalienably possessed,

requiring a possessive prefix, but in the collocation with *xin* or *wa'el,* the possessive marker is prefixed to the latter, indicating that *a'-xin-k'ab* ('your-left-hand') is a nominal compound. Most people we asked did not accept the generalization of *xin* and *wa'el* to other body parts, but a few would accept the extension to 'ear', 'eye', 'breast'. In sum, *xin k'ab* 'left arm/hand' and *xin akan* 'left foot/leg' are complex body-part terms, but Tenejapans deny that the body is divisible into *xin* ('left') and *wa'el* ('right') halves.

If one turns to the better-studied neighboring language Tzotzil, for comparison, one finds only a word for left hand (Laughlin 1975):

*tz'et2* N1d 'left hand'
*ta jtz'et* 'with my left hand'
*ta jtz'et k'obtik* 'on the left hand side, to the left'

with the right hand being designated as the 'true' or 'correct' hand *batz'il k'obtik,* revealing already a value judgment at least not overt, and perhaps not present, in Tenejapan Tzeltal.[37]

The use of the Tenejapan terms *xin* and *wa'el* may be elucidated by comparison to Piaget's three stages for the acquisition of *left* and *right* in English (or *droite* and *gauche* in French). At first, prior to any proper acquisition of the concepts, there is only confusion. In the first stage of actual acquisition, there is correct naming of the child's own left and right hands and other body parts. In the second, the child learns to make the rotation required to name the body parts of a confronting interlocutor. In the third stage, the relation between two nonhanded (e.g., inanimate) objects can be specified by taking into account another relation, namely how the reference object lies with respect to ego's left and right (as in *The orange is to the left of the bowl*).

Tenejapan usage of the terms *xin and wa'el* is very infrequent. There are hardly any practical issues where the terms are essential, as we shall see. Nevertheless, Tenejapans have perhaps only a little more than the usual difficulty specifying which hand is their own left or right (Piaget's stage 1). They are noticeably hesitant, but perfectly able, to do the mental transfer required in assigning 'left' and 'right' to the hands of a facing interlocutor (stage 2). But there simply is no usage corresponding to Piaget's stage 3. The reason is that the terms are *not terms for regions*; hence in the usage that Piaget labels stages 1 and 2, there is also no usage corresponding to 'to

the left', whether this is egocentric ('to my left') or altercentric ('to your left'). The terms *xin* and *wa'el* are basically body-part words—they name human parts. And although Tzeltal makes extensive use of body-part terms for spatial description, these also primarily denote actual parts of things, rather than projected regions from named facets.

It follows of course that Tzeltal fails to make the Kantian cleavages of space along the three planes of the human body. Unlike in English or German, there is no entire cosmic system of orientation extended from ego's body.[38]

Following Kant's reasoning, one might search for other Tzeltal notions that are interdefinable with left and right, like clockwise/anticlockwise, or a sequence of cardinal points read clockwise from, say, north. Equally, one might have distinct, labeled enantiomorphs that appear as reflections about the vertical axis, like ▶ versus ◀, which would serve the same purpose.

First, then, 'cardinal points': in Tenejapan Tzeltal there is a system of 'uphill'/'downhill' orientation that is fundamental to the spatial system. We have described this in detail elsewhere (Brown and Levinson 1993b). Suffice it to say here that this system is based on the overall inclination of the terrain of Tenejapa from high south to low north, so that although 'uphill' (*ta ajk'ol*) (and correspondingly, 'downhill' *ta alan*) has primary reference to the actual inclination of the land, which may or may not at any given place be tilted up toward the south, the terms may be used on the flat to refer to cardinal orientations, or prototypical 'uphill' direction. This system then replaces our use of left/right in many contexts: when there are two objects in my field of view oriented such that one is to the south of the other, I can refer to it as the 'uphill' object. Unlike Piaget's stage 3 use of 'left' and 'right', the position and orientation of the speaker is completely irrelevant to this usage.[39]

Now curiously, this system of north/south alignment is not complemented by a similar differentiation of the orthogonal. There is a named orthogonal (*ta jejch*), but the term is indifferent as to whether it refers to, for example, east or west; what it really means is 'transverse to the incline'. So there is a three-way distinction: uphill (related to south), downhill (related to north), transverse (related to east/west). Significantly, then, it *makes no difference whether one rotates clockwise or anticlockwise* from 'uphill'—either way, one comes first to 'transverse' then to 'downhill'. The system is also

reflected in corresponding motion verbs with a verb meaning 'to go up, ascend' (*mo*), a verb meaning 'to go down, descend' (*ko*), and another meaning 'to go across, to traverse' (*jelaw*).

There is some evidence that speakers think of life as all uphill (i.e., the canonical situation is viewed as walking uphill). When wishing to talk of the facets of an object that lacks intrinsic facets of this sort, the 'flanks' (*xujk*) may be assigned to the sides that lie on the transverse line, across the uphill/downhill axis. When the system gives rise to temporal metaphors, the future lies uphill. The ceremonial center of Tenejapa lies 'uphill' from much of the rest of the township. Most telling, there is a restricted special deictic use of the 'uphill'/'downhill' opposition, in which the term 'uphill' can be applied to one of two objects within my reach—in this case it refers to the one further away from me (i.e., 'higher' is arrived at later if one is walking uphill). If this supposition of canonical direction is correct, then there is a correspondence between the lack of a left/right differentiation for any spatial descriptive use and the absence of any east-west orthogonal to the north-south line.

How could any peoples ignore the rising and setting of the sun, with all its natural symbolism? Of course the Tenejapans do not. They refer to the relevant directions as 'the coming out of the sun' *slok'ib k'aal*, and the 'spilling of the sun' *smalib k'aal*, but this is an independent axis, not thought of as orthogonal to 'uphill'/'downhill' (nor indeed would it be geometrically related, since the one system is tied to a fixed terrain, and the other to the movement of the sun across the edges of the mountains from solstice to solstice). Tenejapans use many other 'landmarks' as points of fixed reference, in order to make up for the absence of 'left' and 'right': they utilize the locations of other villages, mountains, named features like cliffs, and so forth, so that one could refer, for example, to a branch of a tree as the one pointing out toward the Red Cliffs. The possibility of reference to east and west belongs to this system and not to the 'uphill/downhill' system with its well-developed grammar of location and motion description.

What about enantiomorphs, especially left-right reflections about a vertical axis? As already mentioned, the culture provides little in the way of paired objects of this sort, with the exception of shoes which are still only worn, especially by women, on special occasions, and have never been made locally. Our evidence, for

what it is worth, suggests that the perception and conception of left-right asymmetries is in line with the linguistic resources of the language (i.e., such asymmetries are not salient and are not easily described in systematic terms). We conducted a number of informal experiments and structured elicitation sessions, described elsewhere (Brown 1991, in press; Brown and Levinson 1993a, 1993b, 1993c; Levinson 1992a). All in all, our informants performed on at least 11 tasks where left/right discriminations were at issue. (It should be noted, however, that many of these tasks were devised not for the purpose of elucidating Tzeltal concepts of 'left' and 'right' but for exploring the indigenous alternatives.) These tasks are sketched in Table 2.

Task 1 was a set of interactive 'space games' (see Brown 1991; de León 1991) played by two Tzeltal speakers, one a director who describes, one by one, a set of photographs so that the other, the matcher, visually screened from the director and holding an identical set of photographs, can distinguish the photo being described from the others in the set. Among these were pairs where, for example, (1) a model man was either to the left or right of another model man; or a dog was lying down either to the left or right of a standing one; (2) a bag of corn was either to the left or the right of a pot; a cylindrical shape of corn dough was either to the left or right of a cube.

The results here were as follows. Often, identical descriptions were used for both enantiomorphic pairs; in effect, informants simply failed to recognize the difference, or at least failed to realize its pertinence to the task. Where the objects to be related were animate in kind (model people or animals), one pair of players resorted to left-right descriptions *from the point of view of the people or animals in the photos.* So, where a model man had at his (intrinsic) left hand a model woman, the following description was used:

<1> ay       j-tul    winik sok   j-tul     antz
    EXIST one-NC man  CONJ one-NC woman
    "There's one man plus one woman,

    tek'el     ta,    ta   s-wa'el k'ab te    antz    te   winik-e
    standing PREP PREP 3E-right hand ART woman ART man-CL
    the man is standing at the woman's right hand."

which distinguished it from the description of its enantiomorph:

&lt;2&gt;  ay      j-tul    winik sok  j-tul     antz,
       EXIST one-NC man  CONJ one-NC woman
       "There's one man plus one woman,

       tek'el    ta,     ta     s-xin  k'ab te    winik-e.
       standing PREP PREP 3E-left hand ART man-CL
       the man is standing at her left hand."

In the case of some of the photos, the two models were almost touching—so that *ta s-xin k'ab* 'at the left hand/arm' implied contiguity. In some cases, the figures were at some remove— roughly the same distance as the breadth of the model figure itself. The *ta s-xin k'ab* expression could still be used to refer to the separated figure. This might be held to indicate that 'left' and 'right' here *do* have regional extensions after all. We do not believe this to be the correct interpretation. All body-part terms in Tzeltal allow some latitude in contiguity, although the extent of this varies greatly with each term; but in no cases are we really dealing with *projective* as opposed to *topological* notions, to use the Piagetian terminology. None of the body-part terms are used to assign planes that cut up space or divide the whole visual field. Instead, they denote just *body parts*, which in collocation with the preposition *ta* designate *positions of adjacency* to the body part; and just like English *at*, they allow a certain latitude (often very small) of interpretation (cf. *John is waiting at the station*, which is a correct description even if he is outside it).

Now this system of 'left/right' description from the point of view of animate entities could not be generalized to the inanimate objects in the photos, because that would require a convention of sidedness for such objects that simply does not exist. (In English, the sidedness is projected from the point of view of the speaker's visual field, giving us a true projective use of 'left/right' as in *the cat to the left of the tree*). Here the pairs were given identical or near-identical Tzeltal descriptions, and successful matching was a matter of chance. After one game, we confronted the players with two such paired photos of left-right inversions of inanimate objects and asked them what difference they could see. They repeatedly claimed them to be identical, *pajal*, 'the same'. When pressed, they replied by finding tiny details of asymmetry either in the arrangement of the objects or the finish of the photograph. In some way, in the context of the task at least, (in contrast with Task 9, described below) the asymmetry of left/right reflection was 'invisible' or

TABLE 2

SOME RELEVANT TASKS GIVEN TO TENEJAPAN INFORMANTS

**Task 1:** Matcher to choose a photo, from a set laid out in front of him, as described by director who has the identical set; each set containing *inter alia*
—left-right inversions of inanimate objects
  *result:* failure to distinguish, no left/right labels
—left-right inversions of model people and animals
  *result:* failure to distinguish OR left/right use from point of view of models (informants either back-to-back or same orientation separated by screen)

**Task 2:** Director to describe an arrangement (made by the investigator) of familiar objects or animal and human models set out in each square of a 4 × 4 matrix, so that matcher can reconstruct the arrangement in each square of his/her own matrix. (Informants back-to-back or in side-by-side position, screened off.) Arrangements of objects include:
—left-right inversions of objects in two of the squares
—asymmetric arrangements in the left/right visual field in some of the squares
  *results:* left/right never used (even with model persons); instead uphill/downhill, body-part, geographic, and deictic systems

**Task 3:** Matcher to put an artist's maquette or 'wooden man' into position described by director looking at stimulus photos of particular arrangements of the same maquette (director can see and verbally correct matcher):
—includes need to lift left arm, raise right leg, etc.
  *results:* descriptions generally avoid the 'left/right' terms, substituting 'uphill/downhill', 'toward sunset/sunrise', etc.. Where a 'left'/'right' term is used, it refers strictly to hand or leg body-parts and is usually corroborated with an absolute direction description ('toward uphill, sunset', etc.).

**Task 4:** Informant describes location of one of two identical inanimate objects arranged on large plane surface; one object has been characterized as having special associations and must be kept track of. The objects are arranged in various positions, including cases where each lies to the left/right in the informants' visual field.
  *results:* no use of 'left/right' terms; instead use of three systems (deictic proximal/distal, body-part segmentation of the plane surface, 'uphill/downhill' system). Where these are all collectively neutralized, informants are at a loss for any description.

**Task 5:** Director instructs blind-folded finder where to go to find objects distributed on large level patio
  *results:* (a) English trial: 'turn left, forward, right', etc.
         (b) Tzeltal: no left/right, 'turn uphill (i.e., south), downhill (i.e., north), ascend, descend, straight ahead'

**Task 6:** Commentator gives running commentary on movements of model car (plus driver, passengers) through model landscape on level patio
  *results:* no use of left/right; instead 'ascend', 'descend', 'uphill', etc.

**Task 7:** Informant draws 'map' on ground with running commentary on how to reach each place
  *results:* no left/right

**Task 8:** Two informants role-play request for route-directions
  *results:* no left/right; instead 'ascend, descend, traverse, turn away, turn toward, uphill, downhill', etc.

**Task 9:** Sorting enantiomorphs (left/right inversions in photographs)
  *results:* informants could sort photos into pairs of left/right inversion versus identical pairs versus singletons (i.e., they could perceive the differences in this context)

**Task 10:** Describing abstract enantiomorphs (e.g., diagonal lines, oblongs, rectangles)
  *results:* no left/right; informants distinguished them in terms of orientation of the parts of figures with respect to one another, or in terms of absolute coordinates (e.g., pointing toward sunset)

**Task 11:** Labeling human and animal body parts and divisions of the body
  *results:* informants labeled, for example, 'hand/arm' 'foot/leg', but never volunteered 'left' or 'right' designations

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irrelevant to the informants. The differentiation of paired animals or people in photographs were the only cases where left/right terms were used for identification.

Another kind of task (Task 4) involved differentiation of two identical three-dimensional objects where these fell in a left/right relation in the visual field. A pair of identical bottles on a table, or a pair of benches on a patio, were never distinguished by reference to their left/right place in the visual field. Instead, they were located by reference to one of three strategies. Their location along the absolute 'uphill'/'downhill' axis mentioned above was used to distinguish them ("It's the one *ta ajk'ol,* uphillwards", for example). Where the pair lay on the transverse to the uphill/downhill axis, even though the two sides of this transverse are labeled identically, *ta jejch,* the two objects could be distinguished using deictic distinctions. Finally, where the objects lay near a labeled part of the reference area, use was made of another aspect of Tzeltal spatial description, the segmentation of objects into 'body parts' (see Brown 1991; Levinson, in press); then one bench could be said to be at the *chikin* 'ear' (i.e., corner) or at the *ti',* 'lips' (i.e., side, edge) of the patio, or to be at 'its top' (*s-ba*) or 'its bottom edge' (*y-ejtal*) — these latter terms being in turn related to the 'uphill'/'downhill' dimension. All these systems break down if the objects are perfectly arranged on a diagonal to the uphill/downhill axis, at the middle of the table or patio (where no body-part differentiations are possible), and the speaker is himself orthogonal to that diagonal

(so that the two objects are equidistant from him). In these circum-
stances, speakers were at a loss—any right/left terms applicable to
objects in the visual field would have rescued them, but none are
available.[40]

Two other tasks cited in Table 2 deserve special mention. One,
Task 3, involved one informant instructing another to put an
artist's 'wooden man' with flexible joints into certain positions, for
example, raising an arm or a leg, bending it to a certain angle, and
so forth. What was striking here was that terms for 'left' and 'right'
would have been extremely useful, and for this task—naming body
parts—they are of course available. They were, nevertheless, used
just three times (note the similar result from Task 11). Instead,
absolute directions in terms of 'uphill'/'downhill' (quasi-cardinal
points) and geographic landmarks 'toward the sunset', 'toward the
big banana tree', and so forth, were used to distinguish the two
hands or legs.

From inspection of the text, it seems that one reason for the
avoidance of 'left/right' terms is an uncertainty that they will be
correctly interpreted: the matcher tended to ask for confirmation
in 'absolute' terms. This is reminiscent of the following anecdote
published as a short note in *Science* in 1931. There was an American
boy who was noted to have an outstanding sense of absolute
direction; investigation showed that the source of this unusual
development was that his mother frequently confused left with
right, and so had substituted cardinal points, as in "Get me the
brush on the north side of the dresser".[41] Where one or more
parties is unsure of the application of 'left' versus 'right', it will pay
to abandon it as a routine mode of reference. And this seems to be
the case in Tenejapa.

This may also illumine the second task we would like to draw
attention to (Task 5). This involved a game of 'blindman's bluff'
where a director had to manoeuvre a blindfolded finder by verbal
instructions over a large flat expanse. Our 10-year-old son did this
for us in English by the natural device of indicating rotation in
terms of left/right ('turn a little to the left, a bit more', and so on).
Our Tenejapan informants did not do this. Clearly, rotation of the
body is not usually so described. Instead, they took the absolute,
non-body-centered perspective and directed the finder to move
'uphill', 'downhill', 'traverse', even though the search area was
dead flat and the finder blindfolded. The assumption was that the

developed absolute sense of direction in terms of canonical 'uphill' (south) and 'downhill' (north) would be sufficient to overcome the handicap. And so indeed it was.

The absence of left/right descriptions in these structured tasks is paralled in verbal descriptions of directions and locations in naturally occurring events. In a number of events that we tape-recorded and/or videotaped—the building of a house, the construction of a chicken enclosure, the pruning of a large tree—locations and directions are never indicated by the left-hand/right-hand terms, but again by the prolific use of 'uphill/downhill', positional adjectives, and the directional particles *tal* ('toward speaker') and *bel* ('away from speaker'). In summary, Tenejapans make no essential use of 'left'/'right' terms in daily life. There are such terms, referring strictly to body parts, but there is evidence that Tenejapans are slow and uncertain in their processing of these terms, further undermining their limited utility.

If we refer back to Table 1, we may briefly indicate where we have positive evidence of the nature of Tenejapan left/right discrimination. Our informants gave us equivocal evidence about the perception of left/right reflection enantiomorphs (point 1.0 in Table 1). The very same informant could in some sense 'see' the difference (e.g., specifying a model man as at the left hand of a model woman in a photo), and yet on anther occasion fail to 'see' the difference (e.g., asserting that left/right reflections of inanimate objects in a pair of photos were identical). This behavior is, of course, in line with the linguistic resources that permit left/right terms only for animate entities. Informants were quite adamant that there *was no difference* between the left/right inversions of inanimate objects in photos, and this ratiocinative opinion was also reflected in the failure to give differential descriptions in Tasks 1 and 2. On this evidence alone one might infer that the linguistic gap actually determines a partial perceptual gap. Later tests (Task 9), however, made it clear that when informants were asked to sort photos into identical pairs versus mirror-image pairs without other distractions, they could certainly do this. Although denied a simple linguistic formulation of the systematic character of, for example, left-inversions, they described the difference between mirror-image pairs as *sjelk'axumtaye sbaik,* 'they have exchanged themselves'.[42]

We later carried out a more carefully structured perception/judgment task to test the hypothesis that Tenejapans system-

atically fail to distinguish enantiomorphs. Subjects were presented with 19 pairs of line figures, each pair consisting of one member which is a larger whole and another member which is a putative part that might be perceived within it. The figures were drawn from a systematic set that has been extensively employed in perception experiments (Kolinsky et al. 1987; Kolinsky et al. 1990; Palmer 1978) (see Figure 1). As shown in Figure 1, there were three kinds of pairs: one kind in which the putative part was an actual part of the figure, one kind in which the putative part was a mirror-image (left-right reflection) of a part within the figure, and one kind where there was no relation between figure and putative part. The task was to identify the true part-whole pairs, rejecting the mirror-image and unrelated pairs. The experiment was run on 16 Teneja-pan subjects, and 15 Dutch subjects for comparison. Subjects were introduced to the problem by training with acetate overlays, so that the distinction between true parts and mirror-image parts was at least clear in principle.

The results were as follows. Whereas the Dutch group (consistently over 19 decisions) maintained a distinction between genuine and mirror-image parts, only 1 out of the 16 Tenejapans did so, and only 3 had a majority of decisions recognizing the distinction. Six of the Tenejapans consistently conflated mirror-image and genuine parts, and 13 did so in most cases. Although one expects nonliterate subjects to perform differently from literates on such a task, (1) the Tenjapans consistently rejected the nonparts, showing that they understood the task, and (2) their performance is entirely different from that revealed by comparable studies on European illiterates.[43]

With regard to left/right response differentiation, Tenejapans (like virtually all vertebrates!) can no doubt give consistent responses on one side or the other of the body. But it is possible that stimuli may not be conceived of as in the left/right half of the visual field, for example; they may immediately be 'coded' in terms of absolute directions. Where the stimuli are terms for left/right body parts, there is definite if unsystematic evidence that informants are slow and uncertain in their interpretation of these terms, and they also had difficulty in identifying photographs of a single hand as being the 'left-hand' or 'right-hand' of the person.

As for the linguistic system of labels itself (Table 1, point 3.0), the Tzeltal terms are restricted to those of type 3.1, not being used

i. B is a genuine part of A
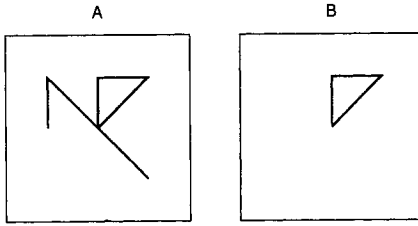


ii. B is a left-right mirror image reversal of part of A
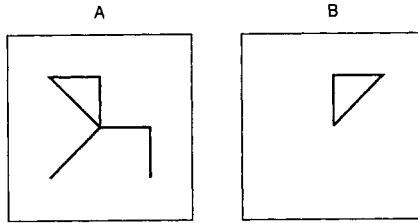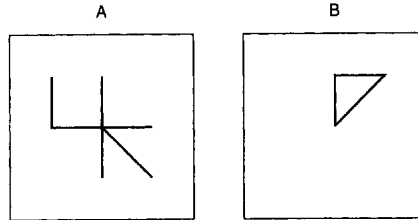


iii. B is not a part of A



Figure 1. Examples of pairs used in Palmer part-whole discrimination task.

as projective spaces as in 3.2 (with the exception of some very limited topological 'stretching'), and not being projectable on the relation between two inanimate entities as in 3.3. Tenejapans thus have available linguistic resources a bit like those attained by English children in Piaget's stages 1 and 2, except that these have no projective uses from ego's or alter's location, but they lack the system that Piaget thought so significant in the development of Western children, where the terms become truly projective (Piaget's stage 3). We hasten to add that we use the Piaget classification merely as a typology of systems, without any attribution of retarded development; that would be an impossible charge, since Tenejapans master an absolute system of projective space probably as early as age 4 or 5, when European children cannot even

systematically label their own left and right.[44] That is the beauty of a system divorced from left and right. An absolute system of directions has a conceptual elegance, with only one—but a substantial one—drawback, the need for a developed sense of direction and the constant demand for a mental 'dead-reckoning' conducted in the mental 'background'.[45]

## THEORETICAL CONCLUSIONS

In the light of much Western thought, the existence of a culture that makes no use of the left/right plane through the body for spatial conception seems rather shocking. Kant, at least, would have been deeply surprised by this absence of such a basic 'intuition'. Hertz, and especially his modern structuralist descendants like Needham, would have found disquieting this profligate discarding of the primordial binary opposition. Psychologists have even used this sociological 'universal' as firm evidence against a cultural source for handedness (e.g., Corballis and Beale 1976:123), and although psychologists are well aware of the complex tangle of factors underlying left/right discriminations, they tend to the view that there are deep physiological underpinnings that might therefore be expected to find universal cultural development. Children might be expected to pass naturally along a developmental path from the recognition of different sides of the body, to the naming of the sides, and then to the generalization of regions vis-à-vis ego, then alter, and ultimately objects, this development coinciding with the slow maturation of laterality.

Instead of all this, the Tzeltal facts point to a different conclusion. We can happily dispense with left/right as the basis of the third plane in our naive conception of abstract space. We do not need to be attuned to left/right visual asymmetries (i.e., to enantiomorphs). We can ignore the distinction between east and west as points found by rotating clockwise from north. Indeed, we do not need to be attuned to the distinction between clockwise and anti-clockwise, and life goes on just fine in such a world! But perhaps Kant was right that these ideas are all intimately linked—because in Tenejapa they are all *simultaneously* absent. You can live consistently in a Leibnizian world, with space thought of merely as a network of positions, provided you eschew all those interlinked concepts and stick firmly to the idea that a left hand and a right hand have just the same shape.

In retrospect, if we look carefully at the literature on enantio-morphs and writing systems, we can see that the results there all point in the same direction. Left/right discrimination is simply not as basic or 'natural' as our cosmological scheme would have it be. So we can expect to find plenty of other cultures where, like in Tenejapa, right and left or right hand and left hand are words that have no more theoretical resonance than short and long or foot and tooth.

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## NOTES

1. We have relied on a number of critical Kantian exegeses, including Broad (1978), Smart (1968), and especially van Cleve and Frederick (1991); the latter two publications include English translations of the relevant parts of Kant's works.

2. You can easily define left, for example, in terms of clockwise. To find your left hand, imagine your front is a clockface: now let both hands fall—the left moves clockwise. Therefore, the notion of clockwise versus anticlockwise rotation is interdefinable with the notion of handedness (cf. Smart 1968:6–7). See below for Hertz's definition of 'clockwise' as forward circumambulation with the right shoulder inward.

3. The flavor of Leibniz's views may perhaps be savored from the following extracts from the correspondence with Clarke:

> I have proved that space is nothing other than an order of the existence of things, which is observed when they exist simultaneously. Thus the fiction of a finite material universe, the whole of which moves about in an infinite empty space, cannot be admitted. . . . [T]here is no real space outside the material universe. [Leibniz 1973(1715–16):226]

> *Place* is that which is said to be the same for A and for B, when the relation of co-existence between B and C, E, F, G, etc., entirely agrees with the relation of co-existence which A previously had to those bodies. . . . Lastly, *space* is that which results from places taken together. [Leibniz 1973(1715–16):231]

4. Only slightly more exactly: an enantiomorph is an asymmetrical object that *could* have an incongruent counterpart in the space in which it exists. See Frederick's introduction to van Cleve and Frederick (1991:10).

5. Tractatus 6.36111 (quoted in van Cleve and Frederick 1991:49). To see this, consider an L and its mirror image on a page: no amount of rotation in that plane will make the two Ls congruent—but add a third dimension and flip it over, and the two can now be exactly superimposed. Kant himself foresaw n-dimensional geometries, and Wittgenstein's point was already clear to Möbius just 60 years after Kant's paper (see Möbius 1991[1827]).

6. See, for example, Gardner 1991:72 or Nerlich 1991:158.

7. See Smart 1968:7.

8. Hertz had read his Broca and the physiologists of his day (see 1960[1909], footnote 2).

9. "It is in accord with what we have learnt of the associations with left and right in Nuer thought that Nuer youths should emphasize the contrast between the two hands by putting the left arm out of action altogether for months or even a year or two. This they do by pressing a series of metal rings (*thiau*) into the flesh of the left arm from the wrist upwards so tightly that sores and great pain result and the arm is rendered useless for any purpose other than the display of fortitude" (Evans-Pritchard 1956:235).

10. The idea has been especially appealing to structuralists, who have followed the lead of Lévi-Strauss in the search for dichotomies reflecting an innate mental tendency to binary opposition. There have also been sceptics: "I suggest that some of the associations of right and left are less reflections of the structure of human thought than of the structure of the human body (mediated of course by the mind). It is hard to see how any linguistic system could avoid such an elementary opposition" (Goody 1977:65). (See also Sperber 1985, ch. 3.)

11. This occurred during a minor festival in the hamlet of Majosik', which was videotaped and extracts edited by us as a videofilm *Holy Basketball*.

12. The *Oxford English Dictionary* relates the origin of *port* and *starboard* to an asymmetry in old Teutonic vessels: a large paddle on one side acted as rudder, as steering board (hence *starboard*), making it essential to dock or *port* or load (*larboard*) on the other side. If it had not been for the Anglo-Saxons, we might have been in trouble, as Roman ships had such paddles on both sides.

13. For example, it appears to take considerably longer to trace a left-turn on a map when one is heading south than when one is heading north: in the former case, we have to make a 180° mental rotation between the canonical orientation of the map in front of us (north to the top or away from us) and the canonical direction of travel (forward) (Shepard and Hurwitz 1985:161–193). Experiments too show that we can recognize a picture of a human hand quickly, but it takes a lot longer to figure out whether it is a right or a left one (Cooper and Shepard 1975).

14. The rarity and ecological unimportance of enantiomorphs in nature is something really of note. Kant noted that natural species spiral either from left to right (hops) or right to left (beans), that most but not all species of snails spiral clockwise. The editor of one edition notes that Kant actually oversimplified the facts: Bittersweet occasionally spirals in a contrary direction; four genera of mollusks have species that seem to indifferently spiral left or right (Handyside 1929:29). Further information can be found in that marvelous compendium of the mathematics immanent in life forms, Thompson's (1968[1917]) *On Growth and Form*, vol. 2. He tells us that from Linnaeus onward the biologists have been embogged in the terminological confusions attending the description of left and right spirals, nevertheless it is clear that left-to-right clockwise spirals are overwhelmingly the rule; exceptionally, in the genus *Ampullaria* some species go one way, others the other, while the pond snail *Fusus ambiguus* exhibits races of left and right spiralling individuals (Thompson 1968[1917]:819–821; by the way, Kant seems to be right about hops!) The evidence now is that this vacillation is genetic in one sense, since the pattern is induced by a 'mould' formed by a ring of cells around the egg, but the information is not carried in the egg itself (see Corballis and Beale 1976:119 for references). The point of all this is merely to illustrate how *useless* it is to be able to distinguish enantiomorphs—where whole families and genera concur in 'handedness', it will not help one spot the delicious from the poisonous snail; spotting races of the same snail, very occasionally possible, would be likewise useless; and only the very rare species-specific linkage between type and enantiomorph as in *Ampullaria* would carry any ecologically useful information. Thompson notes elsewhere (1968[1917]:907) as "a very remarkable and anomalous thing" that the narwhal very occasionally has two horns. When this is so, "they do not form a *conjugate* or symmetrical pair, they are not mirror images of one another but are *identical screws, with both threads running the same way*." The anomaly is of course that attached paired body parts in nature are overwhelmingly enantiomorphs (see Weyl 1952).

(It is now known that the narwhal's horn is an enlargement of a left-hand tooth—a striking asymmetry in nature. See Gardner 1967.)

15. What is the relation between enantiomorphic objects lacking their counterparts and just plain asymmetric objects? Only perhaps a question of simplicity; a weather-beaten tree is asymmetric, but its mirror-image counterpart would take some conceiving. Laying the table with the fork on the right is not only simple, our 10-year-old finds it positively easy.

16. Of the scripts avoiding enantiomorphs, Chinese and the derivative Japanese scripts are preeminent. Studies seem to show that Japanese users of *kana* and *kanji* (traditionally written mostly from top to bottom) exhibit little or no dyslexia (Corballis and Beale 1976:163)! Nevertheless, the order of symbols may be left-right, right-left, or top-down in traditional Japanese writing (p.c. Ino Flores d'Arcais).

17. The paper is unfortunately very condensed and aimed just at showing that there is an implicational hierarchy of the following kind:

left-right flips are graphemic → up-down flips are graphemic
up-down flips are allographs → left-right flips are allographs

(i.e., reflections about the horizontal plane are more naturally distinctive than reflections around the vertical plane, a finding that coincides with psychological results). Most of the scripts surveyed historically derive either from a Semitic source or a Chinese source, so it is not really an adequate sample.

18. The introduction of movable type must have had a profound influence, because of course such three-dimensional enantiomorphs cannot be rotated in our three-dimensional world; likewise typewriters have limited keys, favoring reduction of allographs.

19. Kendon (1988) reports of Aboriginal Australian sign languages (used in the central desert in response to mourning taboos) that informants claimed a distinctiveness of hand for certain kin terms, but actual usage showed this not to be the case.

20. Corballis and Beale 1976:142ff review relevant studies, from Davidson (1935) to recent cross-cultural studies.

21. On the first point, see Serpell 1971; on the second, see Corballis and Beale 1976:171 for references on the somewhat equivocal results from studies of Hebrew-reading subjects.

22. We are particularly partial to Corballis and Beale 1976, because (unlike most such works) it attends precisely to the issues pertinent here; more recent are Young et al. 1983, Hellige 1990, Corballis 1991.

23. It seems that in morphogenesis, the control of left-right asymmetries lies beyond the cells of the parts: for example, "if a left-side limb bud [of a chick] is transferred to the right side, it will grow into a right-side limb" (Corballis and Beale 1976:114). "In general, there appears to be no evidence that specific directional information can be coded genetically. . . . [W]here directional asymmetric variations can be linked to genetic variation, we can suppose that the influence occurs through interaction with an underlying cytoplasmic gradient" (i.e., a prevailing tendency for cell growth to be fastest on the left side due to conditions in the surrounding maternal cells) (Corballis and Beale 1976:121).

24. Corballis and Morgan 1978. For the problems with this account and further references, see Harris 1983:234.

25. See also Olson 1970.

26. Dogs, however, cannot easily be trained to lift the left paw, unless the stimulus is iconically from the same side. Less surprisingly, the octopus exhibits complete failure to tell left from right (Sutherland 1960), but then eight limbs do rather confuse matters.

27. Recent work suggests there are more asymmetries in 'pawedness', lateralization of function and brain structure in nonhuman animals than used to be thought; see Hellige 1990. The fact remains that most primates, for example, do not show consistent handedness.

28. Piaget 1928; Laurendeau and Pinard 1970:275ff.

29. There is no evidence, incidentally, of very different percentages of handedness in different human populations in either the historic or the prehistoric record (see Coren and Porac 1977; Frost 1980).

30. For example, Laurendeau and Pinard (1970:297, following Piaget) asked children to say whether objects were to the left or right of other objects, including model animals; they failed to notice that answers like 'to the left of the cow', which they classify as wrong, are actually right if one takes the point of view of the cow. Whether objects have intrinsic lefts or rights (like desks) or not (like tables) is an extraordinarily complex part of the spatial system of the European languages, and most of the Piagetian literature seems blind to these linguistic distinctions.

31. See Laughlin 1984:21.

32. There is no preferred direction, informants said, but a dispreferred direction is with head 'downhill' (i.e., in the direction of the downward-sloping lay of the land to the north). This would amount to sleeping *kojkoltza'*, 'upside-down'. However, they noted that they themselves often ignore this precept.

33. On weaving and dress see Branstetter 1974.

34. Women pleat their skirts and wrap belts many times around themselves, but it is not clear whether this favors one direction (Branstetter 1974 gives no clues). Certainly not all women do it in the same direction, although any given woman always does it the same way. Films we have taken of festivals indicate that male office-holders tend to wear their ceremonial white net bag on the right hip and grasp their ceremonial staffs, unsurprisingly, in the right hand.

35. That is, Tenejapans—including ritual experts—do not articulate any rationale for the direction of a given ritual circuit in terms of clockwiseness or handedness; its direction is "simply the way we've always done it." In fact, there does seem to be a tendency for such circuits to go counterclockwise. Rostas (1986) notes that in the fiesta for San Tziako, a major festival in Tenejapa center, the route followed by the procession through the town is always the same, a counterclockwise circuit, and in some fiestas, a small counterclockwise circuit is also conducted inside the church before returning the saints to their places. Similarly, in the prayer for restoring someone's lost 'soul', the curer verbally searches from township to township, circling in a counterclockwise direction around Tenejapa. But 'counterclockwise' is our description of a route that Tenejapans do not conceive of in these terms, and some ritual circuits differ. As mentioned above, in a local festival we have watched a perambulation of the sacred image that started out counterclockwise, then retraced its steps clockwise.

36. Like many languages, Tzeltal has a single term for upper limb (including hand) and another for lower limb (including foot). See Stross 1976 for the details of Tzeltal anatomical terminology.

37. The Berlin, Kaufman, and Maffi (1990) Tzeltal dictionary lists an adjectival root *xin 2* (distinct from the noun root *xin 1*) with negative connotations: *xin 2*, A root, aj, 'stinking'; *xinal*, A root, aj, 'stinking' (attributive form); *xinal(il)*, A root, n 3, 'stench'. Tzotzil, although lacking the noun *xin* 'left-hand' (or cognates) has the same adjectival root, *xin* 'rancid, smelly, of body odor, acid flavor given to food by metal pot' (Laughlin 1975). Haviland (p.c.) thinks this may be of recent origin, a corruption of *señora* (to *xinora* and hence to *xin*) the Indians making associations between fat-eating and the city-dwelling Ladinos. Certainly no Tenejapan informants offered us any association of this sort with 'left hand'. It should, however, be noted that recent missionary activity has drawn the attention of converts to biblical references to 'the right hand of God' and the weakness of the left hand.

38. de León (1992) makes an analogous observation for Tzotzil, which, she argues, lacks the cleavage of space along the front/back axis of the body.

39. There is another usage that *does* take into account the orientation of the speaker; in this special and restricted use, 'uphill' means 'further from speaker'. See discussion below and Brown and Levinson 1993b.

40. See Brown and Levinson 1992 for details of this case.

41. See DeSilva (1931). Thanks to Eve Danziger for drawing the reference to our attention.

42. These were photographs with two objects portrayed in each photograph, but with a left/right reversal of the objects in the corresponding member of the pair. For these sorts of paired objects, the description 'they have exchanged themselves' is applicable, as the two objects in one photograph have 'exchanged' their positions in the other. The root *jel* here gives rise also to notions of counterpart, namesake, successor, and so forth.

43. See Kolinsky, Morais, and Brito Mendes 1990 for comparable data on Portuguese literate or near-illiterate subjects. For part-whole figures of the kind that we used (high 'goodness' parts), her subjects correctly distinguished parts from mirror-image parts about 70 percent of the time.

44. Here we perhaps illegitimately extrapolate from findings by de Léon on the acquisition of spatial competence in Tzotzil children (de León, in press). Tenejapan children's absolute directional system needs to be checked. The youngest subjects in the tasks discussed here were about 9 years of age and used the absolute system flawlessly. Investigation of the acquisition of these and other Tzeltal spatial terms is in progress (see Brown 1993 for some preliminary findings).

45. For some remarks on the processing demands, see Levinson 1992b:20ff.

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