

Chapter 1



Meaning and Reference

Any field of study that takes as its subject human action must be concerned with people's thoughts and feelings and with how they communicate these to one another. If indeed "it is possible for one person to know what another person thinks" (Premise 3), what people think must be expressible in language, and it must be the case that "a language spoken by one person can be correctly interpreted by someone from outside that linguistic community, and a text in one language can be translated into an approximately equivalent text in another language of comparable resources" (Premise 4), even if the languages involved are *ideolects* of the same tongue. Questions of meaning and reference are therefore critical for the historical enterprise. In this chapter, we shall be concerned with such issues.

We will consider first the relation of thought to language, and argue that although thought is usually expressed in language, it is a mistake to identify the two. Thought is prior to and richer than language; people may make conceptual distinctions that do not find linguistic expression and indeed may have concepts that are not linguistically expressed. Second, we will examine the nature of concepts, which I take to be mental states. Third, we will consider the theory of meaning, and I shall defend the position that meanings are conceptual "cores"—the central theoretical matrices of concepts. Fourth, we will deal with the theory of reference, including issues of naming and ostensive definition. Fifth, since the determinacy of reference has been a matter of considerable recent debate, we will examine two arguments for the relativity of reference. The first is Quine's doctrine of

ontological relativity, which will be discussed in some detail. As I hope to show, Quine's doctrine rests on a mistaken analogy between languages and theories—an analogy that underestimates the referential determinacy of natural languages. The second is the famous "hermeneutical circle." Although the discussion here will only be a preliminary one, I will argue that the same instruments that anchor natural languages in the world of experience serve to break the circularity of interpretation. Finally, I will briefly discuss the status of perceptual judgments. The theories advanced here will serve as the basis for the discussion of the following chapters.



Thought and Language

In 1969, Quine published an article entitled "Epistemology Naturalized" in which he argued that the traditional concept of epistemology as a "first philosophy" that justifies our knowledge should be abandoned and replaced by a concept of epistemology as an empirical science that seeks to explain how it is that we have the knowledge we do. As such, Quine held, "epistemology merges with psychology, as well as with linguistics."¹ Although Quine's proposal has not been greeted with universal acclaim,² it is hardly a new one; certainly this was William James's view, and James never claimed that it was original with him.³ Nevertheless, Quine's proposal has had considerable influence in philosophy and in a number of fields beyond.

This development is partly owing to the fact that by 1969 psychology was already resuming the long abandoned task which Locke and the Scottish Realists had undertaken of seeking to account for human knowledge. Linguists, under the influence of Chomsky, were wrestling with the problem of how language is learned, and a variety of other fields were converging on the issue of the nature of cognition. In computer science, the attempt to simulate human thought with machines led to the development of the study of artificial intelligence. In neuroanatomy, advances in the understanding of the electrochemical nature of the brain promised new breakthroughs in our knowledge of how the brain functions. In primatology, work with higher primates was rapidly forcing extensive revisions of our notions of the capacities of our simian cousins. And in philosophy itself, new ideas—particularly those stemming from the work of Wittgenstein—were forcing revisions in long-established views of language, concepts, meaning, and understanding.

This convergence led to the emergence of what is currently called "cognitive science," which lies at the intersection of all of these fields, and to important advances in our understanding of cognition. Clearly, something very like a naturalized epistemology is in the process of development. It is therefore particularly ironic that this development has taken a course very different from that which Quine sought (and seeks) to promote.

Throughout his long career, Quine has been a staunch empiricist, an unrelenting advocate of behaviorism, an enemy of mentalism, and a foe of innatism. In this, he stands in a long and honorable tradition. Ever since Locke declared the mind of the neonate a *tabula rasa*, it has been an article of faith among empiricists that there can be no such things as innate ideas and that all knowledge must be the product of experience, aided by such content-free abilities as the capacity to learn. But the concept of innate ideas is ambiguous. One could mean, as advocates of the Platonic theory of recollection evidently do, that the neonate comes into this world already stocked with certain ideas. But one could also mean that the neonate is so structured that upon the presentation of certain stimuli, he will form certain concepts. If the latter view is taken, it articulates with studies of such phenomena as imprinting among birds; and on evolutionary grounds it is not obvious why human beings could not be so endowed. The question of what neonates know, and when and how they know it, is for a naturalized epistemology an empirical question to be settled by research. One cannot begin with *a priori* assumptions about the nature of cognition if the nature of cognition is to be determined by scientific investigation. Philosophical dogmas have no place here. The innatist hypothesis is not logically self-contradictory, and cannot be dismissed on *a priori* grounds.

The assumption that it is unscientific to talk of mental entities rests similarly on purely dogmatic grounds. Some empiricists, influenced by positivism and by Ryle's ghost stories, have apparently concluded that only an unremitting behaviorism is permissible. Quine's own position here is less clear than one might think from his attacks on mentalism, for although he endorses a form of behavioral dispositionalism, it is one that contains reference to internal neural states about which at present we know nothing at all.⁴ Most cognitive scientists, however, reject behaviorism outright and have no hesitancy in speaking of mental states or internal representations. But I know of no cognitive scientist who does not believe that such states are purely physical: Spiritualists and Idealists have not found cognitive science a congenial field. Nevertheless, the issue is a purely scientific one. Certainly it is legitimate to postulate internal states if a better theory of cognition is thereby achieved, and pointless to postulate them unless a better theory is thereby achieved. Here again, dogma has no place and hypotheses should be considered on their merits only.

Quine's anti-mentalism has led him to argue that traditional terms for mental entities, such as "idea" and "concept," should be abandoned and that we should talk only of words; that is, that thought should be identified with language, or, more exactly, with dispositions to verbal behavior. Thus Quine:

We want to know how men can achieve the conjectures and abstractions that go into scientific theory. How can we pursue such an inquiry while talking of external things to the exclusion of ideas and concepts? There is a way: we can talk of language. We can talk of concrete men and their concrete noises. Ideas are as may be, but the words are out where we can see and hear them. And scientific theories, however speculative and however abstract, are in words. One and the same theory can be expressed in different words, so people say, but all can perhaps agree that there are no theories apart from words. Or, if there are, there is little to be lost in passing over them.⁵

This view is I believe erroneous, and because the consequences of this view are so serious, it is important to point out that recent work in cognitive science is incompatible with it on at least five different scores.

First, and most obvious, is the extensive work done over the past several decades on animal cognition. Many animals, including even pigeons, are able to group objects into categories by similarity,⁶ and chimpanzees and rhesus monkeys even by prototypes.⁷ The existence of cognitive maps—allocentric representations of physical space—has been demonstrated in dogs, cats, and chimpanzees.⁸ Premack has shown the ability of chimpanzees without language training to categorize by matching to sample and even to recognize similarities of proportions. With language training the apes were able to accomplish considerably more, largely because teaching them the words "same" and "different" helped them to focus attention on similarities and differences. These apes were able to compare proportions of different substances—e.g., one fourth of an apple, a bottle one fourth full, etc. In other words, they could attend to similarities of relations, not just of objects.⁹ However, this does not show that the *concepts* of similarity and difference were introduced to the apes by language training. As Premack remarks, "There is no evidence that concepts previously unknown to the animal were introduced by language."¹⁰ These and other findings on cognition in animals without language (or only the minimal language that apes can acquire) demonstrate the existence of concepts and conceptual relations that are independent of language.

A second source of evidence is provided by the rapidly growing corpus of work on brain-damaged patients. For example, patients suffering from prosopagnosia¹¹ can be shown to be implicitly processing information concerning familiar faces although the patient is unaware of the fact and the processing is dissociated from verbal operations.¹² Similarly, studies of patients with various types of disorders—amnesia, blindsight, dyslexia, Broca's and Wernicke's aphasias, and hemineglect—also show implicit knowledge in conditions where explicit knowledge is either absent or poor. This situation does not appear to be explicable in terms of impairment of the language production mechanisms nor their dissociation from other systems. Not only is implicit knowledge sometimes verbally expressed but the phenomenology of those neuropsychological syndromes in which impairment of the language production mechanisms is crucial is different from those cited above.¹³ As Kertesz puts it, "the relative preservation of non-verbal performance in the severely affected aphasics . . . argues for a dissociable process of language and high-level thought."¹⁴ Particularly striking are the data reported by Bisiach concerning hemineglect:

If you ask these patients to describe their mental image of a complex object from a definite vantage point, you may find evidence of an impaired representation of the side contralateral to the lesion. Thus, when describing the appearance of a familiar place, our left-hemineglect patients omitted salient particulars located on the left side of the imaginary line of sight. Most important, these particulars were afterward reported when the patients had to describe the same place from the opposite point of view. Conversely, details which the patient had reported a few instants earlier from the right side of their image were neglected in the description of the reverse perspective, into the left half of which they were to fit. . . . Now, the occurrence of space-related pathological constraints affecting mental representations of the analogue type after focal impairment of neural space may arouse no wonder; on the contrary, it is proof of the actual existence of this kind of representation. Less obvious is the fact that verbal representation alone could not fill the imaginal gap. This suggests that language *per se* cannot be considered an autonomous form of representation, in the sense that it has no independent data-base of its own: all representation (originally) missing in the analogue mode is (derivatively) missing in the verbal mode as well.¹⁵

Thus there is substantial evidence for the existence of mental representations of a non-verbal sort and for thought processes that do not involve language.

A third source of evidence comes from cross-linguistic studies. As Clark has pointed out,¹⁶ English words for putting on clothes do not distinguish the part of the body being clad. In Japanese, there are four different words used, depending on what part of the body is being covered; one term is used for covering the head, a second for covering the upper body, a third for covering the lower body, and a fourth for accessories (e.g., rings, gloves, etc.). Yet no one would seriously doubt that English speakers make a conceptual distinction between putting on one's hat and putting on one's pants. The point of course is that languages do not always contain distinct words for each concept; the speakers make the conceptual distinctions, but the language does not. There is not therefore a one-to-one correspondence of words to concepts; there are more concepts than words.

In the example above, one can use phrases to do what single words cannot. But Clark uses a second example to show that this need not be the case. English has about eleven basic color terms: black, grey, white, blue, green, brown, yellow, orange, red, purple, and pink. But in Dani, there are only two color terms: *mili* (black) and *mola* (white). However, Clark notes, "Dani speakers appear to organize colors in memory and use colors in matching tasks in just the same way as English speakers: the concepts appear to be much the same, even though the terms available for talking about them differ in the two languages."¹⁷ In this case, the Dani language lacks the resources to articulate its speakers's color concepts. It is not therefore correct to say, as Quine does, that we can dispense with concepts and deal only with words. Words do not fully express the conceptual system of the speakers.

A fourth source of evidence comes from the work on neonate cognition. Recent research in this field demonstrates that if subjected to appropriate stimuli, the newborn child develops a rather remarkable range of concepts at a very early age. Thus there is very strong evidence that by the fourth month the child is able to perceive the world in terms of a three dimensional space.¹⁸ Indeed, neuroanatomists have apparently identified the specific neurological structures that produce this cognition, although exactly how those structures produce that result is yet to be determined.¹⁹ Similarly, the human eye is sensitive to the electro-magnetic spectrum from about 400 to 700 nanometers. Of course, the variation in wavelength over this interval is continuous, but humans perceive the spectrum categorically in terms of focal colors (red, yellow, green, blue). The perception of focal colors is universal, although just where the boundaries are drawn between colors, and the number of hues which receive distinct names, varies from

culture to culture.²⁰ As Anderson somewhere remarks, no one has ever claimed that we learn to see colors. A third example of particular importance occurs in sound perception. Although acoustic stimuli vary continuously, the neonate perceives sounds categorically. Moreover, the neonate is able to form equivalence classes of stimuli which are very different acoustically, and these equivalence classes correspond to phonetic categories. Thus the word “bat” presents acoustically very different stimuli when uttered by a male voice and a female voice, yet the neonate of four months perceives these stimuli as equivalent.²¹

One of the most hotly debated issues concerning neonate cognition is the formation of the concept of a physical object. Until fairly recently, the work of Piaget dominated this subject, and in Piaget’s theory the concept of a physical object as an enduring entity in space and time is the product of what he calls Stage IV—the sensory-motor stage—at approximately the end of the first year. Piaget found that, when younger children had observed an object at point A, and then saw the same object covered up at point B, they would still commence the search for the object at point A. Piaget interpreted this to mean that the child had not yet conceptualized the object as enduring in time and space, so that once out of sight it was out of mind, and that the child did not conceptualize the object as an enduring entity until he could make the transition to searching first at point B. This transition comes during the late sensory-motor stage. The formation of the concept is thus held to result from experiences of the physical manipulation of objects, and is prelinguistic—that is, language is not learned until after the object concept is formed.²² More recent work suggests that Piaget drew the wrong conclusion when he took search behavior to be an indicator of the presence of the object concept. Diamond has shown that the AB pattern—searching at A rather than at B when the object was hidden at B—is probably related to the maturation of the frontal cortex, and that the AB search pattern of young children is virtually identical to that of monkeys with ablation of the prefrontal cortex.²³ If this is so, the AB search pattern may have nothing to do with the development of the object concept but may relate to the development of capacities of action.²⁴

During the last decade, Spelke, Baillargeon, and their co-workers have done a series of experiments that have radically advanced our knowledge of neonate cognition. They have shown that by four months a child is able to perceive objects by the principle of common movement. Of course a child of that age cannot use language, so non-linguistic indicators must be used. The one most commonly employed to indicate recognition of a difference on the children’s part is the length of time the children look at the object (the longer they look, the greater the difference recognized). The indicator has been shown to be reliable. If an object is partly occluded by a

screen (as for example in Figure 1), the child does not recognize it as a distinct single object. But if both non-occluded portions of the object move together behind the screen, either laterally or in depth, the child perceives a single object moving behind the screen. If the screen is removed to show two separate objects which are not joined together behind the screen, the child looks considerably longer. Baillargeon et al. developed a second experiment in which a block was shown to the child, together with a screen larger than the block which was capable of rotation through 180 degrees. The child is seated facing the screen (see Figure 2), so that the rotation of the screen was toward or away from the child. When the child saw the block placed behind the screen and the screen was rotated until its motion was interrupted by the block, the child showed no special interest. But when the screen was rotated through the space occupied by the block (removed without the child's knowledge), the child looked much longer. Thus it seems clear that the child not only expected the object to persist when occluded, but also believed that two objects could not simultaneously occupy the same space.

Figure 1

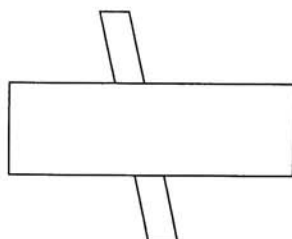


Figure 2



In a third experiment, a toy car was placed on a track which passed behind a screen. The child's gazing time was not affected when the car passed behind the screen and emerged on the other side. Neither did it change when the car which emerged from behind the screen differed in

color or shape from the car that had passed behind the screen. Evidently the child's object concept at this early age does not include color or shape invariance. Then the experimental design was altered by lowering the screen so that the child could see the experimenter place a solid block either behind the track in one case or on the track in the other, and the screen was again raised to occlude the track and the block. When the block was placed behind the track, the child showed no change in gazing time when the car passed behind the screen and emerged on the other side. But when the block was placed *on* the track, and the car again passed behind the screen and reemerged on the other side, the child looked considerably longer. These experiments support the hypothesis that the child regards objects as solids and believes that one of them cannot pass through the space occupied by another. They also support the hypothesis that the child has a concept of object identity which is defined in terms of spatio-temporal continuity.²⁵

These and similar results have led Spelke to the following conclusions about the object concept in infants.

Objects are apprehended by a relatively central mechanism that takes as input the layout as it is perceived, whatever the sensory mode by which it is perceived, and that organizes events in ways that extend beyond the immediately perceivable world in space and time. This mechanism organizes the layout into bodies with at least four properties: *cohesion*, *boundaries*, *substance*, and *spatio-temporal continuity*. Infants are able to find such bodies, because these properties limit where surfaces stand and how they move with respect to one another. The surfaces of a cohesive body must be connected and they must remain connected over the body's free motions; the surfaces of a bounded body must be distinct from the surfaces around them and they must move independently of their surroundings; the surfaces of a substantial body must move through unoccupied space; and the surfaces of a spatio-temporally continuous body must move on connected paths. Infants apprehend objects by analyzing the arrangements and the motions of surfaces, I suggest, because they conceive the physical world as populated with bodies whose properties constrain surface arrangements and motions.²⁶

Moreover, Spelke believes that the infant's "mechanism for apprehending objects" is a theory of the physical world "whose four principles

jointly define an initial *object concept*.”²⁷ This theory remains basic to the adult view of the physical world; indeed, the adult view is built upon this initial theory by a process of “enrichment” in which further notions are added to “an innately structured domain.” But the initial theory always remains as the core of our concept of the physical object. It is important to note that this theory contains within it a theory of object identity, in the form of the spatio-temporal continuity of the object. And this theory is present in infants only four months old.

A final source of evidence comes from the fact that people can and do think without words. Testimonial evidence from people afflicted with extreme dyslexia is compelling on this point, but no less a figure than Einstein has testified that his scientific thinking was not done in words.²⁸ The mathematician, Jansons, who suffers from an extreme form of dyslexia, has testified to his use of visual and kinesthetic representations rather than verbal ones.²⁹ Roe’s study of distinguished scientists showed a remarkable range of kinds of representations used in thought, including visual, verbal, and kinesthetic.³⁰ And Goodman has provided a well-known study of the types of symbolic systems that function in the arts, many of them clearly non-verbal (e.g., music).³¹

It seems clear, therefore, on the basis of a wide range of evidence, that there are internal states that constitute concepts and relations among concepts, that these are not linguistic representations, that the linguistic system is not necessarily isomorphic with the conceptual system, and that the study of linguistic representations alone does not succeed in revealing our conceptual structure. Moreover, it should be clear that conceptual structures exist by at least the fourth month of life in a far more complex form than has previously been thought. It is therefore essential to gain further clarity on the nature of concepts, and the relation of thought to language.

Concepts

In recent years, there has been a lively debate over the nature of concepts. The “classical” view—that all instances of a concept share properties both necessary and sufficient for membership in the category it defines, and that the conjunction of these properties defines the concept—has been shown to be inadequate to deal with many of the phenomena discovered by experiments on categorization during the last fifteen years. For many concepts, it has proven impossible to specify what the necessary and sufficient properties are—as Wittgenstein’s famous example of games made clear.³² There are disjunctive concepts—e.g., Scandinavian—that do not fit the conjunctive model.

More crucial is the demonstration by Rosch and others that categorization is often done by prototype.³³ Thus, for example, subjects rate robins the most “typical” of birds, but consider chickens, ostriches, and penguins much less typical. The prototype is taken to be in some sense the central tendency of the various properties of the instances. The prototype, so defined, is not an actual instance, but a conceptual model constructed from the associated properties—a stereotype, in Putnam’s terminology.³⁴ Similarity to the prototype then provides the basis for categorization; because robins are seen as more similar to the prototype than other birds, they are rated the most typical. This view admits of multiple formulations. The “properties” may be taken as purely qualitative or as dimensions in a metric space, and various algorithms have been proposed for combining features, whether qualitative or quantitative, with varying degrees of success.

Prototype theory does avoid some of the problems of the classical theory, and there is substantial experimental evidence to show that people do categorize by something that looks like prototypes. Nevertheless, there are serious problems with this theory. First, it offers no explanation of what particular set of properties should be combined to form the prototype, nor of how those properties are related. Second, it provides no bounds on the variation in dimensions, nor on what properties can be used. Third, which features of a given instance are important clearly depends upon context, but the theory has not provided a way of dealing with context effects.³⁵ Fourth, no adequate solution has been found to the problem of how the prototype of a conjunctive concept can be generated from the prototypes of the conjuncts. Thus, given a prototypical mouse, and a prototypical large thing, how does one generate a prototypical large mouse?

A variant of this view is the feature-bundle theory, according to which the concept of an object—say, a bird—consists of a bundle of conjoined features. Judgments of typicality have been shown to depend upon the distribution of features; that is, a number of characteristics are associated with membership in the category, and the more of these characteristics a given instance has, the more typical it is judged to be. No one set of properties is true of all instances; hence there are no properties that can be said to be necessary and sufficient for membership. Thus, flying is a feature strongly associated with birds. But the absence of this feature alone does not eliminate a creature from birdhood if enough of the other features in the bundle are present.

An important critique of these views has been written by Armstrong, Gleitman, and Gleitman.³⁶ Prototype theory, they argue, implies that typicality ratings will be obtained for instances of concepts where there is no classical definition of the concept—i.e., no necessary and sufficient defin-

ing properties. But where such necessary and sufficient properties exist and are known to the subjects, all instances of the concept should be equally typical. To test this, they used two sorts of concepts—those for which Rosch's work indicated that a prototype structure should exist (fruits, vegetables, sports, vehicles) and those for which well-known classical definitions exist (even number, odd number, plane geometrical figure³⁷). Subjects produced typicality ratings for both sorts of concept instances. Subjects were then asked whether they thought some even numbers were more even than others (and similarly for odd numbers and geometric figures), to which they replied that they did not. But when again asked to rank instances of these concepts by typicality, they did so.

As Armstrong, Gleitman and Gleitman point out, these responses were not contradictory: "Subjects responded differently because they were asked to judge two different matters: exemplariness of exemplars of concepts in the one case, and membership of exemplars in a concept in the other."³⁸ As Kelley and Krueger have also done,³⁹ they point out that typically rankings do not imply degrees of membership: a pekinese may be an atypical dog, but it is one hundred percent dog for all that. Armstrong, Gleitman, and Gleitman note that an identification function that enables one to pick out instances for the concept may well yield the typicality rankings quite apart from the core of the concept itself. But their general conclusion is pessimistic: "We are back at square one in discovering the structure of everyday categories *experimentally*."⁴⁰

One particular point made by Armstrong, Gleitman, and Gleitman requires special discussion. Both the prototype and the classical theories of concepts make use of the notion of a "property." But what is a property? If a property is itself a concept, there seems to be an obvious circularity involved in the theory. What theorists have in mind by "properties" are clearly perceptual characteristics such as color, shape, etc.; but while we do perceive colors and shapes, it is also true that the term "property" as used above must represent a concept of which the perceived aspects of things are instances. Is it possible to speak of perceptual characteristics of experiences that are not also conceptual without being at once accused of reintroducing the late lamented "given"?

It will, I trust, be granted that in perception there is *some* aspect of the experience that is not purely conceptual—otherwise, one would be forced into a type of conceptual idealism. But it does not follow that such aspects are not to some degree influenced by conceptual factors. Anyone who looks at his own hand will observe something that has a particular color. Possibly the actual experience of the color is influenced by his color concepts, but we know enough about color vision to know that the principal component is not conceptual. The important point is that we experience objects as hav-

ing certain aspects—shapes, hues, etc. Normally, we do not have words for just those aspects—it would require a language with an infinite vocabulary to provide such a description—but we can recognize a given aspect and attend to it, thereby prescinding it from the rest of the object. Such aspects are compared and contrasted, and are grouped into equivalence classes on the basis of similarity.

That this presupposes both innate ability to note similarities and differences, and some inborn similarity space, is true, but this much innate endowment is generally admitted by all.⁴¹ Color aspects, for example, are known to be categorized on the basis of similarity to focal colors, and the perception of such focal colors appears to be universal, whether a given language has names for them or not. This is clearly a case of categorization by prototype. Such similarity relations among aspects constitute a property or feature; the similarity relation “as blue as” is not distinct from the property “blue.” Such matching relations are reflexive and symmetrical, but not necessarily transitive; color matching, for example, is not transitive, since one can move along the color continuum by steps each of which is less than a just noticeable difference, yet widely separated points on the continuum are clearly discriminable.⁴²

The words “property” and “feature” as used in the theories of concepts discussed above are ambiguous because they sometimes refer to such things as the color of an object and sometimes to what I have called an aspect of an object. Both involve conceptualization, but to different degrees. To use Quine’s metaphor of the continuum between the conceptual and the observational, “aspects” are at the observational extreme of the continuum while full fledged “concepts” (e.g., bird) are at the conceptual extreme. But in prototype and feature-bundle theories of concepts, it is assumed that the constituents of the concept are further toward the observational end of the continuum than the concept being analyzed. The question is not therefore one of circularity but of more or less.

In the case of logical or mathematical concepts, such as even number, there are no observational components. One can of course distinguish between primitive and defined terms, and one could regard defined terms as in some sense more “complex” than their defining terms, although it is not obvious what would be accomplished by doing so, given that the choice of what terms are to be taken as primitive is purely arbitrary. There is in any case no possibility of reducing “complex” logical or mathematical terms to some combination of “simple” terms in any meaningful sense of “simple” and “complex.”

It should not, however, be thought that properties as they occur in these theories are always qualitative. Among the characteristics of an object is the configuration of its aspects—i.e., the relational pattern in which its

aspects stand. That configuration is itself an aspect that can be prescinded and in terms of which objects can be compared for similarities and differences. Thus a given bird has many aspects—its colors, its shape, its motions, etc.—but a bird is not an unordered bundle of aspects; rather there is a characteristic configuration of these aspects. That configuration may be far more important in judging likenesses and differences among birds than any individual aspect taken separately.

As these remarks suggest, any n -tuple of objects or aspects has itself an aspect by which it can be compared to other n -tuples as like or different. With Peirce and James, I believe that some relations are directly perceived. But what can that mean except that certain aspects of aggregates—in the simplest case, of pairs—are perceived, just as aspects of single objects are perceived? Thus suppose we have a number of pairs (a,b) , (c,d) , . . . , each of which has a particular aspect, and that these aspects are similar. To fix ideas, let a child have been introduced to the complexes *apple-on-the-table* and *doll-in-the-box*. If he has prescinded the aspect of the apple being on the table, he should find *block-on-the-shelf* more similar to the *apple-on-the-table* than to the *doll-in-the-box*. Of course, the prescinded aspect must include the order of the pair—that is, it is *apple-on-the-table* and not *table-under-the-apple*; otherwise the relations *on* and *under* could never be distinguished. Relations then are abstracted from the aspects of n -tuples.

This way of defining relations will seem bizarre to some, since a relation is usually defined as a set of ordered pairs. For purely extensional purposes, that definition is unexceptional, but it does little to help us with ordinary experience. What after all is the relation defined by $\langle 4, 2 \rangle$, $\langle \text{love, golf} \rangle$, $\langle \text{Ronald Reagan, Checkers} \rangle$, $\langle \text{my garbage pail, the moon} \rangle$, $\langle \text{Joe Montana, Helen of Troy} \rangle$? To claim there is one is to prefer extensionalism to common sense. It is equally obvious that when we induce a relation from the pairs $\langle \text{Kareem Jabbar, Richard Nixon} \rangle$, $\langle \text{the Empire State Building, my house} \rangle$, $\langle \text{Pike's Peak, Cheyenne Mountain} \rangle$, $\langle \text{Wilt Chamberlain, Margaret Thatcher} \rangle$, we do so in terms of a particular similarity among aspects of these pairs.

There is, however, some important new work on concept development which suggests a somewhat different view. Keil's research on the development of concepts in young children has yielded some significant new insights into this process. Keil contrasted the development of concepts of natural kinds, such as biological species, with that of nominal or artificial kinds, such as artifacts. Rather than a progression through global stages of sophistication, in the manner suggested by most stage theories of development, he found that transformations tended to be domain specific, occurring first with respect to natural biological kinds, then with other physical natural kinds (e.g., minerals), and last with nominal kinds.⁴³ Fur-

thermore, it is clear from his experiments that concepts are not just bundles of characteristic features; rather, they involve causal relations that account for the clustering of and relations among features. This integration of characteristics into a causal structure does not include all features associated with the concept, but it includes an increasing number of them as development takes place.

In one particularly interesting set of experiments, Keil used photographs to determine whether kindergarten, second grade, and fourth grade children thought one kind could change into another. Three sorts of transformations were tested: natural kind to natural kind within biological categories (one kind of animal into another, one kind of plant into another, etc.); nominal kind into nominal kind (one type of artifact into another); and cross-ontological changes (animal to artifact, animal to plant, machine to animal, etc.) The children were shown two pictures chosen to maximize common features (e.g., a horse and a zebra, a toy bird and a real bird, etc.), and were told that one represented the creature before a scientist operated on it, the other the creature after the operation. The children were then asked if the object shown in the first picture had been changed into that shown in the second (e.g., "Did he change it into a zebra, or is it still a horse?").⁴⁴ At all ages the children were least resistant to accepting the change of one artifact into another; they were more resistant to changes of natural kinds within categories, with the resistance increasing sharply with age, and at all ages they were strongly resistant to cross-ontological category changes. As Keil notes

This study strongly indicates that kindergartners, and very possibly considerably younger children, are not the pure phenomenologists they appear to be, even when making distinctions between members of the same ontological category. They have beliefs about what sorts of mechanisms underlying characteristic feature changes are relevant to membership in a biological kind and what ones are not; and although many of these reasons may not be correct in the eyes of most adults, they are nonetheless theoretical constructs that may well be specific to biological kinds.⁴⁵

As the comparison of kindergartners, second graders, and fourth graders shows, these theories rapidly become more sophisticated, emphasizing origins, deep as opposed to surface features, what the parents were, what sorts of offspring could be expected, and the basic impossibility of change of kind. In looking at the development of these concepts of natural kinds,

what one is seeing is the development of theories in which a variety of characteristics are integrated through underlying causal processes. Keil makes the point explicitly.

Most concepts are partial theories themselves in that they embody explanations of the relations between their constituents, of their origins, and of their relations to other clusters of features. This is readily apparent for concepts of events but is even more important with regard to objects, since one's full concept of an object (say, a dog or a typewriter) crucially depends on understanding not only the causal relations between its properties and why they cluster as they do, but also the potential causal roles such an object stably and regularly engages in when interacting with other objects.⁴⁶

This does not of course mean that all characteristics associated with the object are fully integrated into such a structure. There remain correlated properties represented in and part of the concept, although related by association rather than by causal connections. But the model of the concept as a bundle of features assembled on the basis of similarity only—whether it is the common property classical view or the match to prototype view—is clearly inadequate to explain the experimental data. The view that theories are built up out of relations among concepts that are themselves atheoretical simply will not wash. Conceptions appear to *be* theories in their own right.

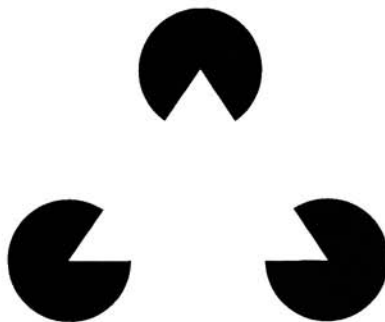
This view of concepts implies that the notion of causality is central to conceptual development, at least with respect to concepts of the natural world, and that it is present even among children of kindergarten age. It is therefore an important question just how early this notion appears among children, and how its presence is to be accounted for. Although Piaget's work on this subject is probably the best known in the literature,⁴⁷ the crucial experimental advance was made by Michotte. In a remarkable series of experiments, Michotte showed that adults *perceive* causal relations, and that this perception is often an illusion. The experimental apparatuses used by Michotte were of two sorts: discs rotating behind a screen which contained a viewing slit, and coordinated Kodak projectors. Both created images in which subjects saw squares or other figures perform various sorts of movements. In other words, the subjects were not viewing physical objects like billiard balls, but images only. In what he called "direct launching," Michotte used the rotating disc apparatus so that subjects saw two squares, A and B; A approached B, which was stationary until the two

squares appeared to touch; A's motion thereupon ceased, and B moved away from A.

Michotte's subjects perceived A as causing the movement of B. Moreover, the perception of causality was overwhelming in direct launching, even when the subjects knew how the apparatus produced the apparent motions. As Michotte emphasized, "All the causal impressions mentioned in the book have occurred in the presence of observers who knew perfectly well that 'in reality' no causal influence was operating."⁴⁸ This point is crucial; observers's knowledge that no real causality was involved, or that the sequence of events they were seeing was physically impossible, had no effect upon their perception—they perceived the interaction as causal in spite of their knowledge to the contrary.⁴⁹ Michotte developed from his experiments a set of rules that enabled him to create this illusion, and to make it vanish by varying certain features of the scene perceived by the subjects. But the central point is that the subjects perceived the interaction of the images as causal even knowing that the perception was an illusion.

In recent years, perceptual illusions have received a great deal of intensive study. Bruner and his coworkers have shown that there are cases in perception where prior knowledge can have a marked effect on what is perceived.⁵⁰ To use Pylyshyn's term, in such cases the perceptual system is "cognitively penetrable" by conceptual knowledge.⁵¹ But the existence of perceptual illusions shows that this is not always the case. For example, when subjects look at this figure, they see a white triangle, and the triangle appears to be whiter than the surrounding white background. It makes no difference at all that the subject knows there is in fact no triangle and that the surface within the illusory figure differs in no respect from the rest of the background.⁵² In such cases, the perceptual system which yields this illusion is "cognitively impenetrable"; conceptual knowledge has no effect on the perception.

Figure 3



Illusory phenomena are among the data that have led Marr,⁵³ Fodor,⁵⁴ and others to propose that the perceptual system contains “modules”—relatively self-contained perceptual units that process perceptual data “from the bottom up” and then input the results of this processing to more central cognitive systems. The modularity theory has now acquired substantial experimental support. Among other virtues, it offers an explanation for the existence of illusions such as the Muller-Lyre, the triangle illusion, and many others. These result from the automatic action of the module, and the fact that the module processes “from the bottom up” means that higher-level beliefs have no influence on its working. Conversely, illusions that are cognitively impenetrable become clues to the existence of modules. As Leslie has pointed out, the existence of causal illusions of the sort demonstrated by Michotte and the fact that these illusions are cognitively impenetrable provide a strong argument that they result from a modular perceptual system.⁵⁵

If such a modular perceptual system yielding causal perceptions exists, it would be quite reasonable to assume that it exists in infancy. Leslie has carried out a series of experiments on infants 27 weeks old that support the hypothesis that they perceive direct launching as causal. Using the habituation-of-looking method, he has shown that these infants perceive direct launching as having a more complex internal structure than other interactions in which causal perception should not be present. This result is predictable from the hypothesis that they perceive direct launching as a causal process. Leslie has also shown that two-year-old children have a well-developed understanding of causality that enables them to employ causal principles in counterfactual reasoning. To do this, he created “pretend” games with these children—for example, having a pretend birthday party for a toy animal. When the experimenter “accidentally” tipped over a cup filled with pretend tea, the children were perfectly able to describe what the effects would be. By using a series of such pretend situations, Leslie showed that the children had an accurate grasp of real-world causal notions, and that they applied them in pretend situations to determine what the consequences of various events and accidents would be.⁵⁶

These results strongly suggest that causal notions are not the end result of learning but its basis—that is, that the infant has a causal perceptual system, probably from birth, which underlies the development of a causal theory of the world as the child grows, and that, by the time the child is two, this theory has reached the point where causal reasoning is employed not only in developing an understanding of the real environment, but also in counterfactual situations. It should therefore be no surprise that concepts developed as part of this enterprise of understanding the world should involve causal principles. One would be surprised if they did not.⁵⁷

Spelke has argued that by the fourth month, the child already has a rudimentary theory of physical objects organized around the notions of substance, cohesion, boundaries, and spatio-temporal continuity. Is this object theory also to be attributed to modular perceptual processes? Spelke thinks not, and Leslie has produced some very remarkable evidence to support her position. Baillargeon's experiment with rotating a screen through the space apparently occupied by a solid block has already been discussed. It is not obvious how this experiment, which involves the notion of substance, could be explained on the basis of perception alone. But more important, Leslie has shown that the Pulfrich double-pendulum illusion actually involves the illusion of one solid rod passing through another. In brief, this illusion involves two pendulums with rigid rods swinging in opposite phase in a frontal plane. Under appropriate viewing conditions, the illusion is produced that the pendulums are following elliptical paths in which they are, as it were, "chasing each other around."⁵⁸ But for this illusion to work, the rods from which the bobs are swung must pass through each other, despite the fact they are solid rigid objects. The illusion does work, and the rods do appear to pass through each other. This is strong evidence that the principle of substance (that two objects cannot co-habit in the same space) cannot be based on a perceptual module; it must be a higher-level principle of the cognitive system. It would appear therefore that our view of the world as one of individuated objects is a cognitive theory that, given its extremely early appearance in infancy, is the result of hardwired cognitive processes.⁵⁹

Meaning

The argument to this point has concerned the development of concepts and theories. It is an explicit premise of this argument that language is distinct from thought and that substantial conceptual development takes place in children prior to the acquisition of language. But such a position leaves unexplained the question of the relation of language to thought. Clark's Lexical Contrast Theory seems to provide the most satisfactory answer to this problem currently available.⁶⁰ Clark's theory is based on several premises: (1) that concepts are distinct from, and predate, language, (2) that the primary motive for language acquisition is the desire of people to communicate with each other, (3) that "the conventional meanings of every pair of words (or word-formation devices) contrast," and (4) that "for certain meanings, there is a conventional word or word-formation device that should be used in the language community."⁶¹

From (4) it follows that in language learning, children will look for consistency in word usage across occasions and will modify their own usage to achieve such consistency. From (3) it follows that the child will assume that new words contrast with those he already knows. Both consequences are empirically supported. From (1) through (4) it follows that in acquiring words the learners' goal is to fill lexical gaps—that is, to find words that will enable them to express the concepts they want to use. Thus when children want to talk about an instance of a concept, they will seek an appropriate word with which to do so. Similarly, when children hear new words, they will assume that these contrast with those they already know and will seek a concept to match the new word. Further, given the communicative motive, children should seek most for words related to members of those categories they find most salient. But words once acquired should have a reciprocal function. Thus just as contrasting concepts will lead children to seek appropriately contrasting words, so new words should lead the child to seek appropriately contrasting concepts.

What does this theory imply regarding language acquisition? In view of (2), not only is language acquisition driven by communicative needs, but it is to the intended meanings of the child's linguistic expression that the principle of contrast applies, not always the actual expression used. That is, since children seek to communicate and, by hypothesis, have yet to acquire fully adequate means of doing so, they will try to make the linguistic resources they do have go as far as possible. One predictable result should be overextension of terms, e.g., calling all four-legged animals "doggie." This phenomenon is well known and amply documented.

A second is that children will not overextend a term to cover instances for which they already have an appropriate term. Thus once children have command of the term "cow," they will not extend "doggie" to include cows. It also follows from the desire for communication and the principle of contrast that overextension should diminish as the child acquires more words that make possible more precise communication.

A third consequence is that in the early stages of language learning, the learner will rely heavily on general-purpose words such as demonstratives and deictics and broadly extendable substantives such as "thing." The same phenomenon will be observed with verbs; thus young children use "do," "make," and "go" to cover a wide variety of actions and events. Here too one would predict that as the lexicon expands, the use of these all-purpose words will be restricted.

A fourth consequence is that, lacking words to fill felt gaps, children will invent new words for the purpose. The use of affixes—particularly suffixes, the conversion of words from one category to another (verb to noun or vice versa), and the compounding of words (e.g., "doorknob") are all