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# SPACE, TIME, SEMANTICS, AND THE CHILD[1]

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In the last decade psychology has witnessed a resurgence of interest in the mechanisms and processes by which the child learns his first language, and a primary issue in the recent literature has been the question, What is innate? The main proponent of the innateness hypothesis is N. Chomsky (1965, 1968), who has argued roughly as follows. The child must acquire his first language from the speech he hears around him. But this speech is simply too meager and too full of errors to enable him to induce the correct structure as quickly as he does. Therefore, he must have some a priori knowledge about that structure—some innate knowledge of language—that he brings to bear in acquiring language. Chomsky has also argued that the innate knowledge must be capable of accounting for those aspects of language that are truly inherent to language, i.e., to all possible human languages. So far, however, the innateness hypothesis has had a certain air of mystery about it, for most of the talk has been about disembodied ideas affecting the acquisition process in unspecified ways. Clearly, however, if a priori knowledge is to enter into the acquisition process, it must be transported by particular vehicles which can be followed through their course of development. Instead of appearing out of thin air, a priori knowledge must be seen as arising out of specific learning mechanisms, memory constraints, perceptual abilities, motor abilities, and the like.

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The thesis of the present chapter is that the child acquires English expressions for space and time by learning how to apply these expressions to the a priori knowledge he has about space and time. This a priori knowledge is separate from language itself and is not so mysterious. The knowledge, it will be argued, is simply what the child knows about space given that he lives on this planet, has a particular perceptual apparatus, and moves around in a characteristic manner. The exact form of this knowledge, then, is dependent on man's biological endowment—that he has two eyes, ears, etc., that he stands upright, and so on—and in this sense it is innate. For the present, however, it is more constructive to consider the present paper within a cognitive framework. The thesis is simply that the child knows much about space and time before he learns the English terms for space and time, and his acquisition of these terms is built onto his prior cognitive development.

The structure of the present argument is roughly as follows. The child is born into a flat world with gravity, and he himself is endowed with eyes, ears, an upright posture, and other biological structure. These structures alone lead him to develop a perceptual space, a *P*-space, with very specific properties. Later on, the child must learn how to apply English spatial terms to this perceptual space, and so the structure of *P*-space determines in large part what he learns and how quickly he learns it. The notion is that the child cannot apply some term correctly if he does not already have the appropriate concept in his *P*-space. Since this is so, the concept of space underlying the English spatial terms, to be called *L*-space, should coincide with *P*-space: any property found in *L*-space should be also found in *P*-space. This line of argument leads to two hypotheses about language and language acquisition, the correlation hypothesis and the complexity hypothesis.

The correlation hypothesis simply claims that the structure of *P*-space will be preserved in *L*-space—that is, there will always be a close correlation between *P*-space and *L*-space. In the following section, for example, it will be argued that verticality is a fundamental direction of *P*-space and that up is positive and down negative. The correlation hypothesis implies that verticality should therefore also be a fundamental dimension in spatial expressions, and that there, too, up should be positive and down negative. The correlation hypothesis, however, does not spell out the mechanisms by which this correlation comes about. The central thesis of the chapter will be supported even if we find evidence for the correlation hypothesis without being able to specify the acquisition mechanism.

This hypothesis is not a new one. In his important discussion of spatial adjectives in German, for example, Bierwisch (1967) has argued for much the same hypothesis:

> There are good reasons to believe that the semantic markers in an adequate description of a natural language do not represent properties of the surrounding world in the broadest sense, but rather certain deep seated, innate properties of the human organism and the perceptual apparatus, properties which determine the way in which the world is conceived, adapted, and worked on [p. 3].

Relying on this premise, Bierwisch laid out a number of properties in German adjectives which he characterized as "semantic universals." He did not, however, try to specify the "innate properties of the human organism" any further, nor did he try to set down the process by which the child would acquire the spatial terms and thereby manifest the semantic universals. In the language of the present paper, Bierwisch has supplied some of the properties of *L*-space, but none of the properties of *P*-space.

The complexity hypothesis is perhaps of more direct interest to developmental psycholinguists. It posits that the order of acquisition of English spatial terms is constrained by their rules of application. A rule of application is a condition that must be met before a word can be applied to a perceptual event. *Tall*, for instance, can be applied to a dimension only if that dimension is vertical (or canonically vertical, cf. below). More specifically, the complexity hypothesis claims that given two terms *A* and *B*, where *B* requires all the rules of application of *A* plus one or more in addition, *A* will normally be acquired before *B*. One aim of the present paper is to suggest rules of application for some of the English spatial terms and thus to allow the hypothesis to be tested on the pertinent acquisition data.

The complexity hypothesis is obviously a close cousin of Brown and Hanlon's (1970) "cumulative complexity hypothesis." The latter was proposed to account for the order of acquisition of certain complex sentence constructions. Their hypothesis was that given two constructions *A* and *B*, where *B* requires all the syntactic transformations required for *A* and then some, *A* will be acquired before *B*. There are two main differences between the Brown and Hanlon hypothesis and the present one. First, the Brown and Hanlon hypothesis pertains to syntactic forms whereas the present one pertains mainly to particular lexical items. Second, and more important, the Brown and Hanlon hypothesis makes use of transformations and other constructs internal to linguistic theory itself; in contrast, the present hypothesis refers only to the correspondence between lexical items—specifically, spatial or temporal terms—and perceptual events. The rules of application in the latter theory are not simply rules concerning structure internal to the language; they are rules about extension, about meaning. This complete reliance on meaning alone, in fact, might well be a critical defect of the complexity hypothesis, but such a hypothesis is worth pursuing to see just how far it can go in accounting for order of acquisition.

The complexity hypothesis is also not unique. In this volume, E. Clark presents an equivalent hypothesis—the semantic feature hypothesis—which posits that children learn to apply words to perceptual and cognitive events one semantic feature at a time. Because of this, E. Clark's chapter is an important companion piece to the present one. The chapters, in fact, are more complementary to each other than they would first appear. Besides positing a compatible hypothesis, E. Clark lays out an impressive array of data on the child's first words showing that their overextended meanings are based almost exclusively on perceptual features. Although many of these perceptual features are different from and less specific than those to be discussed here, they constitute further evidence for the first correlation hypothesis: The perceptual features in the child's early cognitive development (his *P*-space) are reflected directly in the semantics of his language (his *L*-space).

The present chapter therefore consists of four sections. The first lays out the properties of *P*-space based as completely as possible on physical and biological criteria. The second explores the comparable properties of *L*-space, those properties that underlie English spatial expressions and that can be derived wholly from linguistic considerations. The third section presents some properties of English time expressions; these terms, it is argued, are based on a spatial metaphor, and they therefore contain some of the same properties as the spatial expressions. The final section examines the correlation and complexity hypothesis in more detail, and discusses some of the available evidence for them.

## PROPERTIES OF *P*-SPACE

Man is an inhabitant of a world consisting of objects, people, space, and time. And because of his biological makeup, he perceives these objects, people, space and time, and their interrelations in a particular way. These are the conditions under which all speakers of any language have learned to speak and to describe the location of objects. But clearly man's physical and biological environment itself places a large number of constraints—a priori constraints—on how he can describe the location of objects. It is these constraints—the properties of *P*-space—that I want to delve into first, for as we will see, the properties of *P*-space are strikingly close to the properties of the linguistic system (or *L*-space) the speaker of English actually uses in describing the locations of objects in space.

There are a number of ways we could describe the physical location with respect to man. If we were physicists or geometers, we would be inclined to see how physical location might be specified in general. Or, if we were

geologists, then we might be more interested in specifying man's location and environment with respect to certain terrestial characteristics—e.g., gravity and the perceived flatness of the earth. Or, if we were biologists, we might want to emphasize that fact that man has the predictable biological characteristics of a human, and these could enter into how we describe man's *P*-space. And finally, if we were social psychologists, we might be more interested in how man talks and interacts with other people, and in what role these other people might have in specifying his *P*-space. That is, there are many ways of viewing man, and as we will see, each of them adds to our understanding, eventually, of why at least the English speaker talks about space and time the way he does.

**Reference Points, Lines, Planes and Directions**

The physicist or geometer would ask, first, about what it means to locate an object in space. In answer, he would probably point out that one object must always be located with respect to other positions in the space, and normally that means with respect to other objects in space. For instance, an object's location can be uniquely defined in three-dimensional space by specifying its distance from each of four other (noncoplanar) locations in space. But this abstract way of specifying location is too clumsy for most purposes, and this has led to the development of reference systems or coordinate systems. The advantage of these coordinate systems—for example, the familiar Cartesian coordinate system with its *x*-, *y*-, and *z*-axis—is that they make distances easier to define and, once defined, easier to use. Let us examine the Cartesian coordinate system in more detail and see what its properties are.

Consider how a physicist would specify the location of a point on a straight line, say, the *x*-axis in a Cartesian coordinate system. By one method, he could set up two points on this line, say zero and one, and then locate the point of interest as five units from zero and four units from one (where the unit is defined as the distance from zero to one). In this instance, he has to specify four things—two reference points and two distances—to locate the point of interest. But in a second and more convenient method, the physicist would first define the *x*-axis as having a single reference point at the origin, or zero, and as having positive values in one direction from that reference point and negative values in the other. Now he can specify his point of interest simply as five units in the positive direction from zero. Although the two methods are exactly equivalent—in fact, one can be translated directly into the other—the second is more convenient, especially in more than one dimension. The point to be gained here is that in one dimension, location is best defined as a directed distance from a zero reference point.

In two or three dimensions, this type of specification generalizes in a convenient way. In two dimensions, i.e., on the Cartesian $x$- and $y$-axes, location is specified by two directed distances, one distance from the reference line designated as the $x$-axis and the distance from the other reference line designated as the $y$-axis. In three dimensions, location is specified by directed distances away from the three possible reference planes, the $x,y$-plane, the $x,z$-plane, and $y,z$-plane. To illustrate, we can locate a fly near the corner of a room as being 6 inches (a distance) up (a direction) from the floor (the $x,y$-plane), 10 inches into the room from the front wall (the $x,z$-plane), and as 13 inches into the room from the left side wall (the $y,z$-plane).

The most basic notions in the physicist's specification of location are: (1) reference points, reference lines, and reference planes; and (2) reference directions. Objects are located with respect to other things in space, and these other things can be other (reference) points in the one-dimensional case, reference lines in two dimensions, and reference planes in three dimensions. These reference points, lines, and planes, by simple geometry, define directions. Consider the reference plane. One can always draw a line perpendicular to the reference plane and call it a direction. Furthermore, it will be a signed direction, for distance away from the reference plane on one side will be positive, and on the opposite side, negative. We will see that the notions of reference points, lines, and planes, and their associated signed directions, are basic to our conception of man's $P$-space.

**Gravity and Ground Level**

Given the physicist's constraints on how we must specify $P$-space, the geologist would immediately point out that our planet affords us at least one natural reference plane and associated direction. Consider gravity. It defines a natural direction—verticality—which can be specified locally anywhere on the earth. Furthermore, there is a natural, terrestrial plane of reference—ground level. This reference plane is also found everywhere on the earth, and in any local area, it is normally flat and roughly perpendicular to the vertical, at least enough so that it can be used quite easily as a reference plane. As invariant aspects of man's environment, ground level and gravity can serve as a natural reference plane and reference direction in $P$-space.

For verticality to be useful, however, it should have a natural positive and negative direction from ground level. The $x$-axis in the Cartesian coordinate system, for example, has a positive and negative direction from the reference point at zero. Fortunately, gravity helps us to define a natural positive and negative direction, for gravity is asymmetrical, pulling objects in one direction and not the other. At this point, it would be arbitrary to call upward or downward positive, although we will later examine biological

reasons why it would be more natural to consider upward positive and downward negative.

**Asymmetries of Perceptual Space**

When the biologist considers man, he might first note that the human body has bilateral symmetry. The external organs of the body are approximately symmetrical left and right of a vertical plane running through the center of the body. The left eye is matched by the right one, the left ear by the right one, the left arm by the right one, and so on. And there are no other lines or planes of symmetry in the body. So man's *P* space contains only one natural plane of symmetry, the vertical plane separating left and right.

In particular, man has a bilaterally symmetrical perceptual apparatus, including, most prominently, eyes for seeing, ears for hearing, nose for smelling, mouth for tasting, and lips, hands, fingers, and face for sensitive touching. This apparatus makes perception itself bilaterally symmetrical, further helping to define a plane of symmetry through the length of the body separating left and right. Another property of all these senses is that they are most sensitive to stimulation in front of the body, and least sensitive to stimulation in back of the body. The ears, even, have pinnae that are directed forward and not backward. The perceptual apparatus therefore defines a clear plane of *asymmetry*, the vertical plane running through the body separating front from back. Notice that by similar criteria, there is another plane of asymmetry at the base of the feet: Objects above ground level are characteristically visible, audible, smellable, tasteable, and touchable, whereas objects below ground level are not. In short, man's perceptual apparatus alone quite naturally defines three reference planes: one plane of perceptual symmetry (the vertical plane separating left and right) and two planes perpendicular to this plane and to each other about which perception is asymmetrical (the vertical plane separating front from back, and the horizontal plane at ground level).

These facts of perception also suggest how we could assign positive and negative values to the directions away from the two planes of asymmetry. First, since everything in front of the vertical plane is easily perceptible and everything behind it is not, the forward direction can be considered the positive perceptual direction, and backward the negative one, where *positive* is taken in its natural sense to mean the presence of something, and *negative*, the absence. Similarly, since everything above ground level is perceptible and nothing below it is, upward is naturally positive and downward is naturally negative. On the other hand, the reference plane separating left from right is symmetrical, and therefore, there appears to be no reason, at least perceptually, to choose either leftward or rightward as being the positive direction.

Another biological characteristic of man is his bipedal stance. When man is talking or walking, or in general when he is alert and in the optimal position to perceive other objects visually, auditorily, tactually, etc., he will normally be upright. This is what I will call man's canonical position, since it is the position from which he carries out most important activities. Note that when man is in canonical position, the biological vertical coincides with geological vertical (where the biological vertical is simply the intersection of the two vertical reference planes, i.e., the line running from head to feet through the middle of the body). So although it is logically possible for there to be two different verticals in *P*-space—a biological and a geological one—when man is in canonical position, these two verticals reduce to one, thereby simplifying *P*-space considerably. We will see later where the notion of canonical position has several important consequences for language.

The final biological fact to be discussed is that man characteristically moves in a forward direction. That is, he walks in the direction he faces, not to the side or backward. Needless to say, this fact fits in well with man's perceptual apparatus, for he moves in the direction over which he has optimal perceptual regard. So we can also define a front–back dimension in man's biological makeup simply from the characteristic direction in which he moves. And from these considerations forward is again the positive value on the dimension, and backward negative, since movement is normal in the forward direction, and abnormal in the backward direction.

To summarize briefly, the biologist would assert that man's *P*-space contains three natural reference planes. The vertical plane separating left and right is symmetrical biologically so that positive and negative values cannot be attached to the left and right directions in any appropriate way. The vertical plane separating front and back, in contrast, is biologically asymmetrical, with frontward positive and backward negative. And ground level, the third reference plane, is asymmetric with upward positive and downward negative. Biological vertical and ground level are even more convenient as reference planes in *P*-space since when man is in canonical position, they coincide exactly with the geological vertical and ground level.

**The Canonical Encounter**

From the social psychologist's viewpoint, man is a social animal, who enjoys, perhaps even needs, to interact socially with other people. What are the characteristics of the most usual interaction between two people, John and Mary? For our purposes, the most important property is that they will be facing each other a short distance apart. It is in this position that John and Mary are situated for the optimal perception of messages—both verbal and

nonverbal—from the other person. John is in Mary's positive perceptual field, and Mary is in John's. If John and Mary were side by side, or back to back, or back to front, or in any other position, these conditions would no longer be optimal. It is no accident that normal conversations are carried out face-to-face. This face-to-face situation is what I would like to refer to, for convenience, as the canonical encounter. As we will see, the canonical encounter, as another basic property of man's *P*-space, has some very important consequences in language.

It is also of interest to note how movement occurs in man's social surroundings. First, other people and objects can move into John's field of view. In doing so, they must first be out of view, then come from the distance, and finally approach his position. Characteristically, if the approaching object is another person (say, Mary), she will approach in his forward (positive) field of vision, walking forward, facing him. The final position will be the canonical encounter. Second, John could move and approach other people and objects which are standing still. These objects will at first be out of his sight, and then they would come into view in his positive field of vision—he is walking forward—and finally he would be in a canonical encounter with that object or person. The point to be made from these observations is simply that potential objects to be described come in and out of John's field of vision in a characteristic manner: They enter the field toward John and leave the field away from him.

### Summary

We are now in a position to summarize at least the main characteristics of man's *P*-space. When man is in canonical position, *P*-space consists of three reference planes and three associated directions: (1) ground level is a reference plane and upward is positive; (2) the vertical left-to-right plane through the body is another reference plane and forward from the body is positive; and (3) the vertical front-to-back plane is the third reference plane and leftward and rightward are both positive directions. Only when man is not in canonical position can we define a geological vertical that is separate from the biological vertical. Finally, there is the notion of canonical encounter, which consists of one man confronted face to face by another man a short distance away.

## THE PROPERTIES OF ENGLISH *L*-SPACE

Having surveyed the properties of man's *P*-space, we turn to the structure of the *L*-space of English, the tightly organized semantic structure of English spatial terms. The main concern here will be with adjectives (like *long* and

*short*) and prepositions (like *above* and *below*), but we will also have occasion to refer to the many nouns that must be considered spatial too (e.g., *top*, *side*, *front*, etc.). Fortunately, there have been a number of excellent studies recently on English (and related) spatial terms, including Bierwisch's (1967) studies of German spatial adjectives, Teller's (1969) related study of English spatial terms, several chapters in Leech's (1970) book on semantics, and a series of papers and lectures on spatial, temporal, and deictic terms by Fillmore (1967, 1971, and unpublished). Although in this and the following sections I have borrowed freely from these sources, these investigators should not be held responsible for the use to which I have put their evidence, nor for the linguistic evidence and proposals that I have added myself.

**General Properties of *L*-Space**

Probably the most obvious property of English adjectives and prepositions is that they require the notion "point of reference," following exactly on the definitions of point of reference from the previous discussion of *P*-space. Consider the prepositions *above* and *below*. The sentence *John is above Mary* is a statement of John's position with respect to Mary's position. Her location is taken as the point of reference, and John is being located with respect to her. The same holds for all prepositions in English. In each case, the object of the preposition serves as a reference location—either a point, line, or plane—for locating other objects.

What is less obvious is that the spatial adjectives also require the notion "point of reference": in fact, each adjective has two points of reference. Consider the adjectives *high* and *low*. To say *The balloon is high* (or *low*) is really to say *The balloon is high* (or *low*) *off the ground*. Implicit in such simple statements is a zero point, an origin, the point of reference from which all measurement is taken. *High* and *low* happen to have a particular reference plane—ground level—unless some other reference plane is mentioned explicitly. This origin or zero point could be called the primary point of reference. Adjectives also have a secondary point of reference. *High* and *low*, to continue the example, both refer to height off the ground, but *high* indicates a distance that surpasses some implied standard, and *low* indicates a distance that fails to meet that standard. This standard depends very strongly on what exactly is being measured, as many linguists have pointed out, for one would describe a balloon as high in a room when it was perhaps 6 feet high, but in a large auditorium perhaps only when it was 10 to 20 feet high. The main point here is that *high* has two implicit reference points: ground level (the primary one) and some standard height (the secondary one). *The balloon is high* may therefore be paraphrased as "The balloon is above some standard height from the ground level." Because of these double points of reference, adjectives are more complex than they first appear.

Another basic property of English spatial terms is the notion of direction. Certain adjectives and prepositions in English apply only to certain directions. *High* and *low*, for example, apply only to verticality, and this is derived from the fact that their primary plane of reference is ground level. *Above* and *below* also apply only to verticality. What will be of interest is whether there is any intrinsic positivity or negativity on the directions defined by these adjectival and propositional scales, as there was in *P*-space. As we will see, there is.

To be able to discuss the structure of *L*-space in detail, we will have to refer often to the notion of markedness. In linguistics there are many structural indications that show that one particular form is less complex than another. The general cover term for these differences is markedness: The more complex term is said to be marked with respect to the less complex term. The structural indications of markedness are quite varied. One of the most general is the use of an extra linguistic element in specifying the marked form. For example, *unhappy* would be said to be marked with respect to *happy* since *unhappy* contains the extra prefix *un-*. Another indication is given by Bierwisch: "A sentence is the less normal [is marked] the more conditions outside of it have to be met for it to be acceptable." To give an example, *How tall is Harry*? is a neutral question about Harry's height, whereas *How short is Harry*? asks about Harry's height, but in addition it presupposes that Harry is relatively short. This presupposition is an additional condition outside of the sentence that has to be met, and therefore *short* can be said to be marked with respect to *tall*. In the sections that follow, I will refer to a number of different criteria, mostly taken from Greenberg (1966), all specifying which of two forms is marked. Since not all of these criteria are as transparent as the two I have listed here, one should consult Greenberg (1966) for further justification of the criteria.

## The Structure of Nonegocentric *L*-Space

The uses of the spatial terms in English can be divided generally into two categories: those that demand reference to the ego as either a primary or secondary point of reference, and those that do not. In this section, I will consider the second category of uses, what Fillmore has called the nondeictic use of the spatial terms. We will examine the information presupposed in adjectives more carefully and determine some of the points of reference and directions implicit in English *L*-space.

### *Adjectives*

English has only a small number of basic spatial adjectives, but they reveal a number of very important properties about English *L*-space. The adjectives to be examined are: *long–short*, *far–near*, *tall–short*, *high–low*, *deep–*

*shallow*, *wide–narrow*, *broad–narrow*, and *thick–thin*. These adjective pairs define the dimensions length, distance, tallness, height, depth, width, breadth, and thickness, respectively. Furthermore, the first member of each pair is unmarked and the second is marked (cf. H. Clark 1969). Note that it is the first member of each pair that is used as the basis for each scale name. Thus, one can define a positive direction for the *long–short* scale as extending infinitely in one direction from the primary point of reference, the zero point of no length. This dimension is called length in English, whereas shortness is defined only with respect to the secondary point of reference. Shortness is a defective scale extending only from that secondary standard in a negative direction to the zero point, the primary point of reference. Each of the other scales works in the same way, with the unmarked member of the pair used as the name of the scale defining the positive direction and as the term labeling an excess in that direction.

These adjective pairs differ, however, in their conditions of application. *High–low*, for example, requires that the object to which the adjectives are applied be three-dimensional and have a vertical dimension. To say *The glip is tall* is to presuppose these two conditions about glips. In this sense, the adjective pairs can be classified into three categories: (1) those that presuppose objects of at least one dimension; (2) those that presuppose objects of at least two dimensions; and (3) those that presuppose objects of at least three dimensions. They can also be classified as to whether they specify the extent of an object or the position of an object.

*Far–near* and *long–short* are the two most elementary pairs of adjectives in that they presuppose only that the object described is at least one-dimensional. The extent of any one-dimensional object—like a line in geometry—is called its *length*; and one speaks of the *distance* from one point to another. The difference between *length* and *distance* is that *length* is extensional—it specifies the extent of an object—whereas *distance* is positional—it specifies the position of one point with respect to another. As the two most neutral terms among the spatial adjectives, *length* and *distance* can be used in the definitions of all the rest.

*Tall–short* and *high–low* are more complex since they presuppose three-dimensional objects and require that the dimension they are applied to be vertical. (Though slightly wrong, this statement will be corrected later.) Normally, tallness and height cannot be defined unless there is some ground level usable as a plane or line of reference, and this condition automatically rules out applications of these terms to objects in only one dimension. Furthermore, tallness and height show the same extensional–positional split as do length and distance. Note that *tallness* can be glossed as "vertical length" and *height*, as "vertical distance," and *high*, for example, means "far off the ground." As already pointed out, height is always taken with respect

to ground level unless some other reference plane is specified, as in *The balloon is high off the table*. Tallness, too, is always measured from some ground level up, although the base of the object specifies what is to be taken as ground level, as in *The flagpole on top of that building is very tall*. As for the properties of *L*-space, *height* and *tallness* are the first terms to show that *L*-space contains: (1) ground level as a plane of reference, and (2) verticality, the direction perpendicular to ground-level, as a reference direction.

*Deep–shallow* is the next pair that presupposes a three-dimensional application, and it means, roughly, "distance into something from its surface." That is, an object to which *depth* is applied must be thought of as a container, having a definable surface and an inside dimension. Thus, we can speak of a deep mine, a deep cupboard, a trail deep into the forest, but not of a deep flagpole (meaning "a long flagpole"), a deep window, or a deep tree. Frequently, the earth is taken to be the container, and ground level as the surface, and then *depth* is taken to be the vertical distance downward from ground level. The facts about this vertical *depth*, in fact, show that upward from ground level is unmarked, or positive, and downward is marked, or negative. Note that whereas the extensional and positional terms are separate for dimensions above ground level—*tallness* and *height*, respectively—these two functions are carried by the same term *depth* for dimensions below ground-level. *The mine is fifty feet deep* speaks of the extent of the mine, while *John is fifty feet deep in the mine* specifies John's position. This is a case of syncretism, to use Greenberg's term, indicating that the two senses of *depth* are marked with respect to *tallness* and *height*, respectively. Furthermore, the positional use of *depth* is defective. Whereas the unmarked term *deep* can be used positionally (as in *the deepest level in the mine*), *shallow* cannot (**the shallowest level in the mine*); this should be compared with *high* (*the highest level in the mine*) and *low* (*the lowest level*), both of which can be used positionally. This, by Greenberg's criteria, would be another indication of *depth*'s markedness with respect to *tallness* and *height*. This evidence shows that distance up from ground level is positive, and distance down is negative. This property of *L*-space coincides exactly with the corresponding property of *P*-space.

Not much will be said about the last two pairs, *wide–narrow* (and its close relative *broad–narrow*) and *thick–thin*. *Width* can generally be applied to objects with two or more dimensions, and *thickness* (in its linear sense), to those with three dimensions. *Width* is a term applied to objects once *tallness* or *length* has applied to the maximal dimension. *Thickness* is generally applied to objects once *tallness*, or *length*, and *width* have been applied to their two maximal dimensions; we speak of a door 6 feet tall, 2 feet wide, and 2 inches thick. Both *width* and *thickness* are normally extensional terms, although *wide*, but not *narrow*, can be used in a positional sense, as in *The arrow*

**Table 1** *A Summary of Some Properties of English Spatial Adjectives*

| Adjective pair | Extent or position | Number of dimensions | Unmarked point of reference | Dimension |
|---|---|---|---|---|
| long–short | + extent | 1 | ego | length |
| far–near | + position | 1 | ego | distance |
| tall–short | + extent | 3 | ground level | tallness |
| high–low | + position | 3 | ground level | height |
| deep–shallow | + extent | 3 | any surface | depth |
| deep | + position | 3 | any surface | depth |
| wide–narrow | + extent | 2 | a secondary edge | width |
| wide | + position | 2 | a secondary edge | width |
| broad–narrow | + extent | 2 | a secondary edge | breadth |
| thick–thin | + extent | 3 | a tertiary edge | thickness |

*went wide of the mark.* The main point here is that both *width* and *thickness* are marked with respect to *length* and *tallness*, since the former require more conditions to be met before they can be used. The main properties of all these adjectives are summarized in Table 1.

*Prepositions*

The adjectives of English share many of their properties with prepositions. For example, prepositions contain certain presuppositions about their point of reference—e.g., whether it is one-, two-, or three-dimensional, what types of inherent properties it has, and so on. The prepositions we will be interested in consist of *at*, *on*, *in*, and related terms, the pairs *ahead–behind*, *in front–in back*, *above–below*, *over–under*, *on top of–underneath*, *up–down*, and certain other pairs.

The most neutral prepositions in English are *at*, *on*, and *in*. Consider the frame *A is at/on/in B*. All three prepositions assert that *A* is in the same location as *B*, but *at*, *on*, and *in* presuppose that the location of *B* is a one-, two-, and three-dimensional space, respectively. So, as Fillmore has pointed out, *John is on the grass* treats the grass as a two-dimensional surface, whereas *John is in the grass* treats the grass as a three-dimensional space where John is inside the space with grass all around him. Furthermore, these three positional terms—*at*, *on*, and *in*—are closely related to the three positive direction terms *to*, *onto*, and *into*, to the three negative directional terms *from*, *off (of)*, and *out of*, and, as Fillmore has also pointed out, to the three path terms, *via*, *across*, and *through*, which I have listed in Table 2. It is clear from this table that the following markedness relations hold: First, positionals are unmarked with respect to positive directionals, since the latter are generally formed by adding *to* to the former. Second, the one-dimensional prepositions are unmarked with respect to the two- and three-dimen-

sional prepositions, since the latter are often formed from the former plus an additional morpheme. (This is particularly the case when one considers *of* simply to be a neutralized variant of *from*.) Third, negative directions can be shown to be the negatives of their positive counterparts (cf. Gruber, 1965), and in this sense, positive directionals are unmarked with respect to negative directionals. Thus, *at* appears to be the least complex preposition, and the farther the word is from *at* in this table, generally, the more complex (or marked) it is.

What should we conclude from these facts? The main point, perhaps, is that the most primitive notion in the use of prepositions is punctual location—the positioning of something at a point. This coincides with the physicist's most basic definition of location. The markedness of two- and three-dimensional terms shows that they presuppose more complex properties of the location—that the location is on a surface (for *on*), or within a space (for *in*). Thus the point of reference is simple in one dimension and more complex in more than one dimension, a fact coinciding with the relative simplicity of one-dimensional *distance* and *length* compared to the more-than-one-dimensional *tallness*, *height*, *depth*, and the other adjective scales. Furthermore, the specification of motion, or directionality, with respect to these locations is more complex than the simple locative specification. This also coincides with the physicists definition of motion, which requires the concept of position plus direction.

The directional prepositions have several other revealing properties. Note that a *from*-phrase indicates the beginning of movement and a *to*-phrase indicates a positive direction for the end of movement. Using this information, one can see that the spatial dimensions that were said to have a certain positive direction are consistent with these prepositional uses. One says *height off the ground*, but not **height to the ground*, indicating that groundward is the negative direction for the height dimension. The analogous statements hold for *John is a great distance from (*to) here* and *John is at a great depth from (*to) the surface of the ocean*. Also, it is more natural to specify a location as from *three to six feet up the tree* rather than as *from six to three feet up the tree*. The metaphor here is one of a journey. *Distance*,

**Table 2** *Prepositions of Location and of Location + Direction*

| Number of dimensions | Location | Positive direction | Negative direction | Path |
|---|---|---|---|---|
| 1 | at | to | from | via |
| 2 | on | onto | off | across |
| 3 | in | into | out of | through |

*height*, and *depth* have their positive directions defined by a metaphorical movement in the positive direction. This fact, too, coincides with the properties of *P*-space: the direction of movement in *P*-space is towards the positive perceptual field.

I next consider what I will call relational prepositions, words like *above–below*, *ahead–behind*, *over–under*, and so on. These indicate location, just like *at*, *on*, and *in*, but they do so by specifying a direction from the point of reference in which the object is located. *Above B*, for example, could be glossed as "at a position in an upward direction from *B*." What is important for our purposes is the direction indicated in these prepositions. Clearly, *above–below*, *over–under*, *on top of–beneath*, etc. presuppose a vertical direction, but this vertical could be defined (1) by direct reference to gravitational vertical; or (2) with reference to the top and bottom sides of the reference object, which are in turn defined (canonically) with respect to gravitational vertical. Even though it is more complex, the second specification appears to be preferable because it will be required for uses of *above–below*, etc., with dimensions not coincident with gravitational vertical, and because it accounts for the explicit reference to top and bottom sides in such terms as *on top of*, *underneath*, *at the bottom of*, etc., which are used as simple prepositions. Furthermore, the second specification fits nicely with the front–back terms—e.g., *in front of–in back of*, *ahead–behind*, *before–after*—which also have to refer to intrinsic properties of the referent objects. To use these terms, one must define the front and back of the point of reference—say, the front and back of a car—and then refer to the space adjacent to the front and back sides as *in front of* and *in back of*, respectively. Unlike the top and bottom, however, the front and back of something can be defined in a number of sometimes conflicting ways. As Fillmore has pointed out, the front is normally the end of the object containing the perceptual apparatus (e.g., dogs, fish, crabs, etc.), or the end that leads when the object is in typical motion (e.g., *in front of the rocket in outer space*), but in some cases these two criteria conflict and one must be chosen as primary (as in *crabs move sideways*).

The relational prepositions vary in the number of dimensions they presuppose of the space their point of reference defines. *In front of–in back of*, *ahead–behind*, and the like presuppose simply a one-dimensional space. One can define the front and back of a point in a single dimension simply by referring to the direction in which the point is moving, although, of course, *front* and *back* can also be defined for three-dimensional objects. These terms, then, are close relatives to *length* and *distance*, which can also be defined in one dimension alone. In contrast, the top and bottom of an object can only be defined in a three-dimensional space, where a ground level and a corresponding vertical are well-defined. Thus, *above–below*, *over–under*, *on*

*top of–underneath*, and the like presuppose a three-dimensional space, just like their close relatives *tallness* and *height*. Furthermore, *beside* presupposes at least two dimensions, since the *side* in *beside* refers to a facet of an object not defined as the front or back, or top or bottom; in this sense, *beside* is like *width* and is applied to a secondary dimension once the primary dimension has been designated. But as we will see later, the use of these prepositions is complicated by the introduction of ego as primary point of reference. The relative simplicity of these terms, therefore, is not exactly comparable to the relative simplicity of the spatial adjectives.

Another point can be made about certain relational prepositions. Consider the definitions of *front* and *back*, and consequently the definitions of *in front of–in back of*, *ahead–behind*, *before–after*, and similar pairs of prepositions. It is *front* that is always defined in a positive way. The front of an object is the facet that contains the perceptual apparatus, as in animals, whereas the back is that facet which does not. The front is the direction towards which an animal moves, and the back is the direction from which an animal moves; front is the positive direction, and back is the negative direction, as discussed above for *to* and *from*. Furthermore, *ahead of* metaphorically indicates positive direction on any scale to which it can be applied, as in *John is ahead of Pete in height* (which means "John is taller than Pete"), *in competence* (which means "John is more competent than Pete"), *in size*, *in weight*, *in intelligence*, and so on. *Back*, on the other hand, is found in many negative constructions, as in *Pete is backward in school*, *John is behind in his work*, etc. In short, *front* and all its prepositional offspring are positive, and *back* and its offspring negative, indicating that *L*-space has a *front–back* dimension that coincides exactly in its asymmetry properties with *P*-space.

## Notion of Canonical Position in *L*-Space

The previous discussion of adjectives and prepositions that presuppose a vertical dimension was complicated by the fact that English recognizes two kinds of verticality—geological (or gravitational) and intrinsic. Certain objects are considered to have intrinsic tops and bottoms, just as some objects have intrinsic fronts and backs. Among these objects are bottles, chairs, tables, people, some boxes, doors, desks, and buildings. The tops and bottoms are not defined relative to gravity, for, even if a bottle, for instance, were on its side, we could speak of a fly on the top of the bottle, meaning "on the side with the opening." Indeed, tops and bottoms in these cases appear to be defined relative to a canonical position, the upright position. Bottles, chairs, tables, people, and so on are normally found in a particular position, and tops and bottoms are defined by gravitation relative to this

position. One striking example of this phenomenon is the convention for measuring the head-to-toe length of people in English. One speaks of very young babies, whose canonical position is *not* upright, as "18 inches *long*," yet of adults whose canonical position *is* upright, as "72 inches *tall*." Also, one does not speak of a girl lying on a beach as "5 feet long," even though she is not in an upright position: We automatically speak of her height *as if* she were in canonical position. In yet another example, Herb Caen (*San Francisco Chronicle*, November 18, 1969) reported a story about a Bank of America vice-president who was asked what would happen to the Bank of America Building in an earthquake three times as strong as the strongest quake ever recorded. The vice-president is said to have replied, "Then, instead of having the tallest building in town, we'll have the longest."

The distinction between gravitational top–bottom (the top and bottom sides defined by an object's present position) and intrinsic top–bottom (the top and bottom defined by canonical position) often leads to ambiguities. If a chair is on its side, then one can say, "There is a fly on top of the chair," no matter whether the fly is on the gravitional top or the intrinsic top. The sentence "There is a fly on *the* top of the chair," however, seems to refer only to the intrinsic top. Furthermore, to the girl lying on the beach, one could say, "There is a fly three inches above your knee," and this could be taken to mean either "There is a fly flying three inches vertically from your knee" or "There is a fly on your leg three inches headward from your knee." In short, canonical position plays an important role in the application of English prepositions to certain types of objects.

**The Structure of Egocentric Space**

When the speaker and/or addressee is included in the specification of English spatial terms, their structure becomes more complicated. Yet, significantly enough, the structure becomes complicated in a direction quite compatible with the properties of *P*-space, for it is at this point that the canonical encounter and other *P*-space properties also appear in *L*-space.

The introduction of the speaker or ego into these specifications means that the ego is now able to serve as a point of reference, and English makes considerable use of this factor. As I pointed out above, the positional adjectives *high*, *low*, and *deep* have a naturally defined plane of reference (ground level) which is inferable whenever no other plane of reference is specified explicitly or by context. As for *distance*, it is the ego that serves as the point of reference in unmarked cases. Consider the sentence *San Francisco is far*. This implies that San Francisco is far from here or from me. The same point of reference is found in variants of this sentence, e.g., *It is far to San Francisco*, *San Francisco is far away*, *San Francisco is 30 miles away*, and so on.

The ego is also often taken as the primary point of reference for *length*, the extensional counterpart of *distance*. Recall that *length* is applied to the primary dimension of an object, while *width* is applied to the secondary dimension. When ego is involved, the question is, what is the primary dimension? Evidence shows that the primary dimension is taken as the one running forward from ego, with ego as the primary point of reference. Consider objects toward which ego has a conventional orientation. People normally face desks, sit on couches and in chairs, face stoves, and so on. The *width* of each of these objects in considered to be the dimension running from side-to-side while ego is in this conventional position. The side-to-side dimension must have been considered secondary, then, to the front–back dimension. Unfortunately, in many objects, the front–back dimension is shorter than the side-to-side dimension, and since there is another rule that states that *length* should be applied to the nonegocentrically longer dimension, we tend not to call this dimension *length*; in couches, for example, it would be confused with the width, the longer dimension. Instead, we use a term like *depth* which is also acceptable. Notice that nonegocentrically, a couch would be described as 10 feet long and 3 feet wide, but when the egocentric viewpoint is taken it is described as 10 feet wide and 3 feet deep. (As we will see, this difference between egocentric and nonegocentric points of view will cause ambiguities again and again in English spatial descriptions.) The main point, nevertheless, is that the ego enters into the specification of length and width, serving as the point of reference for length and thereby defining width as the secondary side-to-side dimension.

In prepositions, the introduction of the speaker and the addressee has even more significant consequences. Note, first, that ego could only have an effect on the relational prepositions, since the others make no reference to directions. And the most important consequences occur in the words referring to *front* and *back*. Again, these prepositions, when used without specific points of reference, implicitly refer to ego as the point of reference, unless context indicates otherwise. *San Francisco is ahead* means "San Francisco is ahead of me" (or of here); and this is also true of *San Francisco is ten miles ahead*, *San Francisco is ten miles behind*, etc.

The use of *front* and *back* to refer to objects without specifiable fronts and backs, however, requires the notion of the canonical encounter. If the speaker is looking at a ball and a fly across the room, he can say: *The fly is in front of the ball.* By this he means, "The fly is between the ball and me." Since the ball has no front or back, we are forced to the following conclusion on the application of these words: the speaker treats such an object *as if* it were the other person in a canonical encounter, a person facing directly towards the speaker. Once we assume this principle of application, all sentences like *The fly is in front of the ball*, *The ball is in back of the tree*, etc.,

become explicable. It should be noted that, in general, the nearer side of such a point of reference is the positive side, since that is the side that will always remain unobscured by the point of reference. In this sense, the application of the positive *in front of* is quite consistent with its other applications. Finally, it is important to note that *this side* and *the other side* (of, say, a tree) have the same properties: *the other side* specifies that side negatively by saying that it is the side that is *not* assumed to be primary.

In English, therefore, there are two fronts and backs: (1) an inherent front and back, as of a car, person, rocket, or whatever; and (2) an egocentric front and back, that defined by the canonical encounter. Unfortunately, these two uses do not always coincide, and when they do not, they can cause considerable problems in communication. Consider a speaker standing not far from the side of a car who announces: *There is a ball in front of the car*. This statement is ambiguous between an inherent meaning of *front* ("the ball is near the front bumper of the car") and an egocentric reading ("the ball is between the car and me"). Someone else looking for the ball would search two quite different areas depending on how he interpreted the description.

Two other egocentric prepositions are *beside* and *beyond*. When used egocentrically, *beside* requires the notion of canonical encounter. One can say, *The ball is beside the tree*, and this would mean that the ball is to the left or right of the tree from the speaker's point of view. The side of the tree is defined in this instance as a facet of the tree not covered by the terms *front* and *back*. If the tree is viewed as an object in canonical encounter, then this definition of *side* can be seen as the one transferred from the nonegocentric definition of *side*.

*Beyond* is one of the most complex prepositions in English, for it always demands the specification of two points of reference, not just one. Consider *A is beyond B*. Implicit in this sentence is a more primary reference point *C*, such that the sentence means "*A* is on the far side of *B* from the point of view of *C*." Normally, *C* is taken to be the speaker, so that *The ball is beyond the fence* means that it is on the other side of the fence from the speaker. In other cases, however, *C* can be made explicit, as in *The ball is beyond the fence from you*.

Finally, it should be noted that *to the left of* and *to the right of*, when used egocentrically, do *not* follow the proper rules of canonical encounter. If one says, *Mary is to the right of the tree*, one would mean "Mary is on the right with respect to me." One does not take the view of the tree, decide what is left and right in that position, and then reverse the application of *left* and *right* as one should. The reason for this failure to reverse is not clear. Perhaps it is because the left and right directions in space are symmetrical, so the terms are difficult to apply to objects in a canonical encounter. We have no trouble with the asymmetrical pairs *top–bottom* and *front–back* in this situa-

**Table 3** *Some Prepositions of Location + Relation*

*Nonegocentric, nonintrinsic prepositions*
three-dimensional:
above–below
on top of–underneath
over–under

*Nonegocentric, intrinsic prepositions*
one-dimensional:
in front of–in back of
ahead of–behind
three-dimensional (requires canonical position):
above–below
on top of–underneath
over–under
two-dimensional:
beside
at the left of–at the right of

*Egocentric, nonintrinsic prepositions (requires canonical encounter)*
one-dimensional:
in front of–in back of
ahead–behind
beyond
two-dimensional:
beside

tion, because their criteria for application are intrinsic to the asymmetries in the situation. But *left* and *right*, even in their normal use, are applied under fairly arbitrary criteria; the reversal of this application in a canonical encounter would seem unnecessarily complex.

The properties of English prepositions are summarized in rough form in Table 3.

*Deixis*

The asymmetries of *L*-space are also seen in the deictic words *here* and *there*, and *this* and *that*. Note first that *there* and *here* can be paraphrased, approximately, as "the far place" and "the near place," respectively. Of course, *far* and *near* here are being used egocentrically, for *far place* means, more specifically, "the place far from me," and *near place* means "the place near to me." Since *far* and *near* are the positive and negative terms on the dimension of distance, one should expect, likewise, for *there* to be unmarked and *here* to be marked. And this is the case. The difference between *there* and *here* can be seen in *There are three men there in the room* and *There are three men here in the room*. The first *there* is used in English exclusively for

existential statements and is a neutral specification of location. To say that something exists is to say that it is to be found at some location, *there*. The other *there* and the *here*, on the other hand, specify locations with respect to the speaker of the sentence. In other words, *there* is the only term that can be used neutrally for location, and this indicates that it is the unmarked or positive term. Similar arguments have been made (cf. Kuroda, 1968) for the markedness of *this* with respect to *that*. In brief, the deictic terms follow the same pattern as do the other adjectives in English: the term specifying distal location with respect to the speaker is considered unmarked vis-à-vis the proximal term.

### Summary of *L*-Space

English spatial terms, therefore, reveal that *L*-space has properties that are identical with those of *P*-space. First, *L*-space shows the universal use of points, lines, and planes of reference, both in prepositions, where there is one or two, and in adjectives, where there are two. Second, there are three specific primary planes of reference: (1) ground level, with upward positive and downward negative; (2) the vertical left–right plane through the body, with forward positive and backward negative; and (3) the vertical front–back plane of symmetry through the body, with right and left both equally positive.[2] Third, *L*-space requires the use of canonical position to define uses of vertical expressions for dimensions that do not coincide with gravitational vertical. And fourth, *L*-space requires the notion of canonical encounter to account for the egocentric uses of terms like *front* and *back*. The coincidence of these properties with those of *P*-space is obvious.

## TIME AS A SPATIAL METAPHOR

For a long time, linguists have noted that the spatial and temporal terms in English and other related languages overlap considerably. On this evidence, furthermore, it can be argued that the description of time in English is based on quite a specific spatial metaphor. That is, it is possible to describe a second level of *L*-space that is found in time expressions and to show that this level is identical to, and therefore derived from, the first level of *L*-space that we have just examined. In this section, therefore, I will sketch out at least some of the main properties of this important metaphor.

[2] In this paper, I ignore the secondary asymmetries of *left* and *right* that appear to be the result of the fact that man is normally right-handed. This symmetry appears to be of quite a different character, since it does not have reflexes in the adjectives as do the other asymmetries. Nevertheless, the asymmetry is compatible with the main thesis of this paper, since the positive connotation of *right* is derived ultimately from an innate biological asymmetry.

The physicist views time in his theories as a one-dimensional continuum with asymmetrical properties. In this sense, the time axis is like the *x*-, *y*-, or *z*-axes in that it is linear, can be given an arbitrary zero point, and is asymmetrical about this zero point. The asymmetry of time is obvious in such phenomena as chemical reactions, which work in one direction only, in entropy, which always increases with time, and in memory, which contains the past but not the future. Furthermore, the physicist does not require time to enter into his equations unless he is describing something with a history, with dynamic properties, with motion. These properties need not be belabored, for they have been discussed by physicists and philosophers for centuries.

What kind of a spatial metaphor would be appropriate for time, given that it has these properties? First, because time is one-dimensional, it ought to be described using one-dimensional spatial terms—that is, terms that do not presuppose two or three dimensions for their application. The appropriate adjectives are *long–short* and *far–near*, and these are certainly used in temporal expressions—e.g., *Time was short*, *The day has been long*, *The end of the world is near*, and *Monday seems so far away*. The inappropriate adjectives include *wide–narrow*, *tall–short*, *high–low*, *deep–shallow*, etc., and these apparently do not occur in productive time expressions in English. The same one-dimensional constraint is satisfied in the spatial prepositions. Note that all the positional and most of the directional prepositions can be used on one spatial dimension, as in *at a point*, *on a line*, *in an interval on the line*, *to or from a point*, *between two points*, *through an interval*, etc., and the same expressions apply to time, as in *at noon*, *on Monday*, *in the afternoon on Monday*, *up to noon*, *from Monday*, *between noon and six*, *through Thursday*, etc.

Second, because time is asymmetrical or directed, it ought to be described with one-dimensional relational prepositions which are, in addition, asymmetrical. As we noted above, the *front–back* prepositions are the only ones in English that do not presuppose more than one dimension in the space they describe; futhermore, they have the happy property that they are asymmetrical, with front positive and back negative. Significantly, the only relational prepositions used for time in English are those derived from *front* and *back*, i.e., *before*, *after*, *ahead*, *behind*, *in front*, *in back*, etc. English does not use relational terms derived from *top–bottom*, except in very specialized terms like *over the weekend*, where *over* is probably derived from its use in spatial expressions like *over the line segment*, a linear expression without vertical properties. Nor does English use *left of* and *right of* in temporal expressions. The generalization here seems significant: the asymmetry of time is expressed in English in the simplest possible way with *front–back* terms that presuppose only one dimension.

Third, because time is required only for events with dynamic properties, time ought also to be described by expressions that involve motion through space. This, too, is the case in English, as in such expressions as *Noon has come*, *Thursday has gone by*, *through Tuesday into Tuesday night*, *five o'clock came up on us before we knew it*, etc.

**What Is the Metaphor?**

Given this introduction into the spatial metaphor of time, let us consider its exact form. Time can be viewed as a highway consisting of a succession of discrete events. We humans are seen in one of two ways with respect to this highway: either (1) we are moving along it, with future time ahead of us and the past behind us; or (2) the highway is moving past us from front to back. These two metaphors might be called the *moving ego* and *moving time* metaphors, respectively.

First, consider the moving time metaphor. As this highway moves from front to back, we describe events appropriate to this metaphor: future events are *coming* events; past events have *come* and *gone by*, are *past* events (= events that have passed), are *bygone* events, are things that happened a while *ago* (ago = gone). Although these particular expressions are relatively frozen, the metaphor is nonetheless productive, as can be seen in *Noon crept up on us*, *Friday arrived before we knew it*, *Thursday rushed by*, *Time flew by*, and so on.

Perhaps the most interesting terms that derive from the moving time metaphor are those used to describe priority in time. Consider *before* and *after*, two spatial prepositions that have now come to be almost exclusively used in a temporal sense. In their use as prepositions, *before* (= in front of) means "pastward of" and *after* (= in back of) means "futureward of," as in *John left before noon*, *Mary left after midnight*, etc. Their use as conjunctions is derived from this prepositional usage. It can be shown (E. Clark, 1969; McKay, 1968) that *John left before Mary arrived* is derived from *John left before the time at which Mary arrived*, in which *before* is explicitly used as a temporal preposition. The same meanings are found in *ahead* and *behind*, as in *Mary arrived ahead of time*, *John left behind schedule*, etc. The moving time metaphor gives a nice account for the meanings of these expressions. Expressions like *ahead of noon* or *before noon* attribute to noon a front and a back. If time is viewed as moving pastward, then the front face of noon is the one that leads and is directed pastward, and the back face is the one that follows and is directed futureward. Thus, *ahead of noon* and *before noon* take on just the right interpretation, namely, "pastward of noon." *Ahead of*, furthermore, is an expression which, when used spatially, generally implies that the object of the preposition can move or is moving in a forward direc-

tion; one can say, *John was standing ahead of my car*, but not *John was standing ahead of my house*. That *ahead of* can also be used temporally, then, is further indication that time is viewed as moving pastward.

There are other expressions for temporal priority that derive from the equations *frontward* = "pastward" and *backward* = "futureward." As spatial terms, *precede* and *follow* mean "go in front of" and "go in back of," respectively, *Pre-*, the Latin prefix meaning "in front of," appears in all sorts of expressions in the sense of "pastward of," e.g., *previous*, *prediction*, *precursor*, *preheat*, *preprint*, etc. Similarly, *post-* means literally "in back of," but figuratively, "futureward of," as in *postpone*, *postwar*, *postelection*, etc. The Anglo-Saxon terms *fore* and *after* have similar meanings, as in *forethought*, *afterthought*, *foreknowledge*, *forecast*, *aftertaste*, etc. More such examples are easy to find.

The moving ego metaphor has quite different consequences. If the ego is seen as moving along a sequence of events, then words like *ahead*, *behind*, *in front*, and *in back* should refer to the ego's, not the event's, front and back, since ego is moving now and not the events. That this is so can be seen in such expressions as *Trouble lies ahead*, *The worst of it is behind us*, *We are just coming into troubled times*, *I look forward to Monday*, *John will be here from Monday on(ward)*, etc.

The moving ego and moving time metaphors, it should be noted, have exactly contradictory equations: for moving ego, the equations are *front* = "future" and *back* = "past", whereas for moving time, the equations are *front* = "past" and *back* = "future." In certain instances, this contrast can be seen quite clearly. Compare *We will be in Paris in the days ahead (of now)*, that is, "in the days future to today," and *We will be in Paris in the days ahead of Christmas*, that is, "in the days pastward to Christmas." The difference between these two expressions is that the first takes the ego as its reference point, so it requires application of the moving ego equations, whereas the second takes Christmas as its reference point, so it requires the moving time equations. It appears that every use of the moving ego and moving time equations is correlated with just such a difference in point of view, although this is still a speculation that remains to be verified in full.

Time descriptions do make use of terms that are not locative, yet these terms evince properties that are in harmony with the locative-based terms. First, consider the trio of adjectives *soon*, *early*, and *late*. Just as *high* and *low*, for example, are closely related to *above* and *below*, *early* and *late* are akin to *before* and *after* (cf. Geis, 1970) in the moving time metaphor. *Early* means something like "before the standard moment" and *late* means "after the standard moment," where the standard moment is a point of reference taken as the dividing point between *early* and *late*. *Soon* also contrasts with *late* in certain contexts and, like *early*, it means "before the standard

moment"; for *soon*, however, the standard moment and the event described must be future to the speaker's point of reference. Following Greenberg's criteria for marking, then, *early* and *soon* are unmarked (or positive) with respect to *late*, since the *early–soon* distinction is syncretized in *late*. The positive nature of temporal priority in *early–soon* parallels the positive nature of *before*, *ahead of*, *in front of*, etc., in the spatial prepositions. The parallels here are striking, although it is mysterious why there are no spatial adjectives corresponding to *early*, *soon*, and *late*.

Next consider *old–young* (or equivalently *old–new*). *Old* has two senses, one extensional and one positional. Extensional *old* is seen in *That man is old*, and positional *old*, in *I long for the old times we had*. In this sense, positional *old* is analogous to *long–short*, and extensional *old*, to *far–near*. Furthermore, *old* is unmarked with respect to *new* and *young*, and so even the marking relations coincide with those locative terms.

Finally, time, like space, also has its ego-centered deictic expressions. Just as *there* and *here* mean "at that place" and "at this place," *then* and *now* mean "at that time" and "at this time." Of course, the expressions *at that time* and *at this time* must be accounted for, too. Imagine the time line (the highway of events) with a point on it labeled "the present moment." Spatially, one would speak of events occurring proximally and distally with respect to that point using *that* and *this*, respectively. The same relations hold temporally. *Then* normally refers to events temporally distal from the speaker's present time, and *now* refers to events that are temporally proximal. Previously, we noted that *there* is unmarked with respect to *here* in that *there* neutralizes in certain contexts. *Then* appears to have the same property, for it also neutralizes in various timeless expressions (e.g., *If x is 6, then the equation is false*), whereas *now* does not. As an expression meaning "at that time," *then* can refer to either the future (*I will do it then*) or the past (*I did it then*), but in either case, it is distal and contrasts with *now*.

To summarize briefly, English descriptions of time appear to be based on a spatial metaphor in which time is viewed as a single dimensional, asymmetric continuum, running horizontally from front to back through the speaker. Furthermore, there appear to be two (not incompatible) movement metaphors: (1) the moving time metaphor views events as moving forward (pastward) past a stationary ego, and (2) the moving ego metaphor views the speaker as moving forward (futureward) past stationary events. These two metaphors give rise to two quite different uses of the relational prepositions derived from *front* and *back*. The spatial terms, as we have observed before, exhibit certain asymmetries of usage—as shown in the marking relations—and these asymmetries appear to transfer to the spatial metaphor of time. This is seen particularly in the terms used exclusively for time (e.g., *early*, *late*, *soon*, *old*, *new*, *then*, *now*, etc.), whose marking relationships are consistent with the spatial metaphor.

## PSYCHOLOGICAL IMPLICATIONS

After first examining the properties of *P*-space, *L*-space, and English time expressions, we return to a consideration of the two main hypotheses considered at the beginning, the *correlation hypothesis* and the *complexity hypothesis.*

### The Correlation Hypothesis

In the previous sections, evidence was brought forward to demonstrate that *P*-space and *L*-space had virtually the same properties: both required points, lines, and planes of reference; both revealed the same three specific planes of reference with the same positive and negative directions from them; both exhibited the notions of canonical position and canonical encounter; and so on. This evidence alone constitutes strong support for the correlation hypothesis, namely that there should be a strong correlation between *P*-space and *L*-space. The correlation hypothesis itself, however, remains somewhat mysterious, for little has been said about what might mediate this correlation. Recall that the main thesis of the paper is that the child is forced to make use of the *P*-space in learning the semantics of spatial terms in English. But how exactly does it follow from this thesis that *P*-space should be directly reflected in *L*-space?

The easiest way to answer this question is to imagine what would happen if the child attempted to learn a language that did not conform nicely to *P*-space. A term with rules of application that referred to natural dimensions of *P*-space will be learned easily, and therefore early, by children, but a term whose rules of application did not refer to any concept the child knew would, according to the thesis of the paper, be impossible to learn. But consider several intermediate cases. First, let us define the preposition *vig*, as in *vig the ball*, to mean "in an upward, leftward, and egoward diagonal direction from." *Vig*'s rules of application are complex in that they do not refer to natural directions in *P*-space. It should therefore be very difficult for children to learn and difficult too for adults to apply correctly. It should become rarer over generations of speakers (unless it has some especially important function to fill) and could well become extinct. As a second instance, let us examine a case more aptly described as an exception. Imagine that *deep* and *shallow* referred to objects in the reverse of English—*deep* referring to shallow things and *shallow* referring to deep things—but yet the name for their superordinate dimension was still *depth.* The child learning the triplet *deep-shallow-depth* would find this exception difficult to learn, since the positive term—*shallow*—would not double as the dimension name —*depth*—as in all other such English triplets. Because this triplet constitutes an exception, the child might mistakenly but consistently use the term

*shallowness* for the dimensional name, and this would tend to make the term *depth* drop out and the system come to equilibrium. Or the child might switch around the terms *deep* and *shallow* to bring about the same equilibrium. In either case, the child's difficulties would have the effect of bringing the semantic system in closer conformity to *P*-space.

The internal structure of *L*-space must be consistent not only with *P*-space, but also with the semantics of the remainder of English. As English is constructed now, for example, the name of each adjective dimension is taken from the positive member of the adjective pair defining the dimension; *length* comes from *long*, *depth* from *deep*, *height* from *high*, and so on. Consider altering this rule so that the dimension name is derived from the negative member instead. The scale names would thereby become *nearness*, *shortness*, *lowness*, etc. The argument is that the child would have great difficulty learning such a system, consistent and thorough as it is, for it is incompatible with the rest of English. Note that for other nonspatial adjectives the *neutral* dimensional names are always derived from the unmarked or positive adjective, as can be seen in the triplets *efficiency–efficient–inefficient*, *happiness–happy–unhappy*, *ability–able–unable*, etc. Given that *P*-space indicates that extent is positive and lack of extent is negative, *long*, *deep*, *far*, and so on will be taken to be positive. If the child generalizes from other English dimension names, then he will take *length* to be the proper name for *long–short*, not *shortness* as our example would have it. If a case like this ever arose, it would certainly evolve into a more regular pattern, with the spatial adjectives coming into line with the rest of English. This example shows that the child is subject to constraints both from *P*-space and the rest of English, all of which conspire to bring *L*-space into conformity with *P*-space.

Finally, the correlation hypothesis implies that since *P*-space is a human universal, it should condition *L*-space in every language. The *L*-space of each language should therefore exhibit properties that are consistent with the *P*-space as briefly described in this paper. This hypothesis does not imply that each language should have the same spatial terms (except for translation) or terms drawn from the same small inventory of spatial terms. Rather, the hypothesis implies that the possible rules of application—those spatial conditions presupposed by the spatial terms—should be universal. Since these rules of application can be combined in a number of different ways, many systems will be consistent with *P*-space. Significantly, the few spatial systems of other languages that I am at all acquainted with appear to be very similar to the English *L*-space (cf. Greenberg, 1966; Bierwisch, 1967).

**The Complexity Hypothesis**

This hypothesis is that given two terms *A* and *B*, where *B* requires all the rules of application of *A* plus one or more in addition, *A* will normally be

acquired before *B*. To see how this hypothesis would be applied, consider *in*, *into*, and *out of*, and a very preliminary specification of their rules of application. The correct spatial use of *in* presupposes simply (1) that its object denote an enclosed three-dimensional space. *Into* presupposes (1) too, but in addition, it presupposes (2) that the subject of the preposition is moving in one direction and (3) that that direction is positive—i.e., in the direction of the space denoted by the object. *Out of* presupposes (1), (2), and (3), but as an implicit negative it specifies (4) that the direction of motion is not positive. These rules are given in Table 4. If these rules are the correct ones for *in*, *into*, and *out of*, then the complexity hypothesis predicts that these terms will be acquired in their correct use in this order.

From this introduction, we can determine some of the specific predictions this hypothesis would make.

(1) In antonymous pairs, the positive member should be acquired before the negative member. This has just been illustrated in the *into–out of* example. The notion is that the positive member specifies the assumed normal direction or relation, and the negative member specifies its direction or relation by negating the assumed one. With *into* and *out of*, the normal direction is toward the space denoted by the object, and *out of*, the negative, specifies its direction of motion by negating that assumed direction. For another case, consider *A above B* and *B below A*. Both presuppose a vertical relation, and as we have seen, the assumed relation is with the point of reference below the object being located, since upward from a point of reference is positive. Thus *A above B* need not specify the relation, other than to say it is the assumed relation; *B below A* must negate the assumed relation, and this requires an extra rule of application. The prediction of asymmetry in antonymous pairs, then, should apply to the adjectives *far–near, long–short, high–low, tall–short, deep–shallow, wide–narrow, thick–thin,* and others, to the directional prepositions *to–from, into–out of, onto–off,* and to the relational

**Table 4** *Illustrative Rules of Application for* in, into, *and* out of

| Preposition | Rules of application |
|---|---|
| A in B | (1) B denotes a three-dimensional enclosed space. |
| A into B | (1) B denotes a three-dimensional enclosed space.<br>(2) A is moving in one direction.<br>(3) The direction is positive. |
| A out of B | (1) B denotes a three-dimensional enclosed space.<br>(2) A is moving in one direction.<br>(3) The direction is positive.<br>(4) Rule (3) is not the case. |

prepositions *above–below, on top of–underneath, up–down, over–under, ahead–behind, in front of–in back of, before–after,* and so on. As we will see, this prediction has much support.

(2) If the above characterization of *in*, *into*, and *out of* is correct, then the location prepositions *at*, *on*, and *in*, should be acquired earlier than their correlative location plus direction prepositions *to*, *onto*, and *into.*

(3) The relational prepositions *above*, *below*, *in front of*, etc. all require two notions: the notion of location, as expressed by *at*, *on*, or *in*; and the notion of relation, where the location is related to something else, as being *above it*, or *beside it*, etc. Thus, these relational prepositions should enter the child's vocabulary after the simpler locational prepositions *at*, *in*, and *on.*

(4) The application of spatial terms to a secondary dimension requires that the primary dimension (like *height* or *length*) be already specified. Therefore, those terms that refer to a secondary dimension—*wide–narrow*, *broad–narrow*, and *beside*—should be acquired after those terms that refer to primary dimensions—*long–short*, *tall–short*, *above–below*, etc. Those requiring both primary and secondary dimensions (e.g., *thick–thin*) should be acquired still later.

(5) It was noted earlier that as adjectives referring to vertical position or extent, *high–low* and *tall–short*, are unmarked or positive with respect to *deep–shallow.* Therefore, the former should be acquired before the latter.

There are certain predictions that the complexity hypothesis seems to make which nevertheless do not hold up on closer examination. Consider the question of whether the prepositions presupposing verticality (e.g., *above–below, on top of–underneath*, etc.) are acquired before or after those presupposing only one dimension (e.g., *ahead of–behind, in front of–in back of*, etc.). At first, one might predict that the one-dimensional prepositions should be acquired before the three-dimensional ones. After all, one is less than three. But the one-dimensional prepositions require knowledge about the direction of motion of objects, whereas the three-dimensional ones require knowledge about geologial verticality. These two types of knowledge are not comparable, and a prediction about the priority of one over the other would seem unwarranted without other information about what the child knows.

## Time

In English, time expressions are based directly on a spatial metaphor, and they therefore also fall into the jurisdiction of the correlation and complexity hypotheses. The correlation hypothesis is immediately confirmed if each temporal term can be shown to be based on a spatial term, and each spatial

term in turn, on *P*-space. Insofar as evidence has been presented for these two conditions, the correlation hypothesis is upheld for the time expressions. The complexity hypothesis makes the same predictions for the temporal terms as for the corresponding spatial terms; for example, positive adjectives and prepositions in the time realm should come in before negative ones, just as they should in the space realm. But the complexity hypothesis makes one additional prediction. Since time is a spatial metaphor, the use of a term to denote time must have been preceded by the use of the comparable term to denote space. In general, therefore, spatial expressions should appear before time expressions, and in particular, each term that can be used both spatially and temporally should be acquired in its spatial sense first.

It is interesting to speculate about how the time–space correlation might be learned by the child. Consider the moving time metaphor. It could begin by the child noting that certain spatial and temporal relations are correlated. If John is walking *in front of* Mary toward ego, then John will arrive *before* Mary arrives; the event of John's arrival will occur before the event of Mary's arrival. Note that this analysis depends only on the fact that events are usually defined by movement and that events come upon the ego by their moving into his perceptual field. The definitions of *in front of*, *ahead of*, *before*, and so on then immediately specify the correlation. The moving ego metaphor works analogously. The ego can come upon events by moving in a forward direction, and in that case, the ego can say, "John's dancing is in front of me," which would change from the *place* of John's dancing to the *event* of John's dancing. At present, although these accounts are merely speculations, their plausibility makes it seem worthwhile to pursue them further.

## Evidence for the Complexity Hypothesis

### *Evidence from Adults*

Although the complexity hypothesis does not apply to adults, a closely related hypothesis, not specified so far, does. This *comprehension hypothesis* might be stated as follows: the less complex of two expressions, as defined by the complexity hypothesis, should be comprehended more quickly than the other. This thesis, essentially a generalization of the "principle of lexical marking" in H. Clark (1969), has a considerable amount of support.

First, positive terms are comprehended more easily than negative terms. In studies on comparative adjectives, this has been shown for the spatial pairs *far–near, long–short, tall–short, high–low, deep–shallow* and *thick–thin*, for *big–little* and *much–little*, if these are considered spatial, and the temporal pairs *early–late* and *old–young* (cf. H. Clark, 1969; in press, for the specifics). The advantage of positive over negative has also been noted for

the directional prepositions *to–from* and *into–out of* and for the relational prepositions *above–below, on top of–underneath, ahead–behind, in front of–in back of*, and *before–after*; the last two terms were used as temporal prepositions (cf. H. Clark, in press, for details). The consistency of this finding across such a range of adjective and preposition pairs is impressive and adds considerable weight to the hypothesis.

Second, in two other studies, it was found that *higher* and *lower* are comprehended more quickly than *deeper* and *shallower*. In one study (Troyer, 1971), people were given sentences like *If John is deeper/lower in the well than Mary, then who is farther from the top?*, which they were to answer as quickly as possible. And in the second study (H. Clark & Peterson, unpublished), people were asked to verify sentences like *Star is deeper/lower than plus* against a picture of a star and plus at different heights. *Height* was easier to cope with than *depth* in both studies, and this is consistent with the finding both in *P*-space and *L*-space that *height* is positive with respect to *depth*.

*Evidence from Children*

Children, it is well known, show different facilities in producing and comprehending sentences, since they are often able to comprehend something they cannot produce. Furthermore, there is no guarantee that what should be acquired first in comprehension should also be acquired first in production. So there is a fundamental problem with the application of the complexity hypothesis to the child: does it apply to comprehension or production? The hypothesis itself was stated neutrally with respect to this question, but before it can be tested, some decision must be made. For reasons to be elaborated, I will take the hypothesis as applying mainly to comprehension.

Although there has been relatively little work on the comprehension of particular lexical items, especially spatial expressions, what there is supports the complexity hypothesis. First, the correct comprehension of antonymous adjectives and prepositions has been found to occur earlier for the positive members of each pair than for the negative members. Donaldson and Wales (1970), using a simple comprehension task, found this to be true for the comparative pairs *more–less, bigger–wee-er, longer–shorter, thicker–thinner, higher–lower,* and *taller–shorter*, as well as for the superlatives of these same forms. In a similar study, Tashiro (1971) supported this generalization even for adjectives in their uninflected noncomparative form: *tall–short, long–short, wide–narrow, thick–thin, big–little,* and *large–small.* In most cases, when the child misunderstood the negative form, he did not simply refuse to carry out the comprehension task set before him; rather, he usually indicated, with considerable confidence, the response that was appropriate to the positive term. In this sense, the child could be said to

know all the rules for the positive term, but not the extra rule for the correct application of the negative term. These data support the notion that the child acquires the rules of application one at a time; the same point is argued in this volume by E. Clark in support of her semantic hypothesis. (For more detailed discussion of the Donaldson and Wales data, see H. Clark, 1970a.)

The same positive–negative generalization holds for spatial and temporal prepositions as well. Bem (1970) asked children to place objects into arrays of items, and in doing so, she used the prepositions *on top of* and *underneath.* She found (personal communication) that the positive preposition (*on top of*) was comprehended correctly by more children than the negative (*underneath*). E. Clark (1971a), in a study on the comprehension and production of the temporal prepositions *before* and *after*, found the comparable result: *before* was understood correctly at an earlier age than *after.* She also noted that some children appeared to take *after* to mean the same thing as *before*, and from this evidence, she concluded that for these children *before* and *after* had the same semantic features, or the same rules of application; later, a feature was added to *after* to give it the appropriate meaning. This evidence again is consistent with the complexity hypothesis.

The complexity hypothesis also predicts that the primary adjectives *tall–short* and *long–short* will be understood correctly before the secondary adjectives *wide–narrow* and the tertiary adjectives *thick–thin.* Tashiro (1971), in her comprehension study, noted that the primary adjectives elicited fewer errors than the secondary and tertiary adjectives, at least for the 3- to 5-year-old children she studied.

Finally, E. Clark (1971a) reports that two of the youngest children she tested interpreted *when* questions incorrectly as *where* questions. When asked questions like "When did the boy jump the fence?" these children answered "there" or "right there." These locative answers to temporal questions are consistent with the notion that time expressions are based on a spatial metaphor acquired after spatial terms are acquired, and therefore, time expressions will at first be misinterpreted as spatial expressions.

Before considering the evidence from production, we must look at several qualifications, or cautions, to be observed in relying on such data. First, as E. Clark points out in this volume, children do not always mean what adults mean when they use a word, and so the child's use of a word cannot be taken as indicating the acquisition of the adult rules of application for that word. Second, the child's first utterances are full of omissions and deletions of adult prepositions, and it is difficult to know how to treat such utterances. For instance, one of Brown and Bellugi's (1964) children said "Baby high-chair," which his mother interpreted immediately as "Baby is in the high-chair," Should this child be credited with production of a sentence appro-

priate to *in*? This seems too strong, for the child might not understand, or have knowledge about, the distinction between *at*, *in*, and *on*. Perhaps then he should be credited with knowing the notion of location common to *at*, *in*, and *on*, but this seems problematic too, although less so.

Third, one must use caution in interpreting the child's first explicit use of a locative term, even given the first qualification. The problem is that the child might produce a more complex term first simply to mark the sentence with respect to a less complex, but deleted term. For example, the child might contrast *Baby highchair*—meaning "Baby is in the highchair"—with *Baby in (or into) highchair* to indicate that the latter is marked for directional movement, i.e., "Baby is going into the highchair." That is, the child would not need to mark the sentence expressing location alone, but he would need to mark the sentence as expressing location plus direction. Therefore, it seems quite consonant with the complexity hypothesis to expect the child to produce the marked term explicitly before the unmarked term, at least at the earliest stages when terms like prepositions are often omitted. Of course, the complexity hypothesis also appears to predict the opposite, but the contradiction is more apparent than real. The complexity hypothesis is based on the order of acquisition of the rules of application, and so data such as the *into* example are consistent with the more basic hypothesis. Nevertheless, this qualification points out the caution required for application of this hypothesis to the earliest production data.

The fourth qualification is that production is also affected by surface complexity which results in perceptual and production difficulties that interact with semantic complexity. In languages in which different spatial components are expressed by different surface features, the production (and comprehension too, probably) of these components will also vary with their surface complexity. Slobin (in press) discusses just such instances in Hungarian and Serbo-Croatian. So the complexity hypothesis is uncontaminated only when the *A* and *B* terms are of the same syntactic form; when they are of different syntactic forms, the predictions break down. In English, this has not been a problem, for the prepositions and adjectives both form relatively homogeneous classes with respect to syntactic complexity. But applications across classes even in English—say, across prepositions and adjectives—should be complicated by the surface complexity factor.

Now let us consider a few examples of spatial and temporal terms in the child's spontaneous speech. Two of the first spatial terms to be noted are the simple deictic expressions *there* and *here*, which have been reported in most children with two-word utterances (cf. e.g., Braine, 1963b; Brown & Fraser, 1963; Miller & Ervin, 1964), with perhaps the positive term *there* predominating. *There* and *here* are location terms that neutralize the *at/on/in* distinction and, in this sense, have very simple rules of application. *That*,

*this* and a deictic *it* also appear early, with *that* perhaps predominating. Unfortunately, little is known about whether the use of *there–here* and *that–this* implies that the child has a primitive distal–proximal distinction, using the ego as point of reference. If this were true, it would show the very early use, perhaps necessarily earlier than other spatial uses, of the ego as a reference system, and this would clearly be consonant with the centrality of ego in the *P*-space.

The first prepositions to appear consistently seem to be *on* and *in*. According to Brown (in press), they came into his subjects' speech in obligatory contexts at about the same time and apparently before any other prepositions. According to the complexity hypothesis and the discussion of *L*-space, however, *at* should appear before either of these, since it appears to be less marked. One problem could be that *at* does not need to be explicitly marked, whereas *in* and *on* do, and so the latter appear first. (Note that *there* and *here* implicitly contain the neutral notion of *at*, and they do appear earlier.) Other early prepositions include *out*, *over*, *under*, and *away*, according to Miller and Ervin (1964). Though relatively sparse, these data at least suggest that, in agreement with the complexity hypothesis, the location prepositions (e.g., *in*) appear before location plus direction (e.g., *into*) and before location plus relation (*over, under*).

With respect to time, the general impression of the acquisition literature is that spatial terms are used spontaneously before temporal terms, as the complexity hypothesis predicts. In Brown's data (in press), the listing of the uses of *in* includes only three temporal uses (*in a week*, *in a while*, and *in a minute*) compared to a large number of locative uses. These temporal uses might also be nonproductive, with phrases like *in a week* being holophrastic. Also, E. Clark (1969), Ervin-Tripp (1970), and D. Ingram (unpublished data) all report the use of *where* questions before *when* questions. *There* and *here*, of course, appear before *then* and *now*, their temporal counterparts. The examples could be multiplied. In addition, E. Clark (1969) noted that the positive *before* appeared spontaneously before the negative *after* in the 3½-year-olds she studied, and that the previous literature has reported similar findings for other temporal expressions like *first–last*, *early–late*, etc.

In applying the complexity hypothesis to children, it has been assumed that the child knows all about space before he even begins to learn language. Although this assumption seems plausible, it is in no sense necessary. It could be, for example, that the child comes to know *P*-space—at least the intricacies of *P*-space—very slowly, and so the learning of specific spatial terms must wait until the child knows the appropriate properties of *P*-space so that he can learn the correct rules of application. This alternative assumption, which implies a closer relation between the learning of *P*-space and *L*-

space, predicts that the order in which the child learns spatial terms should be affected by the order in which the child learns the properties of *P*-space, not just by the complexity of the rules of application. The evidence for either assumption is slight, although Slobin (in press) does present evidence for the first assumption. He discusses the case of Hungarian–Serbo-Croatian bilingual children, who learn the locative terms in Hungarian long before they learn the locative terms in Serbo-Croatian. The child would have had to know *P*-space to learn Hungarian; therefore, the lack of knowledge of *P*-space could *not* have been the cause of the late development of spatial terms in Serbo-Croatian. Rather, Slobin suggests, the later development of Serbo-Croatian appears to result from the complexity of the surface features required for expressing the spatial notions in Serbo-Croatian.

## CONCLUDING REMARKS

In this chapter, I have presented the thesis that the child acquires English spatial expressions by learning how to apply them to his prior knowledge about space, and that he acquires English temporal expressions in turn by extending the spatial terms in a metaphor about time. The main evidence for this thesis is the strong correspondence between the properties of the spatial terms and the properties of man's innate perceptual apparatus, and between English spatial and temporal expressions. The correspondence is so strong, I would argue, that it simply could not be coincidental and it therefore needs explanation. Time, for example, is not just expressed with an occasional spatial simile, but rather it is based on a thoroughly systematic spatial metaphor, suggesting a complete cognitive system that space and time expressions have in common. In this paper, my purpose has only been to outline the thesis, its evidence, and what it could mean for the acquisition of English. Admittedly, the discussion is preliminary, and there will have to be much more thought about how to specify the rules of application more accurately, how to describe the mediating mechanisms for the correlations between *P*-space, *L*-space, and temporal expressions, how to specify the complexity hypothesis more satisfactorily, and so on. Laying all details aside, however, the present discussion does attest to the plausibility of the thesis and suggests that further work along these lines will be profitable.

Although I have argued only that knowledge of *P*-space is a prerequisite for the acquisition of spatial and temporal terms, this knowledge might well turn out to be prerequisite for far more of language than that. It would be very exciting, for example, if *P*-space could be implicated even in such fundamental properties of language as the syntactic notions *subject of a sentence*, *agent of an action*, *object of the verb*, and so on. In fact, Anderson

(1971) has recently made just such an argument in reviving the traditional so-called "localist theory of case." This theory argues that grammatical relations are fundamentally locative in nature, and they are therefore derived ultimately from notions of location. Anderson demonstrates that there is a wealth of evidence to support such a view and suggests himself that the localist theory has significant "ontological and chronological" implications. Indeed, with this type of evidence, it is not far-fetched to believe that knowledge of *P*-space is the basis for much more of the universality of language than I have argued in this paper. In any case, these theories concerning space and location present intriguing possibilities for future work in language acquisition, and it is the student of language acquisition who will ultimately be called on to solve the important puzzles about the relation between language and prior knowledge.