Vision, Sign, and Inference

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In this paper I defend the thesis that perceiving—and by implication, vision—is inferential or semiotic. Whenever a person sees an object, that object's stimulation of the perceiver functions as a sign that is interpreted in the conscious response of the perceiver; the stimulation functions as a premise from which the perceiver infers a conclusion which is a conscious response. The argument has two basic steps. (1) Perception is a three-termed relationship between the object perceived, a mediating element, and a conscious response; certain facts about how we perceive with the minor senses are taken into account, and cases of identical stimuli resulting in different responses are suggested as evidence that perception is mediated. (2) This mediating element takes the form of a sign which is interpreted by the conscious response, or a set of premises for which the conscious response is a conclusion; some of Charles Sanders Peirce's ideas about perception and signs are developed—especially his concept of a percept and a perceptual judgment, and his classification of signs. There is an important similarity between the perceptual world taken as a system of signs and the system of signs we ordinarily think of as visible language. Just as we learn to read, we learn to perceive.

The thesis I want to defend is that perceiving—and by implication, vision—is inferential or semiotic. That is, whenever a person sees an object, that object's stimulation of the perceiver functions as a sign that is interpreted in the conscious response of that perceiver. By the same token, that stimulation functions as a premise from which the perceiver forms a hypothesis or makes an inference, and what he experiences as a conscious response is a conclusion. If I am correct, it follows that all vision—indeed all perceiving—is, in a sense, linguistic in nature since interpreting signs involves having a system of signs or a language, and since premises and conclusions can be formulated only in some kind of language.[1] After developing and defending my thesis, I suggest that there is an important connection between the perceptual world taken as a system of signs and the system of signs that we normally think of as visible language. As I point out, this

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connection has important implications for research concerning visible language and for the concept of visible language itself. But specific points about visible language and the relationship between visible language and perception in general can best be understood after a general discussion of the nature of perception and the nature of signs.

In defending my thesis, I am taking sides against the predominant trend in the philosophy of perception, a trend exemplified by the following quotation from Roderick Chisholm's *Perceiving: A Philosophical Study*, one of the most influential and most forcefully argued books on this subject in recent years. Chisholm writes,

> It is sometimes said that to perceive something is to "make an inference" or to "frame a hypothesis." . . . To perceive a man walking, according to this "inferential theory," is to "infer" or "frame the hypothesis" that one's sensory experience has been stimulated by a man walking. . . . But surely no perceiver, upon opening his eyes in the morning can be said to "infer" that he is surrounded by familiar objects or to "frame the hypothesis" that these objects stimulate the appearances he is sensing. . . .
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> If we do use the words "inference" or "hypothesis" in this context, we cannot take them in this ordinary sense—in the sense in which a physician, studying symptoms, may be said to "make an inference" or "frame a hypothesis" about the disorders of his patient. . . .
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> Nor should we say that the perceiver takes an appearance to be a sign of an object. . . .[2]

What I intend to show is that, in an important sense, it is correct to say that perceiving involves making an inference or taking something as a sign; thus, seeing is essentially linguistic. Before the sense in which I think this is true and my reasons for holding it true can be developed, I must begin with an underlying controversy. The controversy can be stated as follows. When a person perceives an object, does he perceive it immediately or mediately? Is perceiving a two-termed relationship between the object perceived and the perceiver's consciousness of it, or a three-termed relationship between the object perceived, some mediating element that functions as a sign or premise, and the perceiver's consciousness. Philosophers who have held that perception is immediate include Chisholm, Alfred North Whitehead, and, at one time, Bertrand Russell.[3] Those who have argued that it is mediated include Charles Sanders Peirce, George Santayana, and Wilfred Sellars. My contention is two-fold:

first, that perception is mediated; and second, that the mediating element does in fact function as a sign, or as a premise from which the conclusion—the conscious response—is drawn. I will first indicate some of the reasons for believing that perception is mediated, then argue for the sign-inference model of mediation.

There are at least two types of considerations which support the hypothesis that perception is mediated. These may be called arguments from perceptual relativity and arguments concerning perceiving with the minor senses. I shall discuss these beginning with the latter, assuming that examining how we describe perceiving with senses other than vision can tell us something about vision.

Vision is, of course, the major sense for a normal human being. We depend the most heavily on this sense in our everyday activities, and when two senses give us conflicting information, we often tend to regard the visual information as more reliable. And often vision is used to confirm a belief which is evoked by another sense. For instance, if we think we smell a fire in the kitchen but are not sure, we will go and see. If we think we hear a car in the driveway but are not sure, we will go and see. The reason why a particular sense is the major one in a particular organism probably has nothing to do with the kind of information which is conveyed by that sense, but is due to the potential for the development of that sense in that particular organism, and accordingly, the amount of information that sense can convey. The environment of the organism surely plays a role as well. It is common knowledge that different animals have different senses as their major sense. If I bump into an object that hurts me, I may go back and look at it; but in a similar situation, my dog will go back and smell it. If I hear someone coming, I will go see who it is; but if the dog sees someone, he may go smell who it is. Examples are multiplied when we consider the sense of hearing of bats and porpoises and the sense of heat perception of insects. So there seems to be no sense in general which is the major sense for all species of living creatures.

It is immediately apparent that the consideration of human beings' minor senses lends some credibility to the view that perceiving involves inference since it seems more reasonable to say that blindfolded man infers that there is an object from what he feels or hears

than to say that a man infers that there is an object when he sees it right in front of him. But another type of argument concerning minor senses involves the status of things like smells and their relationship to objects that smell, and this type of argument supports the general view that perception is mediated.

It is an interesting and perhaps important fact about our language that we often talk about smelling smells and hearing sounds, but only in very limited contexts do we talk about seeing sights. Aside from the vocabulary of tourists and unusual circumstances ("Son, you are quite a sight with your hair down to your shoulders") this expression is rarely used. And for the senses of the skin, such expressions are even rarer. Thus, if I say that I hear a horn and someone asks if I heard a sound I would tend to say, "Yes, of course, how could I hear a horn without hearing a sound?" But if I say that I see a horn and someone asks me if I saw a sight, I would tend to say, "Well, I guess you *could* say that." And if I reach out and touch the surface of the horn and someone asks me if I have touched a feel, I will tend to think that he is crazy, or unable to use the language properly. It sounds a little better to ask if I felt a touch, but the usual context for this expression is not when one touches something, but when one is touched by something. Whenever there is an external object that is perceived by a subject, the subject can talk about perceiving it in terms of perceiving a physical object, but only in special cases does ordinary language allow us to talk about perceiving an object in terms of perceiving something like a sound or sight. Following the indications of our language, then, let us assume that we perceive objects rather than sights and sounds. When someone says that he hears a sound, what he really hears is a vibrating object. If he says that he sees a sight, he really sees an object which reflects light. We do not want to eliminate perceptual qualities from our vocabulary and our conceptual framework. We talk of different sound qualities such as tone and timbre, gustatory qualities such as sweet and bitter, olfactory qualities such pungent and acrid, and colors or visual qualities. The suggestion that we perceive objects rather than sights and sounds does not commit us to the position that we do not have some kind of acquaintance with qualities of sight and sound. We might want to say that we have qualities of sight and sound when we perceive objects just as it has been argued that we have a pain when

we perceive a disordered bodily state or have a glimpse when we see something quickly.[4] Yet we do not see glimpses, but objects. And similarly, we do not really hear sounds, but objects. It could be claimed, then, that this having or being acquainted with or making judgments concerning qualities of sight and sound, etc., mediates our perception of objects. At first glance, it does not seem that this is the case with sight. We are so dependent upon vision that it does indeed seem immediate. But it does not seem that this is the case with the other senses. Due to our having or being acquainted with sounds, we perceive horns, the vibration of shoes against pavement, voices (the vibration of vocal chords), etc. From our acquaintance with smells, we perceive fires, spoiled food, edible food, etc. And due to our having pains, we perceive disordered bodily states. Hence, is there any reason why we should not say that due to our having or being acquainted with visual qualities such as colors and shapes, that we perceive food, fires, and people? That is no stranger than to say of a dog that he perceives objects by having or being acquainted with qualities of smell, or that a bat's perception of an object is mediated by the sounds with which he is acquainted. There is no evidence to suppose that the major sense of a particular animal is any different in this respect than any other sense. The use of the major sense is so much more highly developed through learning that it seems that perception with regard to this particular sense is immediate. An examination of the way we describe perceiving with the minor senses, then, offers some relevant considerations in favor of the view that our perception of objects is mediated by what we call sounds, sights, smells, pains, etc.

I shall now consider what I call arguments for perceptual relativity. In their work with perception, scientists have become very adept at studying stimulation to and responses of organisms. However, there seems to be a lack of continuity between the stimulus and the response. There is continuity when energy is traced from an object to sense receptors to the brain, but, perhaps due to our lack of knowledge, there seems to be a gap between this point and the response. This has given rise to the familiar "Black Box" analogy. The mind of the subject is likened to a black box. Stimuli go into the box and responses come out. No one can see into the box, so we do not know

what happens inside. We do not know what happens to change the stimulus energy into a response. This leaves open the possibility that there is a mediating element in the black box, a third term which makes perception a triadic relationship. Of course, since we cannot see into the box, any statement concerning the mediating element is a hypothetical statement, a posit. The fact that sometimes, in two different cases, the same stimulus can go into the box and a different response can come out, gives some credibility to the hypothesis that there is a mediating element involved. Thus, the facts of perceptual relativity are relevant to the hypothesis that perception is mediated. There are several different kinds of cases of perceptual relativity, and I want to examine these in terms of the concepts of stimulus and response. By this I mean I want to consider cases in which stimulus conditions are identical or similar in two or more instances, yet the responses (or how the thing appears) are different. I think there are at least three varieties of this. There are cases in which the stimulus condition produces a response on one occasion and no response on another, or what might be called a positive response as opposed to a negative response. Within this group there are cases in which identical stimulus conditions produce a negative response at one time and a positive response at another time, and cases in which a very slight modification in the stimulus conditions will evoke a positive response where before the modification was made, there was no response at all. Thirdly, there are cases in which identical stimulus conditions produce varied positive responses. I shall begin with this last type of case.

One striking example involves what is usually referred to as the power of suggestion. For example, if two glasses of milk are poured from the same bottle, and at one time the subject is asked to try the milk to see if it is a little sour, he may well respond that the milk does taste sour. But if he is asked to taste some fresh milk, then he is likely to find that the milk tastes just fine. So with the same stimulus to the gustatory and olfactory receptors, and the same corresponding input into the brain from that stimulus, there is a different response.

There are other interesting examples concerning the sense of taste. For example, there are some food items for which we must acquire a taste. Do these items actually taste different to a perceiver before and after he has acquired a taste for them even though the sensory input is the same? And what about someone with a trained sense of taste

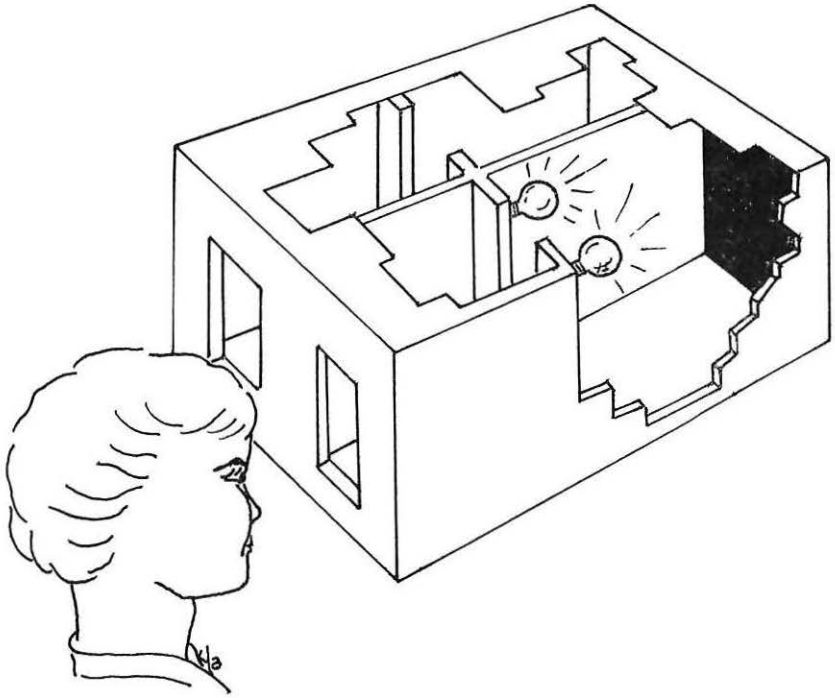

Figure 1.

like a wine taster? Does a particular bottle of fine wine taste differently to him than it does to a casual wine drinker who cannot tell the difference between a good and poor vintage? Again, the input to the brain which can be traced to the stimulation of the taste buds by the wine may be the same.

So far I have not dealt with the sense of sight in my examples of when identical stimulus conditions produce different responses. There are controlled experiments which provide examples of this. One such example consists of a box divided into two parts (see Fig. 1). At the back of one part there is a black surface which is brightly illuminated by lights which are hidden from the perceiver. At the back of the other half is a white surface which is in relative darkness because of the construction of the box. When the perceiver is asked to look into the box and say which surface appears light and which surface appears dark, he will say that the white surface is darker. But if the top is removed from the box so that the perceiver can see what is

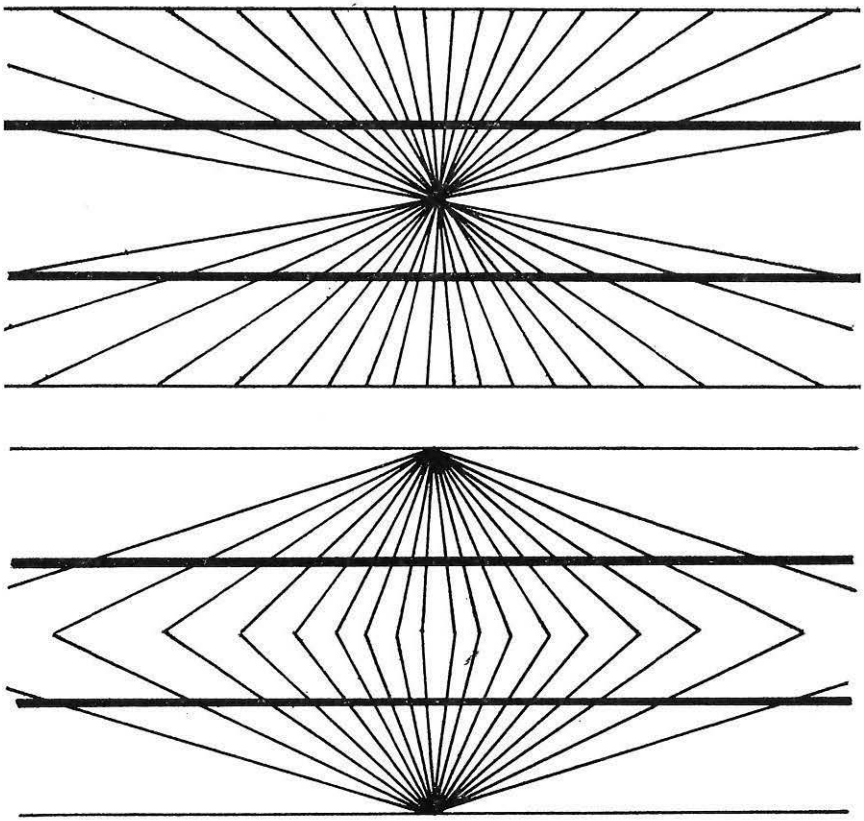

Figure 2. The Herring Figure.

happening inside, when he is subjected to the same test, the black surface will appear to be darker.

There are many other types of cases in which identical stimulation produces diverse perceptual responses. For instance, some illusions such as the Herring figure (Fig. 2) are illusions for people in civilized societies, but are not for people in primitive societies.[5] It seems that in each of these cases the perceptual relativity has some connection with past experience or learning. In the power of suggestion example the experience just prior to the perceptual situation had an effect on how the object appeared. The same is true of the light box example. In the example of the wine taster, and acquiring a taste, long range experience and learning played an important role. And in the

examples concerning illusions in different cultures, the difference is that one learns cues for perspective in our society in which many objects are rectangular which primitive people do not learn because rectangular shapes are not often encountered in their environment.[6]

We might infer two things from these examples. First, of course, since the same stimulus produces different responses, there is something more involved in perception than just the stimulus and the response. There is something else which I have called the mediating element which can explain why the varied responses occur. Secondly, objects that stimulate our senses acquire meaning for us based on our past experience and environment. So, much like the sets of symbols we call words and sentences take on meaning for us when we learn to read, stimulus objects take on meaning for us when we learn to perceive and learn to see. I think these two points, especially the second, receive further support from two other types of perceptual relativity. Cases of these two other types seem to indicate that just as some words have no meaning for us before we learn to read them, some stimulus objects have no meaning for us until we learn to see, or until conditions are such that it is important for us to see them. This is because, at times, there is no conscious response at all to these stimulus objects.

Everyone is surely familiar with the experience of not seeing something that is right in front of him. I often open a drawer looking for a particular object, then close the drawer since I do not see it. Then a few minutes later I will recheck the drawer and see the object right on top. The first time I looked into the drawer, the object clearly stimulated my visual sense receptors, yet there was no conscious response. Perhaps because my mind wandered, as we say, the object had no meaning for me.

Another slightly different example involves seeing objects that are in one's periphery. Most of us abstract out what is in a certain limited area of our visual, or actually stimulus, field and do not perceive many things in the periphery. However, when we are told to attend to the periphery, we can; and thus, our conscious response to the same stimulus conditions is different. There are some people who are trained to attend to their periphery and learn that stimulus objects which are meaningless to most of us are meaningful to them. A basketball player is trained to see what is in his periphery so he can

pass the ball to another man without looking in his direction. A man in a primitive society who gets his food by hunting wild game and is in constant danger of being attacked by an enemy or wild animal learns to perceive what is in his periphery.

Another example is that we abstract out certain sights and sounds in which we are interested, and we do not perceive stimulation to the other sense organs. We may see and hear what is coming from the television and not hear the noises in the street. The fact that we do not usually perceive the pressure of our watch bands on our wrists indicates that this is an element of the stimulus situation that is not abstracted out for perception. And of course the blind abstract much more out of the stimuli to the auditory, olfactory, and tactile receptors than do people with vision.

Next, I want to consider cases in which only a slight change in the stimulus condition evokes a positive response where there was no response prior to the change. When we are sleeping, we learn to respond and wake up to different sounds, sounds which are signs of danger, for instance. A good example of this is a mother who is a sound sleeper, but has learned to wake up when her child cries. She may be asleep while a dog is barking in the yard, and she will not wake up. But if her child begins to cry softly, she will wake up. Even if the dog is barking more loudly than the child is crying, even if the vibrations from the dog set up more intense vibrations in her ear drum than vibrations from her child, she will hear the child and not the dog. The difference here is the tone, timbre, and pitch of the stimulation, not the intensity. Can the fact that she perceives in one instance and not in the other be explained solely in terms of the quality of the sound? I think not. Before she had children, the sound of a child crying did not wake her. So it cannot be the sound quality alone which explains the perceptual relativity. Again, we must consider past experience. Perceiving in this case seems to be something she has learned.

To summarize my conclusions up to this point, it seems that certain facts of perceptual relativity and certain facts about the minor senses indicate that there is something more to perception than a two-termed relationship between a stimulus object and a conscious response. It seems that we must posit a hypothetical, mediating

element between the stimulus and response to account for the fact that in many cases the same stimulus or similar stimuli can produce significantly different, conscious responses. I have suggested that we learn to supply a particular mediating element when we learn to perceive, much like when we see a written word and supply learned information in order to understand what it means. Of course, in both cases our supplying the intermediate information or element is usually (perhaps always in the case of perceiving) an unconscious act. The next question concerns whether this mediating element can best be explained as functioning as a sign or a set of premises from which the response is "inferred."

The first thing to note is that the sign theory of perception and the inference theory are not really two entirely distinct theories, but are two ways of looking at the same thing. This claim will be defended as the two theories are developed. In developing the theories, I will refer frequently to Charles Sanders Peirce, who suggested these theories around the turn of the century, but left them in a very rough and undeveloped form, as indicated by the following quotation from a leading Peirce scholar:

> When approaching Peirce, one cannot help feeling a bit apprehensive about presenting a coherent account of his views on perception for they seem to be entangled in confusion. There is hardly a claim that Peirce makes relating to perception that doesn't appear to be contradicted in some other place.[7]

This impression is completely justified, and I think the reason is due to the fact that Peirce coins a number of technical terms and uses them differently in different contexts. For example, he may use a term differently in a letter to William James than he does in a published work. In some of his rough notes we may even find a third variation. And sometimes it seems that he uses his terms rather carelessly. Because of this, Peirce's views on perception are subject to a number of interpretations. Consequently, I am not trying to give a faithful account of Peirce's theory of perception, rather I am incorporating some of the ideas I get from Peirce into my thesis.

If the object is mediated by a sign, we first have to know what is meant by "sign" in this context. Peirce defines "sign" as follows:

A sign is a Cognizable that, on the one hand, is so determined by something *other than itself*, called its Object, while, on the other hand, it so determines some actual or potential Mind, the determination whereof I term the Interpretant created by the Sign, that that Interpreting Mind is therein determined mediately by the Object.[8]

So the perceiver's conscious response is an interpretant created by a sign which is determined by a stimulus object. Now that we have some idea of what is meant by the sign thesis, I will discuss the inference thesis, and in the course of the discussion, show how it is related to the sign thesis.

In what sense is perception an inference? Peirce says that nobody has ever claimed that perception is an inference in the strict sense of conscious inference, but, " . . . something . . . takes place in the organism which is equivalent to the syllogistic process."[9] What is it? His answer is that it is an unconscious, acritical, abductive inference. Leaving abduction aside for the moment, I will first discuss unconscious inference. According to Peirce, in an unconscious inference, we are aware of neither the premises nor the movement from the premises to the conclusion. If this is the case, just how does this type of inference work? Beginning with some examples of inferences in the ordinary sense, it can be shown how the inference and the sign thesis become one, and how perception can be described as an unconscious inference.

One might make an inference such as the following:

If I am at my desk, then I am in my office.

I am at my desk.

Therefore, I am in my office.

In this example we might say that we have two premises from which a conclusion is drawn. Or we might state the example as follows:

1. I am at my desk, and if I am at my desk, then I am in my office.
2. I am in my office.

Here sentence 1 can be taken as a sign. The actual marks on the paper here may be a sign, or the sounds made when the sentence is spoken may be a sign. The object of that sign may be the possible state of affairs of my sitting at my desk in my office and the actual state of affairs of my sitting at my desk. Now the interpretant of this sign may be the thought, "If I am at my desk, then I am in my office, and I am at my desk." But it is also very likely that the interpretant

will be the thought, "I am in my office." This may be the interpretant that is evoked by the sign. So the inference as it is stated in the first example may be analyzed into sign behavior. And I think it is also the case that sign behavior can be analyzed into inference. When we see a stop sign which is a sign for the state of affairs of a car stopping, and we stop (the act of stopping being what Peirce calls an energetic interpretant), this can be analyzed in terms of inference. It might be analyzed something like this:

There is a sign that means that I should stop (this is simply the stop sign construed as a premise).

When people fail to stop at signs that mean to stop, they often have accidents.

If I want to avoid an accident, I should stop.

I want to avoid an accident.

I will stop. (Pressure is applied to the brake and the car stops.)

Now, of course, we do not ordinarily go through a conscious process like this every time we approach a stop sign. But we are aware of the fact that stopping at stop signs is a case of moving to a conclusion from premises that have been learned and become habitual.

To draw the parallel between reasoning and perceiving, Peirce is saying that even though we are not aware of it, some mental occurrences in perception function as signs for conscious responses just as stop signs function as signs for interpretants and propositions about sitting at one's desk function as signs or premises for conclusions. Since perception can be analyzed as sign behavior, and since anything can be analyzed as sign behavior can be analyzed as some sort of inference, perception can be analyzed as an inference. Perception conforms to this formula of inference even though the things that function as signs are not things of which we are conscious. Some examples of how inference works in perception can now be given.

As the work of the psychologist von Senden has shown, when congenitally blind people who recently have had cataract operations restoring their visual sense organs to normal working order are presented with objects of a certain shape, a ball for example, they are unable to respond "ball" even though they are familiar with the object and its name through the sense of touch.[10] Now suppose an ordinary subject is presented with a ball in his visual field. Since he is being stimulated by the ball, he will have a physiological process

similar to that which one of the post-operative patients, one of von Senden's subjects, will have. This physiological process functions as a premise. Habits which the subject has developed and associated with that process will serve as the other premises. Or one might say that the conclusion, "ball," is the interpretant, and the sign of the object is a complex thing that is made up of the physiological process and the associated habits. One explanation of why von Senden's subjects do not respond "ball" is that they do not have all the premises necessary to draw the inference. Another explanation is that they do not have a complete sign, but only a partial sign, and the interpretant of this partial sign is of the "I don't know" variety. The von Senden subjects' signs are incomplete and meaningless because they are made only of sensory stimulation.[11]

In developing this inferential view of perception in more detail, one place to start is with the notion of habits. It might be objected that perception is not something that is learned and developed as habits are. So I have the burden of clarifying what is meant by "habit" in this context, and offering some justification for the claim that habits play a role in perception.

I am suggesting that if perception is modelled on inference, the stimulation of the subject would function as one premise. The notion of identical stimulus conditions can be used to determine when two premises of this type are identical. Some examples of this type of premise would be the stimulation of the visual receptors for both a von Senden subject and a normal man, the stimulation of the taste buds of both the man who has been told that the milk is fresh and the man who has been told that it is sour. But in these cases, as I have noted, the response is often different, and this can be explained in terms of other premises. What might these other premises be like? My examples indicate that some of them involve expectation. Using the inference formula, perceiving may work something like this:

Premise 1—Sensory stimulation of sense receptors by milk.
Premise 2—I have been told that this milk tastes sour, and when I am told that milk tastes sour, it usually does taste sour.
Premise 3—The memory of what sour milk tastes like.
Conclusion—Sour milk taste.

So one kind of habit that adds premises to the stimulus is a habit of expectation. Actually it would be more accurate to say that this is a

habit of expectation and memory since it involves a memory of how things tasted in the past. Or in the case of someone who has never tasted anything sour, it might involve a remembered explanation of how sour things taste, or a remembered imagination. If one has never tasted anything sour, nor has ever had sourness explained to him, then the word has no meaning and will probably have no effect on his perceptual response.

Two other types of habits which might give us premises are what might be called habits of abstraction and filling in. Abstraction involves attending to only certain parts of, or qualities in, the stimulus situation. Filling in (which may also be called closure or construction) involves adding to the stimulus situation. What are some examples in which habits of abstraction function as premises in perceptual inference? A case I have mentioned is the mother who hears her child cry in the night when the other members of the household, being stimulated by the same energy, hear nothing. And the mother does not hear the dog bark in the yard. She abstracts some elements of the stimulus situation out and perceives them, and this can be understood in terms of her having habitually added premises to her other premises or sensory stimulation, and these additional premises make her hear crying children and not barking dogs. Perhaps the most obvious cases of abstraction are our peripheral vision examples. The basketball player and the hunter have developed habits which become premises added to their stimuli.

In a sense, filling in is the opposite of abstraction, and Peirce gives some examples that illustrate how this operation is performed. One of these examples involves the blind spot that we have in our visual field due to the entrance of the optic nerve into the retina. Peirce has the reader demonstrate that he has this blind spot by performing a simple experiment in which he focuses his eyes on one coin and moves another coin until it seems to disappear because it is in the blind spot. The point is that we think that our visual field is something like an oval, but our stimulus field is not an oval. Our stimulus field is like an oval with a hole in the center. But we do not perceive like this because in addition to the premises given by the stimulation, we have another premise which involves the fact that reality does not have a hole in the center, so we do not see the gap.

The auditory sense gives another good example of how we fill in

perception. When we hear a person talk, it is often the case that not all of the sound waves originating in his vocal chords stimulate our auditory receptors. However, since we are acquainted with the language, we are able to fill in what we do not really hear so it appears that we hear all of what is being said. Our conscious response indicates that everything that was said was heard. But when a speaker has a foreign accent or a strong, unfamiliar regional accent, we will often not understand all of what he says. This is because we are not familiar with his speech pattern, the rhythm of his speech, and the clues that help us fill in what we miss. Anyone who has had a college course under a foreign instructor can attest that for the first few days what he says is almost unintelligible, then it gets progressively clearer through the term until eventually he is understood perfectly. So we learn to add premises to the stimulation, which is to say that we learn to add to the sign, of which the stimulus is a part, so that it becomes complete. We develop these habits and fill in perception.

In addition to abstraction and filling in, and memory and expectation, one other example of how we add premises to the stimulation should be mentioned. There is evidence that we have cues for perspective which we add to our stimulation in order to perceive distance. Peirce claims that since the publication of Berkeley's *An Essay Towards a New Theory of Vision*, it has been generally acknowledged that the third dimension is inferred.[12] Berkeley, who anticipated some of Peirce's ideas on perception, writes:

> It is, I think, agreed by all that distance, of itself and immediately, cannot be seen. For distance being a line directed endwise to the eye, it projects only one point in the fund of the eye, which point remains unvariably the same, whether the distance be longer or shorter. . . . The estimate we make of the distance of objects considerably remote is rather an act of judgment grounded of experience. . . .[13]

There is experimental evidence to confirm the view that the third dimension cannot be immediately given due to the construction of the retina. The von Senden subjects were not able to distinguish between two dimensional and three dimensional objects such as a ball and a disk, and the stimulation they receive is just like the stimulation received by someone who can make the distinction. Similarly, I pointed out earlier that some illusions such as the Herring figure

(Fig. 2) are not cross-culturally transferable since these illusions depend on cues for perspective, and people in some environments have not learned the same cues for perspective we have. So these people add different premises to the stimuli.

There may still be some hesitancy to accept the suggestion that perception involves an inference even though we are talking about unconscious, acritical inference. This hesitancy may be due to the fact that we can contrast perceiving with inferring, and perceiving seems to be an immediate act of cognition while inferring does not. Furthermore, we learn to make inferences and reason, but it does not seem that we learn to perceive by developing the habit of adding premises to the stimuli. I think I can give an analogy which shows that this line of reasoning does not constitute a serious objection to my thesis, and that there are some things that are learned yet do not appear to be learned.

When a boy learns to ride a bicycle, he is taught that if he begins to fall to one side, say the left, he should turn the wheel slightly to that side in order to retain his balance. Therefore, while he is learning, he might be riding along and reason as follows:

I am falling to the left, and I want to remain balanced.
If one begins to fall to the left and wants to remain balanced, he should turn the wheel to the left.
I should turn the wheel to the left.

And he turns it. That this reasoning takes some time and appears to involve some deliberation is evidenced by the fact that the boy proceeds at a slow pace wobbling back and forth for a while. Of course this action, riding a bicycle, is learned. We learn the premise that we ought to remain balanced at a very early age by taking spills. The boy's father teaches him the premises about turning in the direction of the fall. Suppose it is 15 years later and our boy is riding his bicycle in the Olympics. When he begins to tilt to the left, he turns his wheel to the left. This happens immediately, and no conscious reasoning is involved. It seems that what is involved here is a two termed relationship between falling and turning, and it does not appear that there is a three-termed relationship involving falling, a sign or set of premises, and turning. And if we try to explain to the cyclist that his action in staying balanced involves an inference, or

conforms to the formula of inference, he will think that we are foolish. But in this case, the premises have become unconscious habits. The event of falling is followed by a sign, and that sign is followed by an energetic interpretant, turning the wheel. And as was the case when the cyclist was just learning to ride, this sign is the premise set, and turning the wheel to the left is the conclusion.

It appears to everyone that perceiving is a two-termed relationship, just as it appears to the cyclist that his reaction to the tilt is immediate. But just as the cyclist learned to ride by developing habits, we may have learned to perceive by developing habits which serve as premises whenever we perceive. And the fact that perception seems to be immediate offers no argument against this claim. As a counter-argument, one might suggest that we can see how habit and learning are involved in the bicycle example because we are familiar with learning how to ride a bicycle, we can remember the learning process. But, of course, not being able to remember that we learned offers no argument against the claim that we learn to perceive. We have learned many things that we cannot remember learning, like how to crawl and drink from a cup. The only reason why we know that we have learned these things is that we have been told that we learned them and we see other individuals learning them. Suppose that shortly after learning how to drink from a cup a child is abandoned in the jungle where, like Tarzan, he is raised by the apes. He still has his cup and drinks from it for the rest of his life. But he never sees another individual drink from a cup, nor does he see one being taught to drink from a cup. Having forgotten his early childhood with human beings, he will probably think that he never learned to drink from a cup but always knew how. There is an analogy with perception. We cannot remember learning to perceive, nor can we see someone learning to perceive due to the private or egocentric nature of perception. So we assume that we never learned how to perceive, but always knew how.

It appears, then, that there is evidence that perception is an activity which involves learned habits which, together with stimulation of the sensory receptors, serve as premises for the conclusion which is a conscious response.

Having discussed how perception is an unconscious inference, I need to show how it is an abductive inference. An abductive inference is the type of inference whereby we frame an hypothesis. What this means is that when we make a perceptual judgment, we have made a hypothesis about something external to us. We have, in effect, made a hypothesis to explain why we are having a particular type of cognition. This can be seen more clearly by looking at some of Peirce's examples which show the difference between abduction (or hypothesis, as he sometimes calls it) and other types of inference.

> Suppose I enter a room and there find a number of bags, containing different kinds of beans. On the table there is a handful of white beans; and, after some searching, I find one of the bags contains white beans only. I at once infer as a probability, or as a fair guess, that this handful was taken out of that bag. This sort of inference is called making an *hypothesis*. It is the inference of a *case* from a *rule* and a result. We have, then—
>
> Deduction.
> Rule. —All the beans from this bag are white.
> Case. —These beans are from this bag.
> ∴ Result. —These beans are white.
>
> Induction.
> Case. —These beans are from this bag.
> Result. —These beans are white.
> ∴ Rule. —All the beans from this bag are white.
>
> Hypothesis.
> Rule. —All the beans from this bag are white.
> Result. —These beans are white.
> ∴ Case. —These beans are from this bag.[14]

It should now be easy to show how perception can be construed to fit the model of abduction. The result of a particular object being present will be a certain stimulation. This stimulation serves as the second premise in the example of hypothesis or abduction, the result. The rule (or habit) might be that all cases of such and such an object are cases of being stimulated in this manner. Therefore, we have a perceptual response such as, "small red building in the distance." And a response like this is the case.

It is obvious that we can make mistakes in perception, and of

course, every theory of perception should be able to account for this. In the example, some white beans from another bag may have been put on the table, so the hypothesis is wrong. In the case of perception, there might be some cases in which a sign or percept just like the one which consists of the combination of the habit and the stimulation may be produced in the absence of the object like the little red building in the distance. So we have illusions, and we think we perceive a particular object when we do not. The hypothesis which is the perceptual judgment is, then, false; and it does not explain what is going on external to the perceiver.

It should be emphasized that the examples of inferences I have used are oversimplifications. No doubt the inferences involved in perception are much more complex and complicated than the kinds of examples I have given. However, models are often useful simplifications of the things they model, and the point remains that perceiving adheres to the inference model, and is thus a type of inference.

At this point, it bears repeating that the evidence supporting the view that perception is an activity involving learned habits and stimulation serving as premises from which a conclusion in the form of a response is drawn, also supports the view that these learned habits combine with the stimulation to make a sign which is interpreted as a conscious response. The question remains, what is the relationship between the perceptual world taken as a system of signs and visible language as we normally think of it as a system of signs? An examination of just one aspect of Peirce's very complex theory of signs will show that this relationship is not as remote as it may appear at first glance.[15]

Every sign is connected with its object by some kind of rule (implicit or explicit), and according to Peirce, there are three kinds of signs determined by the rule-governed relationship which a sign bears to its object. The three kinds of rules can roughly be characterized as conventional rules, rules involving space-time relationships (such as rules governing causal connections and ostention), and rules of similarity.

Taking these in reverse order, an icon is a sign that bears some qualitative similarity to its objects, and due to that qualitative resemblance, determines an interpretant that refers to that object. Icons are things like maps, diagrams, and portraits. An index is a

sign that is related to its object by a dynamic spatio-temporal relationship. Although Peirce never explicitly divides indices into two kinds, there are at least two kinds that come out of his writings. These might be called causal indices and ostensive indices. An ostensive index is a sign that points to an object to which it is related in space and time. For example, an arrow might point to an object and thus determine a mind to have an idea of that object in the sense that the mind knows to what object the sign is related. A causal index is smoke as a sign of fire; the growth of or certain kinds of ferns as signs of a rainy climate.

The third type of sign is a symbol. Symbols are signs that are related to their objects by conventional rules. It is a matter of convention that red lights mean stop and green lights mean go. There is no reason why we could not all agree to let blue mean stop and yellow lights mean go.

Having distinguished the three types of signs, the next thing to note is that the distinction often breaks down in that we are not likely to find a case of a simple icon, index, or symbol; most signs seem to have elements of at least two of the types, that is to say, involve more than one type of rule. Perhaps the clearest example of this is the blurring of the distinction between icons and symbols. The traditional stick man (Fig. 3) can be considered as an icon of a man. It looks like a man in that its parts bear the same spatial relations to each other as the parts of a man. It could be considered as a diagram lacking in detail. But the stick man really bears very little resemblance to a real man. And someone unfamiliar with this type of sign, when presented with both the figure and a real man, might not be able to figure out for himself that the figure is a sign of a man. On the other hand, if the same man is presented a good photograph of a man together with the man, he could easily see that the photograph is a sign of the man. However, even photographs are not simple icons since they are meaningless to some uncivilized people showing that they too involve rules of learning and habit. It would be rather easy to change the traditional stick man to a not quite so traditional stick man (Fig. 4). Figure 4 bears just as much (and just as little) resemblance to a real man as Figure 3. However, it would be almost impossible to change the traditional stick man to Figure 5 which bears no resemblance to a man. So while a stick man is not simply an icon, it is not simply a symbol either. It is a hybrid of the two.

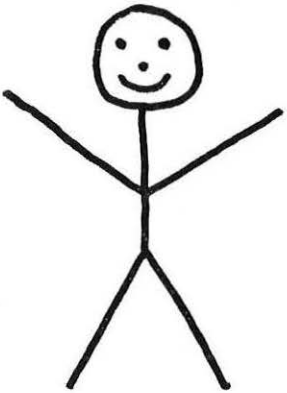

Figure 3.

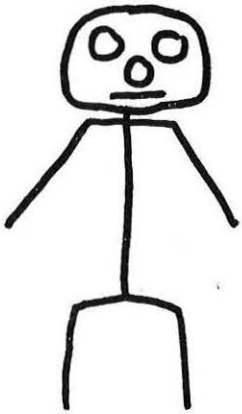

Figure 4.

It is, then, often difficult to say to which of these three categories a sign belongs, and probably the best one can do in many cases is to determine what kind of rule seems to be primary or the most important in a particular case. It should not be surprising if it is found that the percept is a hybrid, a cross between two types. It may not be a simple sign, but a complex sign.

It appears, however, that visible language provides about the closest example of a system of pure symbols we could hope to find. This means that the relationship between a visible word, phrase, or sentence and the object, class, or state of affairs it signifies is explicable in terms of conventional rules. Of course, this does not mean that the rules are arbitrary, but it does mean that they could be changed by convention. Some future British-American Linguistic Commission could conceivably decree that the symbol "JAT" will hereafter signify that type of animal which is presently signified by the symbol "CAT." Yet this commission could hardly decree that rain rather than smoke will hereafter be a sign for fire and that photographs of President Nixon will be signs for Prime Minister Heath.

Once it has been established that perception involves a system of signs, we can see that this system of signs is connected to visible language in that both systems of signs have a symbolic or conventional aspect. Visible language consists of symbols, and the type of signs involved as a mediating element in perception is a hybrid, an indexical

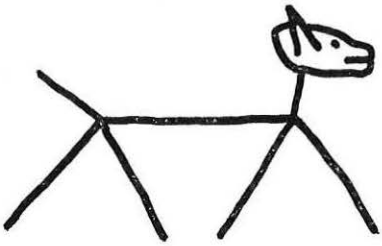

Figure 5.

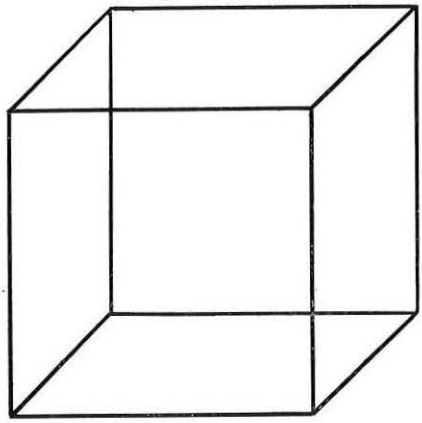

Figure 6.

symbol. My examples of perceptual relativity show that the sign involved in perception cannot be a causal index since like causes produce like effects. Yet there is obviously some causal aspect involved in the connection between a stimulus and response.

I should like to suggest that the best way to explain these cases is that not only do causal laws play a role in determining the way in which we perceive, but rules similar to the ones I classified as conventional rules also play a role. Admittedly, this hypothesis needs to be worked out before it can be accepted, but I think I can indicate the kind of thing I have in mind. For example, when a subject looks at the Necker Cube (Fig. 6) for the first time, it will usually appear as a cube with the front surface lower than the back. This might involve the same conventional rule that makes the sign ↑, as on a road sign, a sign indicating that something is ahead, rather than using ↓ to indicate that something is ahead. When the milk tastes sour, the conventional rule that associates a sour taste with the word "sour" plays a role in determining the way the milk will appear. And also in regard to taste, I think the diet and acquired tastes of a particular culture play a role in the way things taste. To some extent, rules for perceiving distances, that is, cues for perspective, are conventional, and this is why different cultures use different rules for perceiving distance. We could, if we wanted, change our convention of abstracting out the objects directly before us for perception and abstract out

the objects in our periphery. So the rules for abstraction and filling in may also be construed as conventional. Thus, the way one sees seems to depend in part, upon a learned or habitual connection, and this connection varies for different people with different habits. The rules may vary from culture to culture, from wine drinker to wine drinker, and from perceiver to perceiver. Similarly, the way one sees and reads visible language is largely dependent upon the same kinds of habits and conventions. Obviously, the way one responds to a given symbol depends in part upon his culture and environment. An English child and American child looking at flash cards will respond differently to the symbol "lift." And a German child and American child will respond differently to a symbol "arm."

If I am correct in suggesting that not only does all perception involve signs but also that all perception shares a symbolic or conventional character with seeing and reading visible language, it seems to me that this could have important implications for the concept of and approach to visible language. The sort of thing it suggests is that research is needed concerning what kinds of signs are best presented in conjunction with visible language to help the learner develop proper habits which will serve as the mediating element when he learns to respond to the words or sentences correctly. Such signs could be symbols, indices, or icons. They need not be visual, but might appeal to any of the senses. My thesis might also serve to broaden the concept of visible language in a way that is already being done on the highways by substituting iconic road signs for symbolic ones. The concept of visible language takes on a more important meaning when it is realized that, in an important sense, all vision involves visible language.

Figures 1 and 2 are by Karen Allaben. Figure 1 is adapted from the illustration of the Herring Figure in R. L. Gregory, *Eye and Brain.*

1. For a discussion of the sense in which language can be defined as a system of signs see, William P. Alston. *Philosophy of Language* (Englewood Cliffs, N.J.: Prentice-Hall, 1964), pp. 59–61.
2. (Ithaca, N.Y.: Cornell University Press, 1957), pp. 158–159.
3. During Russell's long philosophical career, he did not always hold that perception is immediate. However, in "On the Nature of Acquaintance," *Monist* (XXIV, 1914), he argues that when a subject experiences an object he is acquainted with that object, and he goes on to argue that acquaintance is a two-termed relationship.
4. George Pitcher. "Pain Perception," *Philosophical Review* (LXXIX, 1970).
5. See R. L. Gregory. *Eye and Brain* (New York: McGraw-Hill, 1966), Chapter Nine, especially pp. 137–138 and 160–161.
6. *Ibid.*, pp. 160–161.
7. Richard J. Bernstein. "Peirce's Theory of Perception," *Studies in the Philosophy of Charles Sanders Peirce*, 2nd series, ed., Edward C. Moore and Richard C. Robin (Amherst, Mass.: University of Massachusetts Press, 1964), p. 165.
8. Charles Sanders Peirce. *Collected Papers of Charles Sanders Peirce*, Vol. I–VI, ed. Charles Hartshorne and Paul Weiss, Vol. VII–VIII, ed. Arthur Burks (Cambridge, Mass.: Harvard University Press, Vol. I–VI, 1931; Vol. VII–VIII, 1958), 8.178. The first digit refers to the volume and the numeral after the period, to the paragraph. Hereafter referred to as *Peirce*.
9. *Ibid.*, 5.268.
10. M. von Senden. *Raum-und Gestaltauffassung Blindgeboren vor und nach Operation* (Leipzig, 1932).
11. A similar point is made by George Berkeley in his *An Essay Towards a New Theory of Vision* originally published in 1709. See, George Berkeley. *Works on Vision*, ed. Colin Murray Turbayne (Indianapolis: Bobbs-Merrill, 1963), pp. 37–39, 58–59, 70, 84–85. Hereafter referred to as *Berkeley*.
12. *Peirce*, 5.268.
13. *Berkeley*, pp. 19–20.
14. *Peirce*, 2.623.
15. For a detailed discussion of Peirce's theory of signs, see, Arthur Burks and Paul Weiss. "Peirce's Sixty-six Signs," *Journal of Philosophy* (XLII, 1954).

Graphicacy

Most intelligence tests recognize three basic kinds of ability: verbal, numerical and visual-spatial, and each of the three needs to be educated if it is to come to full fruition. The educated counterpart of verbal activity has long been known as literacy, and more recently mathematicians have coined a parallel word 'numeracy' to produce greater public awareness of the need to educate numerical ability. 'Graphicacy' is an attempt to complete the trio, and is accompanied by the adjectives 'graphicate' and 'ingraphicate'.

Literacy, numeracy, and graphicacy are all skills in communication with both incoming (or reading), and outgoing (or writing) aspects. Graphicacy was originally defined, in an article by W. G. V. Balchin and A. Coleman in the *Times Educational Supplement* of 5th November 1965, as the communication of relationships that cannot be successfully communicated by words or mathematical notation alone, but require maps, pictures, graphs, diagrams, *etc.* Its root is derived from words such as cartography, photography, and computer graphics, and it covers a broad spectrum of operations relevant to a wide range of subjects such as geography, mathematics, art, architecture, engineering, and biology.

'Graphicacy' has become best established in geographical circles where it has been developed by W. G. V. Balchin in a chapter in *Geography for the Intending Student* (Routledge and Kegan Paul, 1970) and in his presidential address to the Geographical Association (*Geography*, July 1972) as well as by various reprints abroad. It was introduced into the art world by A. Coleman in *The Designer* for February 1968 and A. F. Flatteley in the *Times Educational Supplement*, 28th March 1969. Another art teacher, G. Brazil, has arranged with the Schools Council to hold a symposium on graphicacy later in the year and the Geographical Association has set up a working party to further its development.

A note by A. Coleman in the December 1972 *Cartographic Journal*, Journal of the British Cartographic Society.