VISIBLE LANGUAGE

The Journal for Research on the Visual Media of Language Expression

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Cover: Detail of graffiti on a New York City subway car. Photograph by Marshall Swerman; reprinted with kind permission of the photographer and *Print* Magazine. Patricia Conway's comments on subway graffiti begin on page 360.

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Dr. Merald E. Wrolstad, *Editor and Publisher*
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Vision, Sign, and Inference

William E. Hoffmann

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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Author's address: Department of Philosophy, Ithaca College, Ithaca, NY 14850.

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. . . .
>
> 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. . . .
>
> 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

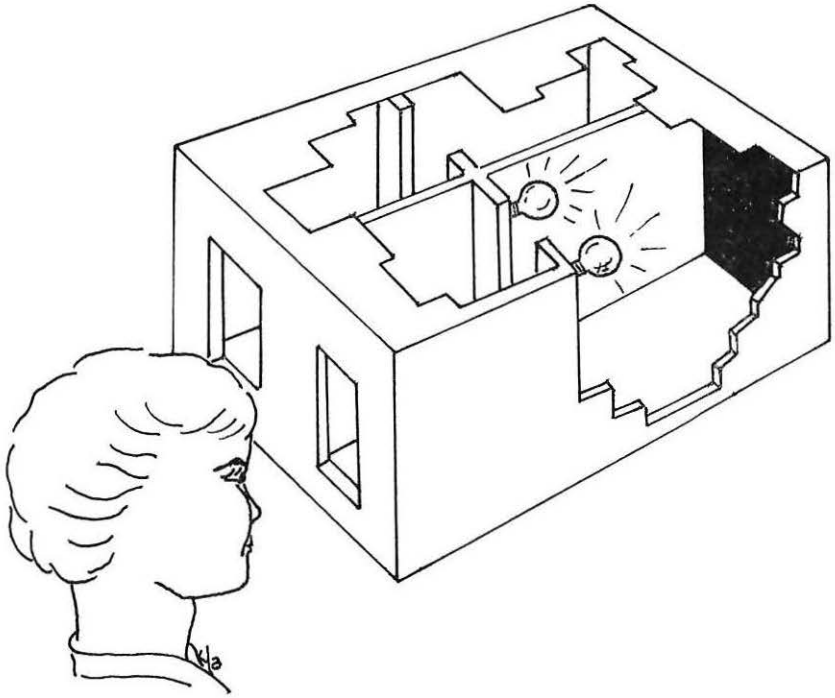


Figure 1.

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

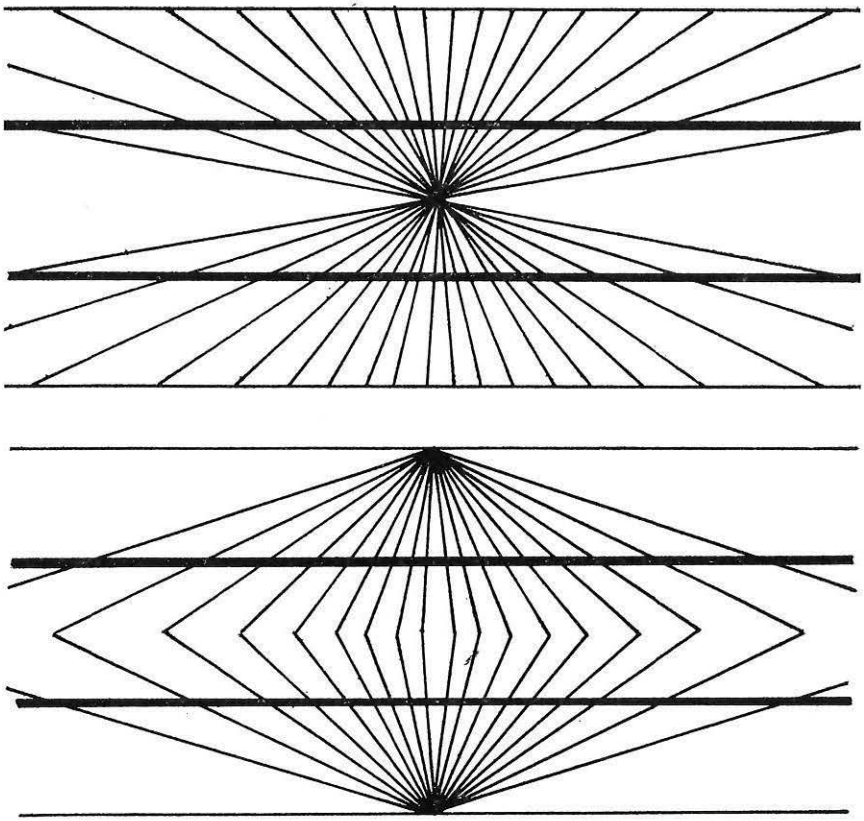


Figure 2. The Herring Figure.

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.

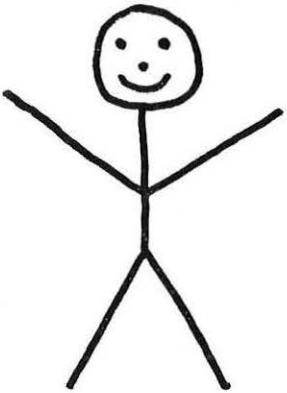


Figure 3.

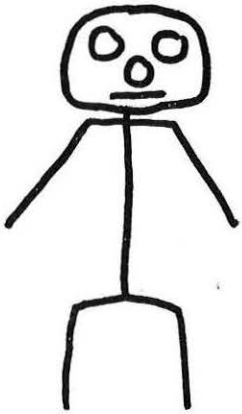


Figure 4.

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

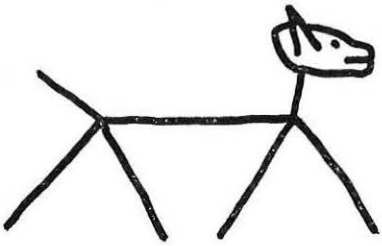


Figure 5.

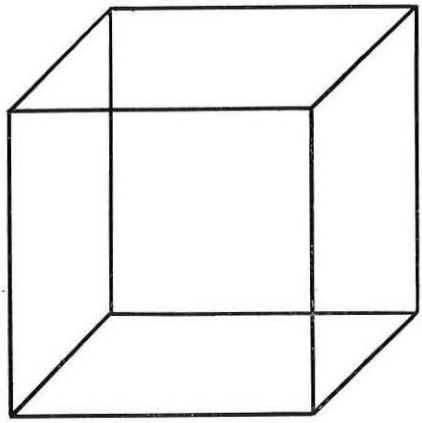


Figure 6.

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.

Space Craft

David Kindersley

The proper fit or spacing of letters has been next to impossible using the type-bearing metal rectangular forms required by typographic engineering; rather, it has required the letter-by-letter attention of an artist/letterer. The advent of film composition and computer technology makes possible again the proper coordination of spacing and design of letterforms. In typography, space and letter are one. Optically adjusted text spacing will require attention to the subtleties of each letter's optical centre and the inner forces involved in our eyes' perception of these letterforms. The author's Optical Letter Spacer is described, and its application for reading research is discussed.

My interest in space craft began as a form of self protection when I was involved with the design of letters for mass-produced signs. These were the days before Letraset or any self-adhesive letter became available to the trade—let alone to the do-it-yourself millions. Apart from being sign written, letters were cast or stamped in aluminium. In this field of stamped sign making, spacing did not exist. The object was to produce at the lowest possible price direction signs and number plates for cars. The cast signs were better. The firms who made castings for industry tended to make cast letters. The tradition was good; the men were trained to use their eyes, and pleasure was taken in arranging the letters. This was a trade that produced the cast locomotive name plates which now are rare collectors' items. It sprang from the age when engineers were creators, but this trade was deteriorating. Why? The blame lay with the largest consumer, the Ministry of Transport, who directly or indirectly caused a standard to be upheld of mutilated letterforms.

This article has been adapted with kind permission from a lecture by David Kindersley to The Wynkyn de Worde Society at Stationers' Hall, London, July 1973.

Visible Language, VII 4 (Autumn 1973), 311–324.

Author's address: Chesterton Tower, Chapel Street, Cambridge, England.

Although designed originally by Edward Johnston and others, they were altered out of all recognition when copied. Only by continuous badgering over many years has the M.O.T. changed its ways. Jock Kinier's fine Motorway alphabet is testimony to that.

Some of the misbegotten ways of the M.O.T. linger on today in number plates for cars. In 1948, I think, the Ministry issued a directive to the makers of number plates: no letters should be closer together than one-half inch. To be on the safe side, the whole sign-making trade carefully put all their letters and numerals exactly one-half inch apart. And so it is today on your car—and ever will be unless someone cares enough.

On the face of it, the proper fit or spacing of letters appears to be immensely complicated. Most printers will agree that it is not possible to obtain perfection unless it is done by an artist, letter by letter. Many typographers take the view that the right attitude toward a machine is to accept its limitations.

I am not a printer, but a letterer. The printer tends to accept unquestioningly the spacing offered to him. A letterer not only makes his letters one by one, but places each one in a precise position in relation to its neighbours.

I have never been able to accept the typefounders' allocation of space; it has seemed to me neither logical nor aesthetically pleasing. Nor is it economical.

The exactness of the spacing of early printing and the scriptoriums leaves little to choose from as regards the textural quality. So much is this apparent and in so many examples that few observers could have escaped the feeling that the discipline adhered to was, in fact, the exercise of some law. Later, engineers required a limited number of units for all letters.

However, at last there is once again the opportunity to have both the design and the space of letters correct. I am, of course, referring to the use of film negatives that in many cases can take the place of the bricks of type integral to the systems of printing devised by the engineers.

Firstly, is there a law that provides us with an even relationship between letters? I believe there is in the square law—at least this

will do as a name for the moment. That it is something very close to this can be proved satisfactorily by anyone who takes enough trouble to apply various mathematical progressions to letters in a particular way.

The designer of a typeface should know about space as a tangible factor, equal in importance to the letter itself. Today, however, he seems mostly ignorant of this other part of letter design, and consequently creates difficulties which cannot be resolved satisfactorily; e.g., he makes forms in black which require a lavish use of space, without reference to economy. The complexity of allotting units to characters in a restricted die-case has made the alphabet designer despair; indeed, the typefounder has relieved him of any experience in this field. In effect, the typefounder says: you are the artist, do what you will and leave the spacing and fit to us. This is far from satisfactory, because space and letter are one; e.g., as soon as you draw a circle you have drawn a space.

Today, with the use of film negatives instead of type-bearing rectangles, once again correct optical spacing—letter to letter—can be considered. The difference potentially between metal and film from a spacing point of view, can be described as follows: (a) The normal spacing of metal type is that dictated by the rectangles within which it is just possible to place a letter. (b) The normal spacing of a film negative should involve letters only.

The fovea—the centre of the retina onto which we focus when reading—sees best under strong illumination and not at all well in the dark. The fovea scans the words on a page, but its receptors respond better to light than dark. (Would it be better to have our printed reading matter in white on a dark paper?) Space and not-space are, of course, interchangeable in theory. The eye, in fact, does not read; it supplies information to the brain. It is the brain that recognizes shapes, whether they be black or white.

Spacing as opposed to space: the forces involved must be equal. Equal "things" must have equal spacing. In the case of a line of similar symbols, the spacing set between the first two absolutely predetermines the spacing for the rest. Every change of shape calls for a modification in spacing so that it may remain equal for the eye. See Figure 1.

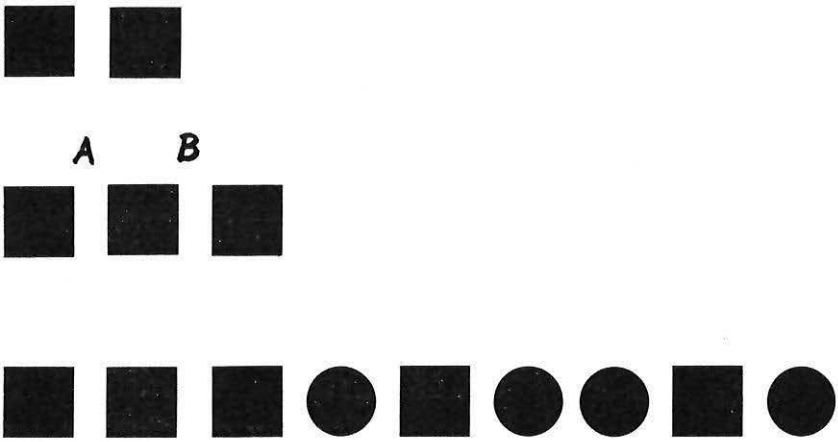


Figure 1. Spacing not space.

The next problem to pose is, "How holy are letterforms"? I will show you what I mean. Figure 2A is a fair and sensible "fit," but Figure 2B would offend many. Yet the spacing in 2B is "for the eye" the same; it is just set more closely. Printing with metal type has tended, for obvious reasons, towards 2A.

Figures 2B, 2C, and 2D all show the quality of pattern that is so desirable in spacing: the texture of text. At all costs, the result shown in 2E must be avoided. It is caused through an unwarranted belief in the sanctity of letters and is a hopeless compromise.

The advantages of optical spacing, with as little compromise as possible, are quite considerable. Letters form more cohesively into words and thus increase out pattern recognition. By and large, spacing is more economical, and a great saving of space is achieved between words. Words have necessarily to be set wide apart in metal type to make certain that the letters of a word belong to each other. However, if the inter-word, letter spacing is more perfect, the slightest change of rhythm will register. Figure 3 is an interesting example—perhaps overstating the point about word spaces—but I maintain that it is still quite readable. The longest line is equal to the justified

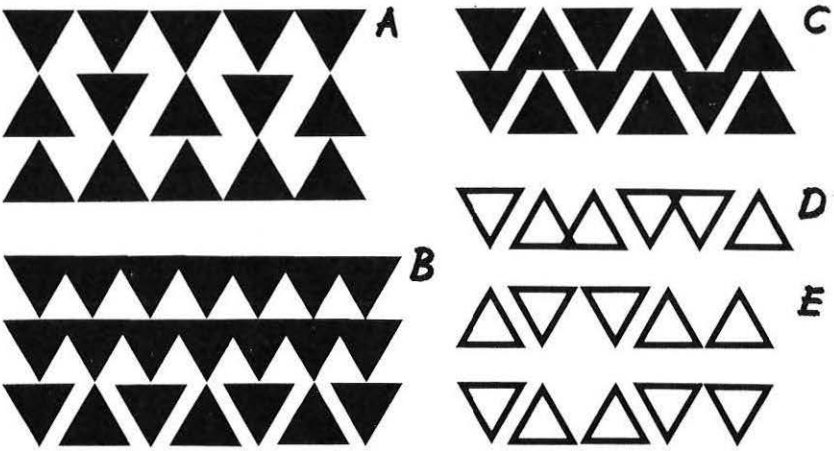


Figure 2. Spacing as pattern.

Figure 3. Difficult to read? Century Schoolbook set extra close in Letraset Spacematic. The extract is from *The Typographic Arts* by Stanley Morison.

It would seem therefore that when engravers working for bookprinters resorted to scribes for the patterns of their punches they were not obliged by technical reasons to do so On the other hand market and manuscript conditions would inevitably encourage the adoption of calligraphical models This however does not prove that printing is or was or ought to be based on calligraphy only that printing then as now was a business The copying of calligraphy is more difficult perhaps than the assimilation of inscriptional models but the calligraphical result achieved by such imitative means is artificial As a permanent method it should have been rejected because it is inconsistent with the nature of printing which is a department of engraving The imitation of calligraphy is excusable in the early period of printing because it was inevitable But while it is one thing to excuse the printers of the fifteenth century for deliberately copying hands familiar to their public it is impossible to be so indulgent towards the sixteenth century printers who reproduced the fashionable highly flourished German calligraphy

Figure 4. Capital and lower-case misfit. These examples of laziness appear all too frequently. They are derived from the rectangular limitation of metal type. "C"—Fun—shows what proper spacing should look like.

text width of the original printing. The x-height of Century Schoolbook is more than 25% larger, and the extract is completed with two lines space to spare. Somewhere between my setting and that of the average page lies a compromise which would result in a legible texture equal to the best of the early printers. That letters can be spaced closer than normal has, I think, been more than proved by Herbert Spencer in his admirable research programme at The Royal College of Art.

The quality of printing today can be as good as that of any period that has gone before; in fact better, when one compares the image imparted to the paper. Where typography falls down is in the relationship of one letter to another. This is as much a technical matter as any other part of the printing process. The machine compositor can do very little, if anything, to improve on the spacing provided by the matrices. The hand compositor can arrange his letters to obtain the best compromise, but I notice that he invariably follows the tradition and limits set by the machine. One frequently sees the mistakes shown in Figure 4.

Willem Ovink commented in his Beatrice Warde Memorial Lecture last year on the fact that capital letters are never spaced, and that it is high time they were. Whether capital letters are eventually dropped in text in favour of lower-case only, depends largely on what trouble is taken over the spacing of capitals at source. One simply cannot expect typographers—even if they have the ability—to space capitals by eye in these days of speed.

I am the last person to blame the providers of type for the work they do. In the absence of any vigorous objective research into the subject of spacing and its relation to the eye, the results are better than they should be. The May 1969 *Scientific American* includes the following comment on Gutenberg's printing type: "The character was not centred; each was cleverly placed on its block in a position such that when blocks were put side by side, the spaces between the characters were well balanced and there were no "holes" or concentrations of black in a word. This is indeed an art, requiring an aesthetic eye and meticulous care; even today, with all our technology, the placement of characters on their blocks is determined empirically by trials involving closer and closer approximations." Approximations to what?

There are too many factors to be held in the head at the same time. A trained eye can space a few words, but it is too much for anyone to arrive at a proper space for each of 100 characters or more so that there is anything like perfect interchangeability. Unless, of course, he happens to be a dedicated scribe working in a medieval scriptorium from sunrise to sunset, day in, day out. Many did just this. No, today our only chance is basic research with a computer to hand.

To my mind there is absolutely no reason why we should not all read optically adjusted text. Two requirements are needed of each letter: (1) it's optical centre, and (2) an ability to measure it's force, it's impact, in terms of the human eye. The first is needed to locate the letter on the centre of it's space, and the second is needed so that the letter will have an exactly commensurate space. To do these two things one must imagine how the retina and visual cortex receive and process the information collected by some 130 million receptors—7 million in the fovea alone! Overly simplified, the probable topo-

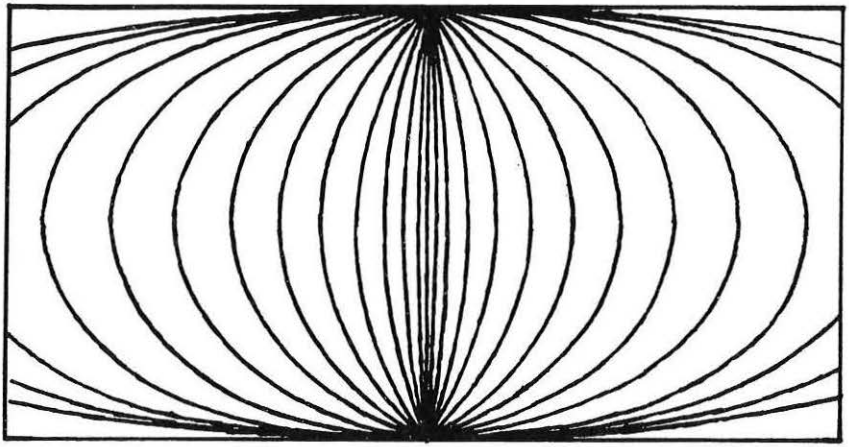


Figure 5. Topography of the reading eye. This "double parabola" wedge is made with a continuous tone from maximum density in the vertical centre to maximum light transmission at the four corners. Any horizontal section conforms to a square law progression.

graphy of the retina in terms of image impact must be something like my diagram in Figure 5. Each contour represents a square law increase from the centre. I have arrived at this form of visualization through collecting the eye-preferred centres of numerous letters and alphabets, and averaging the answers given. As far as I can tell from these results, people tend to agree about letter centres whatever eye sight they have. The greatest divergence of opinion—as you might expect—was with the centre of the capital L, generally the most asymmetrical of letters, and this was not more than 2% either way. Figure 6 shows the capitals C, F, and L with their centres as obtained by the computer, and agreeing with the eye.

The light wedge we use to obtain optical centres, in fact, is made on film so that the centre has the maximum density and the outside edge allows the maximum light transmission. The gradient from the centre to the outside edge being a "square law" progression. This wedge or filter is located in a central position in the Optical Letter Spacer (Fig. 7), and is divided vertically. Thus the light passing through either side can be compared. A clear letter on opaque film is moved to and fro laterally in the optical path between the wedge and the light source until the amount of light passing through both the

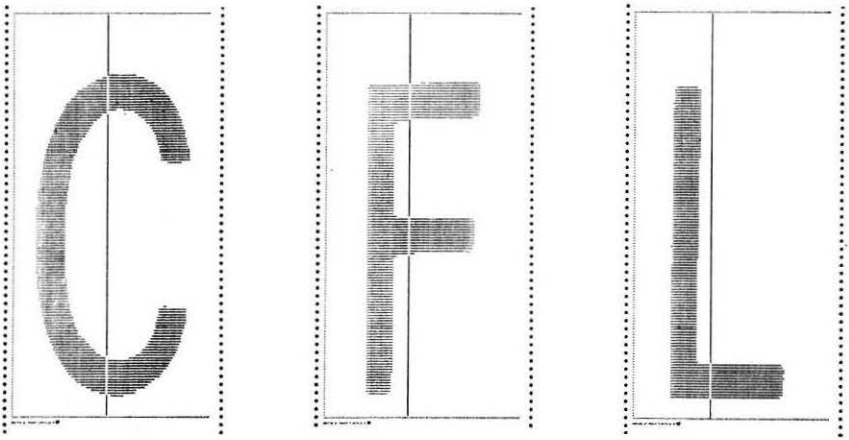
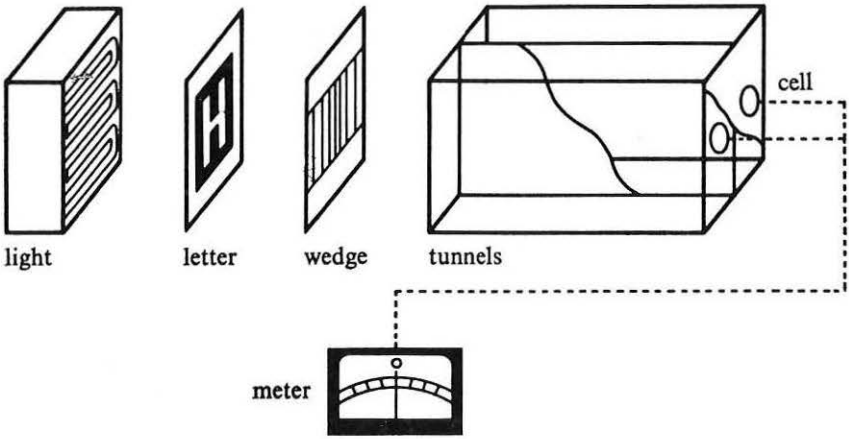


Figure 6. Computerised centres. Eye-chosen centres and the computer agree.

Figure 7. The Optical Letter Spacer. The instrument that has taken us so far, but not quite far enough, awaits its new wedge based on the double parabola.



letter and the wedge is nulled. At this point the letter can be said to be on it's optical centre.

The space required for any particular letter is directly related to its optical centre. The forces that fix the centre are, in fact, those that determine the space. Consequently, my system differs from any other in that it takes into account the space *inside* a letter, as does the eye. It is generally believed that space is something outside the letter and therefore all straight vertical strokes should be flanked by the same spaces, but just a little research by your eye will show this to be erroneous. For example, lower-case i, n, and m may well have different spaces to the side of their vertical thick strokes. Generally, the more space inside a letter, the less outside. The space of a letter should be equal either side of its optical centre; not something tacked on to either side of the letter. And no amount of fiddling will put the spacing right if this rule is not applied. The answer given by the Optical Letter Spacer, being in "light" values, has to be converted to millimetre widths. In order to do this it is necessary to obtain light values for shapes which are measurable. For this purpose we use rectangles of equal height with the letters. The light values for these can be plotted on a graph against their millimetre widths to give a smooth line. Thereafter it is a simple task to plot the light values of related letters on this line and read off their widths.

What we have made, in fact, is an analogue computer. The guts of the instrument is the light wedge. This part has always been made in my workshop, the profiles being accurately hand cut by my colleague, David Parsley. We have made hundreds, searching all the time for a similar function to the human eye. Though our results are very good I am not yet satisfied with the "weighting" of the wedge. However, one thing seems certain, the progression needed is the square law. The square law is in itself interesting because it has affinities with the behaviour of light, and perhaps equally important it is the law of inertia. Inertia seems to be exactly the right description for a letter's position—pulled neither one way nor the other.

One difficulty has been in establishing the correct weighting. Our wedge-making equipment allowed only the making of straight and circular wedges and simple combinations of both. What I wanted to see, we could not make. I needed the help of a computer. As luck would have it, a very distinguished professor at Cambridge University

Figure 8. *Codex Runicus Arnamag*, 14th century. An example of pattern and texture.

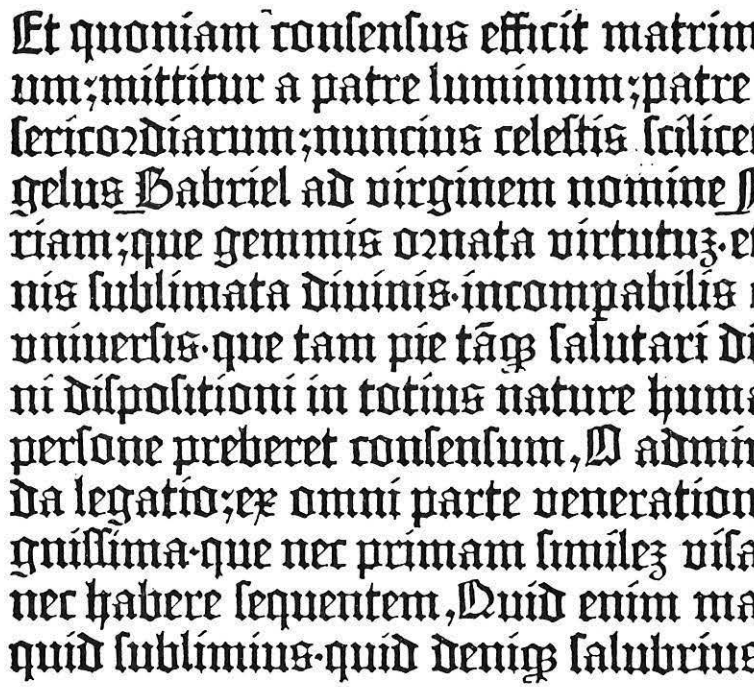


Figure 9. Mainz, Johannes Numeister, 1479. The letters are mostly made up from the same basic thick vertical stroke (with slanted finishing strokes at top and bottom). Each piece of black requires the same compensation of white, which makes correct spacing easier.

asked me to design a letter-head. How much, he asked? I said, "the help of a computer." (Actually, Professor Otto Frisch had first been introduced to me by Evan Gill, who told me that it was he who had held the atom whilst Rutherford split it with a hammer!) Professor Frisch kindly introduced me to the Cambridge Computer Laboratory. Their understanding and kindness in putting up with my rough sketches and ideas deserves the highest tribute! We have worked closely together for six months. Broadly, we adopted two approaches to the problem: the symmetrical and the asymmetrical.

It remains my belief that the wedge is of a symmetrical character. For example, I can find no difference between the space requirements of a triangle with its base at the top or at the bottom. However, it must be stated clearly that the eye does read along the tops of

letters; in other words, the centre of vision at any given moment will be found to be at the top of the x-height of letters (i.e., disregarding ascenders). Therefore, it has seemed sensible to continue an asymmetrical approach to the problem as well. However, if it proves necessary after further research to weight the wedge, it will be a very, very subtle amount.

I started out with the need to provide guidance for the spacing of letters on street signs, and it has lead one to a study of the eye. It seems that reading is done by a very small part of the retina—the fovea—which is about one third of a millimetre across. The receptors are not rods but entirely cones in the fovea. The interesting thing about the cone receptors is that they tend to have a single line connection to the brain, whereas rods tend to be bundled together and share a line. In effect this means that the fovea is extremely accurate but not as sensitive as the peripheral parts of the eye which are dominated by grouped rods. Also, the largest part of the visual cortex of the brain serves this smallest part of the retina.

Man's eyes are very versatile and highly accurate, but they are less acute than a hawk's and less wide-sweeping than a deer's. They are not as efficient at night as an owl's. Yet with all the compromises, they retain a staggering degree of adaptability and precision. They are capable of extremely rapid movement, of instantaneous shifts in focus from a book to a distant star, of adapting to bright or dim light, of distinguishing colours, of estimating distance, size, and direction of movement.

To sum up, I am really hoping for nothing less than a new typographical attitude to text faces—where alphabets are designed to fit together rather than to fit into rectangles. This means an appreciation of a letter's optical centre and the need to design a letter into the mathematical centre of its space. Economy and aesthetics will then go hand in hand.

Whilst alphabet designs proliferate, spacing is largely ignored. In my opinion the next evolutionary step for our alphabet lies in spacing, conjunction, ligaturing, and kerning. Words will take the place of letters. Already some children are being taught words before learning their alphabet. Research with the help of the opthalmologist is long

overdue. The opthalmologist is aware that in 1973 no research has yet really revealed how the eye reads. Could anything be more important?

Finally, is it too much to hope that one day, perhaps using a CRT system, we shall be able to space letters at the time of printing. Such a system would enable an author and designer to work as one—creating the appropriate alphabet for the subject matter and bringing about an immediacy of expression that hitherto belonged only to the scribe. Surely it can now be seen that one single piece of stored information can deal with all likely spacing requirements.

Handwriting Legibility: A Method of Objective Evaluation

C. L. Lehman

A rationale and method is presented for objective evaluation of handwriting according to legibility criteria for the roman alphabet and its slanted version, italic: letter angle, letter length, spacing between letters, and the shaping of counter spaces. Inaccurate performance of letters according to these criteria reduces legibility in our roman-reading culture in proportion to deviation from the system of visual order. Measurement procedures and a flowchart description of the computer process are given. Preliminary findings of a comparative study being made between the commonly taught printscript and a simple italic hand are noted and identified for potential use in modification of curriculum design and teaching practices.

As a quality of handwriting, legibility denotes the formal adequacy of the letters to communicate, and results from high formal correspondence between the handwriting and a model that the reader is prepared to recognize. Legibility is a natural consequence of handwriting produced with distinctive, simple letter models in proportioned form.

The notion of a written alphabet (i.e., a "visual system" of letters) implies a law of order that precedes the individual letters as a cause of visual harmony. For example, the structural design of one letter of a system implies the structural design criteria for all other letters needed for that system. The distribution of scale, proportions, letter angle, and interspace predetermine the system's structural requirements.

Although each letter of a system has distinguishing characteristics of design that are confirmed by wide, consistent use and family relationships with other traditional alphabets, the ability of the form of the individual letters to communicate must be judged in word-producing combinations intended for reading, for reading is the final cause of writing. The evaluation of any handwriting according to structural specifications of the pattern determining the creation will

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Author's address: Tigard Public Schools, 13137 S.W. Pacific Highway, Tigard, OR 97223.

indicate whether or not it can be expected that the writing will be accurately and quickly deciphered by a reader trained in the literacy norm of the culture. It will also suggest whether the handiwork is relatively immune to inaccurate performance under the pressure of speed.

The cause of handwriting legibility is consistent performance of a hand according to a culturally universal visual standard. The standard of the English language is the roman alphabet in the upright and slanted version, italic.[1] Form correlation of many handwriting performances to the many design variations of the roman letters is possible only if the handwriting is objectively measured with the traditional production criteria common to the roman letters: letter angle, vertical length, internal counter shape, and the space between letters. Inaccurate performances of letters according to these criteria reduce legibility in our roman-reading culture in proportion to the extent of the visual deviation from the system of visual order.

The most convincing evidence to support this idea is the principle's use in the common practice of all lettering craftsmen. These elements of basic design: letter slope, space, scale, and shape are fundamental to their work of typography, sign lettering, calligraphy, *et al.*, which requires ease of reading beyond legibility.[2] Handwriting, lettering, and typography must satisfy objective and optical requirements to be legible to the reader. Letter images produced either by hand or mechanically share the same criteria of structural development which serve as the basis for judging the relative effectiveness of various production tools, materials, and techniques. To quote Stanley Morison, "The laws governing the typography of books intended for general circulation are based first upon the essential nature of alphabetical writing, and secondly upon the traditions, explicit or implicit, prevailing in the society for which the printer is working."[3]

The essential nature of alphabetical writing, as determined by Alfred Fairbank, is a "system of movement involving touch."[4] It is the system of handwriting movement that provides the objective and measureable ground for evaluation and research, and many behavioral researchers have built their work around the principle of analytical handwriting evaluation.[5]

The notion of "general merit" of handwriting has been used in many cases as the criterion most suited for evaluation of handwriting.

A summary of the various systems is presented by Virgil E. Herrick and Adrienne Erlebacher.[6] The authors' definition of "general merit" of handwriting, as based on Thorndike's work, "included the artistic or pleasing quality of the writing in addition to its clarity and uniformity of line and form" (p. 212). The authors later support the adoption of "general merit" of a sample of handwriting both "as a criterion for producing handwriting scales and for placing handwriting samples on them." This decision was made by excluding other alternatives which included "single objective measures" (e.g., letter slant, spacing) because "measures made of these factors fail to distinguish between handwriting samples which are clearly different in general merit" (p. 213).

This position represents the rationale of most efforts to evaluate handwriting legibility in public education today. Unfortunately, "clarity and uniformity of line and form" results in a judgment that certain writing is more or less legible without saying why it is so. As a basis for educational diagnosis, the criterion does not supply the kind of evidence needed. Relative legibility is best evaluated by single objective measures of specific deviations from the prescribed forms of the various versions of the roman alphabet and its slanted version, italic.

When is handwriting illegible? Illegibility can be relative to a reader's training for deciphering the message. The commonly accepted "commercial cursive" system is relatively illegible to a first-grade student who is untrained in the models. But when is handwriting relatively illegible to a trained reader? When the alphabet symbols are not produced according to certain minimum criteria of form.

The Criteria

The qualities of size, shape, and position are aspects and implications of the space definition and design created by each letter and word. The following production criteria are another way of expressing these qualities and can be used to determine the frequency, kind, and extent of form deviation in handwriting. Considered together, they are the formal cause of legibility in our cultural standard, the roman alphabet and the slanted version italic.[7]

Letter Angle. Without consistent, harmonized alignment, the reader is required to decipher individual letters rather than symbol patterns, with resulting greater number of eye sets.

Space Consistency Between Letters. Generally, handwriting legibility is improved by even appearing spacing, that is as close as practical. Widely spread handwriting requires greater concentration and confuses perception. Combinations of letters should appear to be equally spaced.

Vertical Length of Letters. The idea of length is less ambiguous than height. Length encompasses the possible evaluation of ascenders, letter body, and descenders. The criterion itself is an aspect of scale, shape, and vertical position.

Counter Space Shape. This criterion is the direct evaluation of form as space definitions that are simultaneously designed white areas, both inside and outside the strokes of the pen. This one measurement indicates the directional thrust and structural magnitude.

Applying the Criteria

Each of the four criteria lend themselves to a practical, convenient measurement for objective analysis of handwriting. Used together they are thorough and individually adaptable to roman or italic letters performed in any conventional handwriting sample. In an actual evaluation, all of the criteria measurements are derived from the model alphabet which is furnished in a format of handwritten words in a sentence. Again, the object of all criteria measurement is to determine frequency, kind, and extent of deviation from the model visual system. A typical sample sentence in a handwriting evaluation is designed to contain all the letters of the alphabet (Fig. 1). For example, the most commonly used sentence is "The quick brown fox jumps over the lazy dog." Evaluation of a handwriting effort is concerned with the production of lower-case letters. The reason for the exclusion of capitals is that a capital letter is regarded as drawn rather than written; and the idea that handwriting is "a system of movement involving touch."[8] Objective measurements of the handwriting performance cannot analyze the quality of movement in the act of production, but they can report the relative structural harmonies of the after effects.

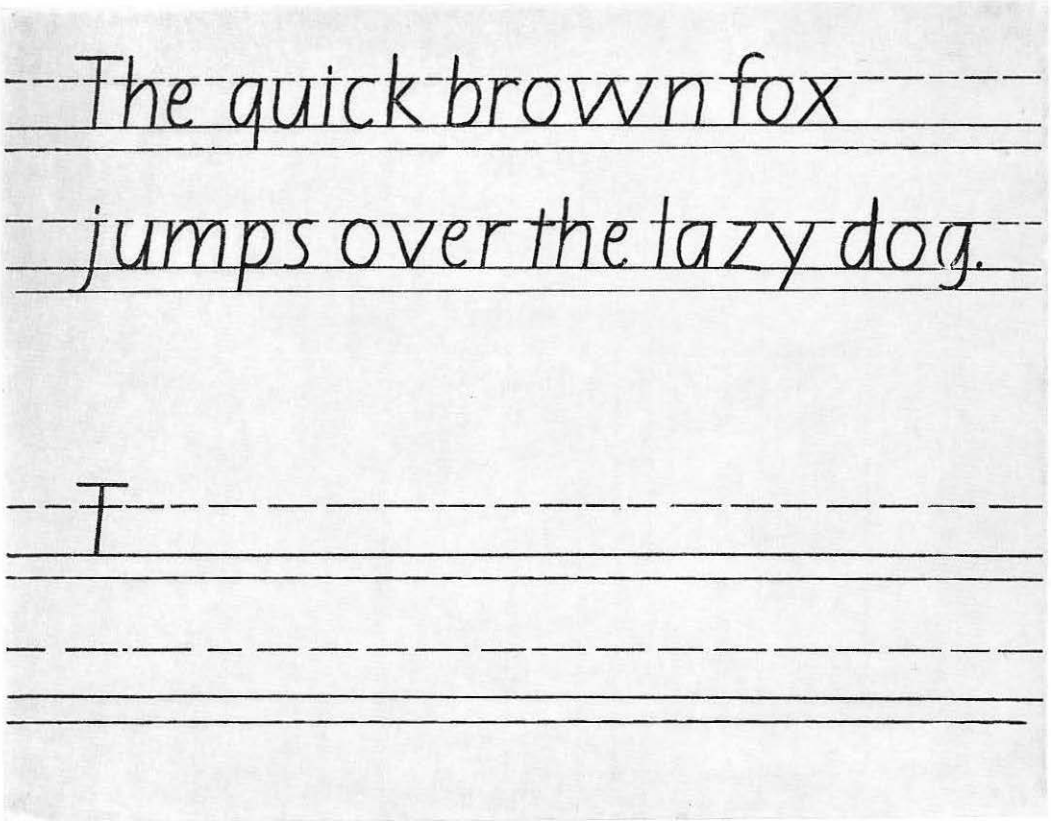


Figure 1. Sample of the worksheet used to gather data from italic-writing students.

Two tools are necessary for tallying the measurements: a score sheet and a computer. The score sheet lists all the letters of the sample sentence down the side of the page and the criteria across the top. Each letter of the sample sentence to be evaluated is then measured four times, once for each criterion. As a deviation measurement is taken, the results are recorded under the appropriate column, opposite the appropriate letter.

Letter angles are measured with a transparent overlay (Fig. 2). The overlay has a horizontal series of lines appearing across it ranging from a 5-degree left tilt at the left side of the page, through vertical zero at the middle, to a 15-degree right tilt at the right of the page. The

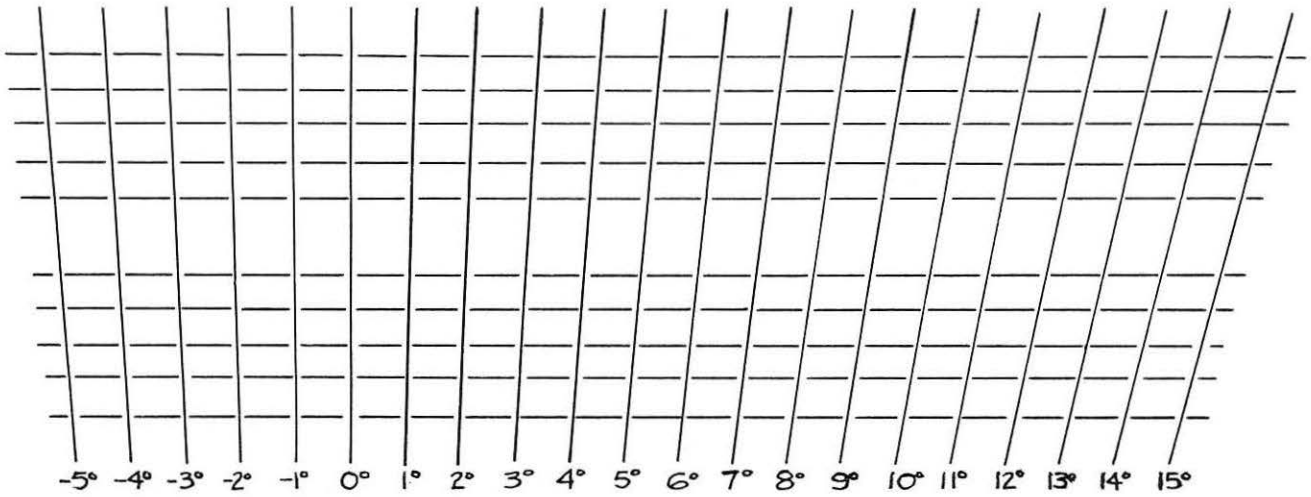


Figure 2. Design for the transparent overlay used in the measurement of letter angles.

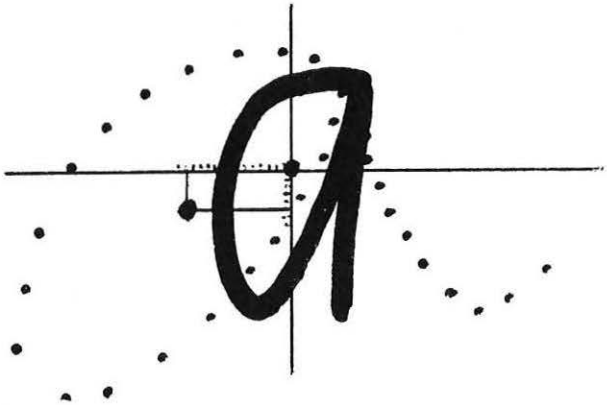


Figure 3. Design for the transparent overlay used in the measurement of shape dislocation. The dotted line indicates a student sample; the black line, a model letter.

series of angled lines is crossed by horizontal lines to serve in lining up the transparency on the sample sheet to be measured. To facilitate taking letter angle measurements, it is best to make them from absolute vertical zero and record them as plus or minus degrees from the vertical zero angle. If the model is designed to slant to the right —as in the case of italic handwriting or commercial cursive—the computer can be required to make the adjustment to a relative value during the tallying process.

The second and third criteria, letter spacing and length, are also absolute measurements in millimetres. The spacing between letters in the model sentence will vary, and the computer can adjust the absolute measurements of the sample writing to be relative to the different spaces of the model letters.

The fourth criterion, counter space shape, requires a double measurement. The intent is to provide numerical evidence of shape deviation from the model. Measurement of the shape's visual axis displacement indicates changes in the structural size and location. The method is to use a transparent overlay that has the model alphabet sentence on it (Fig. 3). The scorer marks a dot at a key optical axis of each letter on the transparency and on the written sample to be evaluated. The appropriate transparent model letter is then aligned over the sample letter being evaluated, taking care to align the stems or, in the case of the letter "o," the logical first stroke

of the letter. If the sample letter has incorrect letter angle, the model must be aligned to it correctly according to the system on the basis of the evaluator's judgment of where an essential structural element is available. In this way it is possible to measure each letter angle, length, and shape in spite of any misplacement away from the sample sentence. The fact of any misplacement, as a deviation in itself, is reported in the spacing measurement.

After positioning the overlay, the evaluator then imposes a second transparent overlay with a cross that has all four branches divided into millimetres. The axis of the cross is placed on the axis of the model letter with the vertical branch aligned with zero degrees letter angle. The measurement then is a task of counting the millimetres of displacement from the optical axis of the model letter to the optical axis of the sample letter. The count is made in both directions on the branches of the cross, known commonly as a Cartesian Grid. For example, the optical axis of the sample may be displaced downwards to the left. In this case the evaluator reports the horizontal deviation under the fourth column on his score sheet as a certain number of millimetres with a minus sign since the displacement was to the left of where it should have been (plus if to the right). Then under the fifth column of the score sheet, he reports the vertical displacement as a certain number of millimetres, again a minus score because the displacement is downwards from the intersection of the grid. The vertical and horizontal branches of the cross in the Cartesian grid are commonly referred to as x and y. A score entry of zero under either of the columns would indicate that the sample did not deviate from the model in that direction.

Many questions of interpretation arise during an evaluation. Consistency of judgment is essential and simple principles help form guidelines. For example, the top half of a letter is more important visually than the bottom half.[9] Therefore: (1) In siting the key counter axis in a letter that is shaped with equal counters in the model form, use the top counter (as in x, k, and s). (2) In other letters with balanced counters (such as f, t, z) commit to one counter area that is common to the group—in this case the lower-right counter space. The letters i and l do not have counters and the scoring of the fourth criterion in their case should be a "zero deviation."

If a letter is omitted, the scoring should regard it, in all criteria, as

zero deviation. In the current project, the evaluators found less than one percent of the letters omitted from the sentences evaluated. Even though the computer tallies the omission as a perfect score for each criterion, it has no significent bearing on the final score.

The computer program computes—as phase one—the class performance averages and standard deviation rates in each of the four criteria applied to every letter of the handwriting sample, letter by letter. In a second phase of computor tally—using the averages and standard deviations from the first computer run—the performance by groups of classes can be compared to evaluate the effectiveness of two different handwriting systems, letter by letter, criterion by criterion. The third and final phase of computor tally reduces the criteria performance scores of each group to an average of the standard deviation rates for each criterion.

The educational value of this "three stage" approach to objective research in handwriting can be judged by the information it provides. Performance deviations of each criterion of legibility of the roman alphabet are gradually synthesized from three specific viewpoints: a classroom teacher's need of close detail, for diagnosis and prescription; the administrator's need of simplified group performance data; and the administrative need for concise, convenient comparisons of research findings.

The Computer Program

The computer program—written in Fortran IV for the Honeywell 1200 computer at the University of Portland—was originally designed in two parts to be sure that computer memory size was no problem. The two programs are designed in a way that will allow them to be combined later. See Figure 4.

The first program takes the keypunched data, checks the code for "traditional" or "italic" letter forms, tabulates deviations for the five criteria used to evaluate legibility, and adjusts for each letter model's relative slope, space, scale, and shape. Averages and standard deviations are calculated. The printout gives the group code, a listing of tallies of each criterion's deviation, average and standard deviation. This is repeated for all the letters of the sample.

The second program takes from the first program the average and standard deviation for each criterion of each letter. An average for

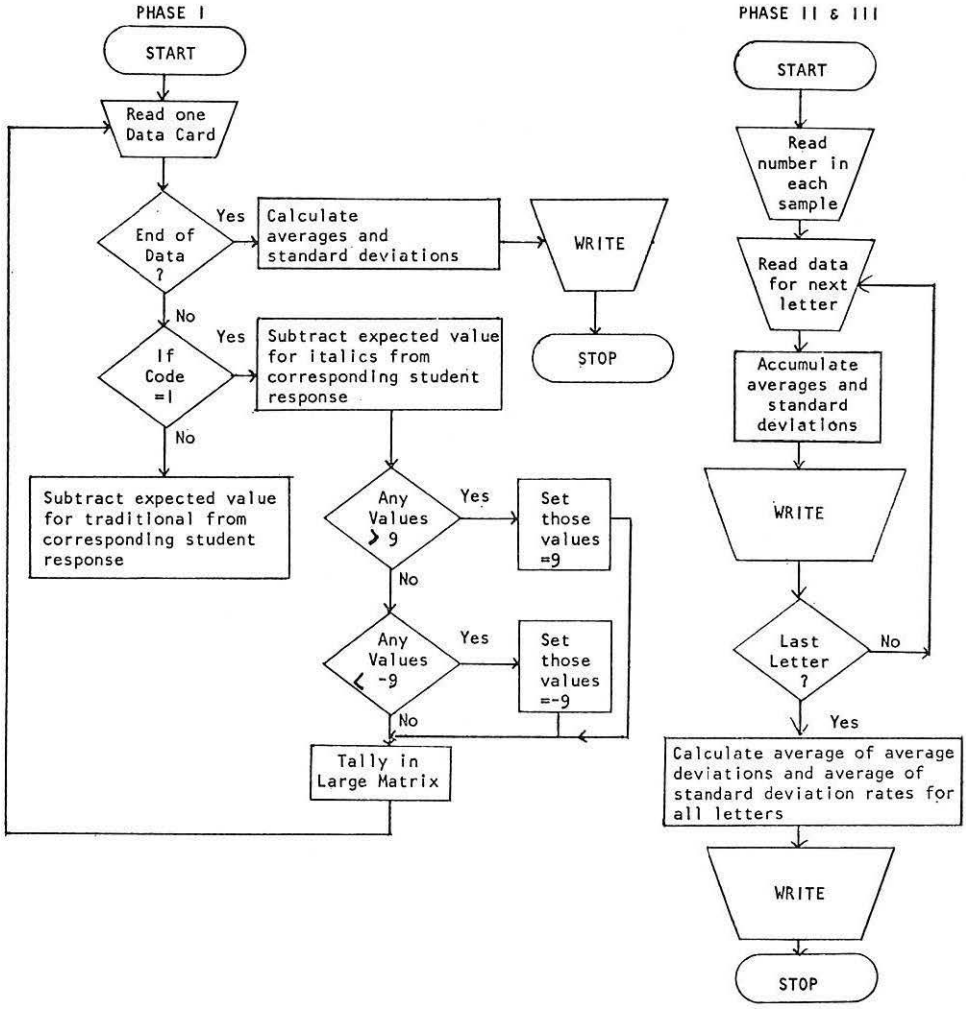


Figure 4. Flowchart for the computer program.

each group is calculated. (We chose to average the standard deviations to provide a simple indicator that would show some significance but not require a person to understand a great deal of statistics to find the indicator meaningful.) The output is a letter-by-letter average and average standard deviation for the style of letterforms. The final output averages the standard deviation rates of all letters for each of the five criteria for traditional and italic letterforms.

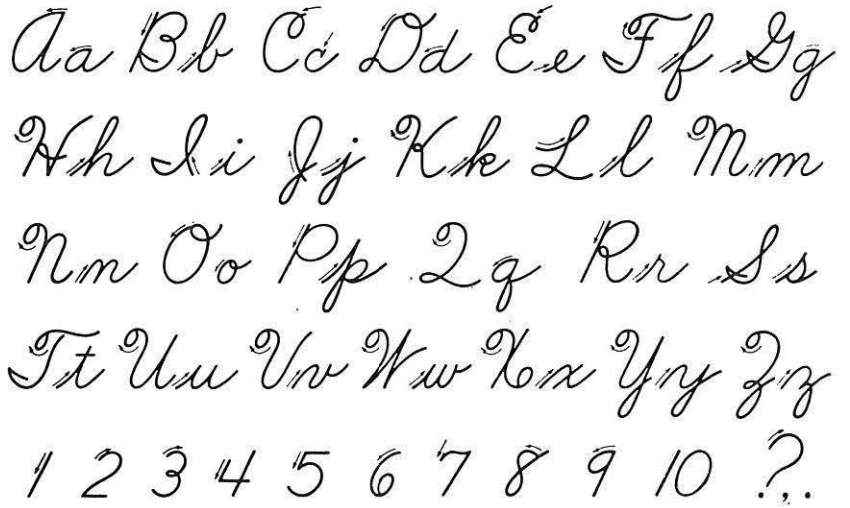
The entire computer program was designed and conducted by Paul Peck, chairman of the mathematics department in the secondary schools of Tigard, Oregon. A complete program listing is available from the author with model sentences, scoring sheets, computer cards, and sample printouts.

FIRST RESULTS OF A CURRENT PROJECT

The rationale of legibility and objective measurement described in this article is the basis for a current handwriting research project in Tigard Public Schools, a medium-sized school district located in a suburb of Portland, Oregon. The object of the investigation is to evaluate simple italic handwriting as a primary grade instructional alternative to the commonly used printscript and commercial cursive. The degree of complexity and nature of the research method were determined by two considerations:

1. In addition to a conventional subjective evaluation based on surveys of parent and teachers, a thorough objective method of investigation was designed and adopted to provide creditable and convincing evidence to educational and behavioral researchers. Any claim of educational effectiveness for an instructional program must be supported by clear evidence that the program can change student behavior in a way that can be observed and measured. In the case of italic handwriting, it is claimed that the educational continuity provided by using one unjoined set of letter models in grade one (which are modified slightly during the second grade by joining the lower-case letters) allows the student to go on learning as he began and results in a more efficient handwriting performance. Further, it is claimed that the use of elliptical letter models derived from the italicized roman alphabet are easier to perform than the circles and vertical lines of printscript. See Figures 5 and 6.

Figure 5, top to bottom. (a) Printscript, usually taught in grades one and two only. (b) Commercial cursive, usually taught in grade three and all subsequent grades. (c) Lower-case commercial cursive wordlist.



Other criticism notes that the changeover from printscript to commercial cursive early in the third grade causes many children to become frustrated by the severe break in continuity and the confusing forms of commercial cursive. Printscript is charged with being bad preparation for commercial cursive because:[10] (a) It uses pen lifts; commercial cursive doesn't. The lack of joins and use of pen lifts makes it impossible to relate printscript to handwriting. (b) It standardizes letter parts, making them accident prone. (c) It demands exceptional motor coordination to perform circles and straight lines, when the hand and eye are best at elliptical shapes and slanting lines. (d) At a critical age of perception training, printscript ignores the essential nature of handwriting: rhythmic movement.

Further, charges are brought against commercial cursive systems and letters: (a) The commercial cursive (all of the nineteen or more "systems" taught in American schools) are accident prone. (b) Due to standardized letter parts, the letters tend to look homogenized. (c) They slope too much. (d) The loops of ascenders and descenders are distracting. (e) The body height is disproportionately small. (f) The joins are visually as important as the letters.

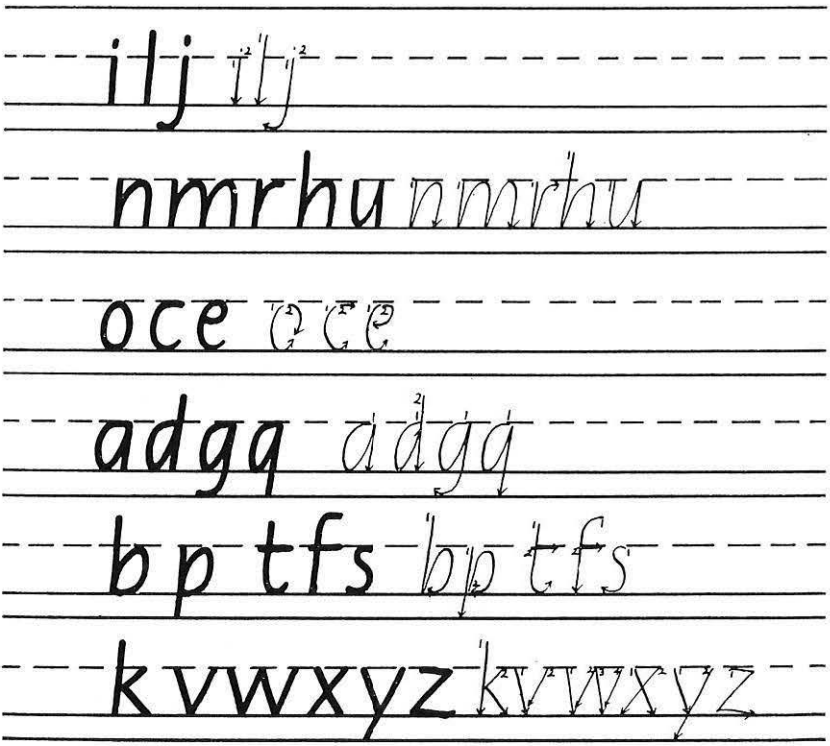


Figure 6, clockwise from above. (a) Lower-case italic (in basic teaching "families") as taught in grade one and all subsequent grades. (b) Upper-case italic in width groups as taught in grade one and all subsequent grades. (c) Same lower-case italic as joined for full cursive hand development during grade two.

2. All of the charges made against printscript and commercial cursive and all of the claims made for italic handwriting are concerned with formal qualities of the letter models that will make their learning and handwriting performance relatively easy or difficult for the student. This fact suggested the hypothesis and method of research: students who are taught italic handwriting as a basal system will deviate less in their handwriting from the formal requirements of the letter models taught to them than will students who are taught printscript and commercial cursive.

wide O C D G Q

H A N T K

M W U V

X Y Z

narrow B E F I J

L P R S

in line lit jet let me
dinner unmarked
him her it ice coke
and dog quick bad
baby pet pad try up
fun try snow sight
very video love ivy
wet wire window
x-ray ox yes yipes!

In the Spring of 1971 six first grade classes were selected for the pilot study. The classes were all in elementary schools in or near Tigard. Some are public and some are private. Beginning in September, 1971, three classes studied italic and three studied printscript as their basic first-grade handwriting instruction. The research is designed to last three years, tracking the students through the third grade which is the usual period for transition from printscript to cursive.

The simple italic alphabet of Alfred Fairbank was selected (with minor modification of the G and t) as the model to be evaluated. The models were adapted from the Beacon series of student work-books. New program materials were designed which included exemplar cards, student worksheets, and a teacher guide. The Noble and Noble printscript program was selected because it is representative of all three handwriting programs adopted in the State of Oregon, and it is the current official adoption of the Tigard Public Schools. Three first-grade teachers were trained in italic during a six-week period. Equal teacher training time was spent with three other teachers who volunteered their classes for the manuscript control group. Each of the six teachers had several years of teaching experience. It was decided that one sampling of student writing would be taken each year in January for objective evaluation, and a second sample would be taken in June for subjective evaluation. See Table I.

Until the final results are in, it will be impossible to begin forming conclusions. But it is possible to assess the educational usefulness of information gained along the way. For example, the record of each class performance of each letter has been of considerable interest to the teachers responsible for the children trying to learn to write. The results of phase one computer tally clearly indicate the relative difficulty that each criterion posed for each class and then, in phase two, relates the class performance to the other two classes in the group. For the first-grade italic teachers, the information gained has resulted in revisions of teaching techniques for this year and some revision in the format of the student worksheets. Changes were made in the techniques for teaching letter slope (the weakest performance of any criterion for all the classes). The teachers also met and planned new strategies for the first-grade instruction of one particularly difficult letter family: the a, d, g, and q. These letters had shown relatively high deviation rates in the first objective evaluation, and

each teacher had also noted difficulties at the time of instruction in a journal of instruction kept by each of them during the first year. The objective scores, combined with the subjective impressions of parents and teachers, provide a comprehensible and apprehensible base of evidence for curriculum directors responsible for program evaluation and selection.

Table I. Results of Objective Evaluation Measurements Made from Student Samples Taken in January 1972 and 1973

The two evaluators are presented here as "A" and "B". The numbers listed under each judge represent their standard deviation average scores with an average of the average deviation rates listed in parenthesis.[11] The criteria are listed at the left. While evaluator "A" measured the traditional instruction classes, evaluator "B" measured the italic classes. Then they switched material to give each group a second measurement. The interjudge reliability for the standard deviation rates was determined by use of the Pearson Reliability Coefficient formula to be .986 for 1972 and .898 for 1973.

	Traditional		*Italic*		*Traditional*		*Italic*	
1972	N=59		N=81					
Evaluators:	A		B		B		A	
1. Letter angle	(+.2)	4.7	(−3.2)	5.5	(+.5)	4.3	(−2.9)	5.5
2. Length of letters	(+.3)	2.0	(+.1)	1.3	(+.1)	2.1	(+.3)	1.2
3. Spacing between letters	(+1.9)	3.0	(+.8)	2.3	(+1.9)	3.0	(+1.0)	2.2
4. Cartesian grid								
Vertical	(−.0)	1.4	(+.1)	.9	(−.1)	1.2	(+.1)	1.0
Horizontal	(+.4)	1.5	(−.0)	.7	(+.1)	.8	(−.1)	.9
1973	N=45		N=60					
Evaluators:	A		B		B		A	
1. Letter angle	(+1.4)	5.3	(−.7)	3.4	(+2.0)	4.5	(−1.5)	5.1
2. Length of letters	(+.0)	1.8	(+.2)	1.1	(−.3)	1.8	(+.2)	1.3
3. Spacing between letters	(+.9)	2.1	(+.3)	1.7	(+.2)	2.1	(+.3)	1.8
4. Cartesian grid								
Vertical	(+.3)	2.2	(+.0)	.8	(−.1)	1.5	(−.1)	.9
Horizontal	(+.3)	1.2	(−.0)	.5	(−.0)	.9	(+.1)	.5

Conclusion

As a process of evaluation, single objective measurements can be used to reliably pin-point the kind and severity of a writer's production deviations for each of the criteria: letter slope, space, scale, and shape. Computerized tally of results can provide necessary diagnostic detail to classroom teachers for the prescription of appropriate remedial practices. Summaries of average deviation rates and standard deviation rates can also be useful to administrators who are charged with program selection and evaluation.

The preliminary progress report of the Tigard School District research indicates that italic handwriting in the primary grades results in less severe handwriting deviations by the participants, particularly in the area of shape making. This is probably due to the elliptical quality of italic letters which also slant slightly to the right as a cursive system from the beginning of grade one. Although the average deviation rate is quite close for the two pilot groups of the study, the standard deviation rate for italic is significantly lower for the criteria with the exception of letter slope. Subjective evaluations, in the form of interviews of parents and teachers, have consistently endorsed the italic program. The parents have expressed aesthetic reasons and the teachers have consistently mentioned the elliptical quality of the letter shapes and the continuity of instruction inherent in the program.

During the third and final year of the pilot study, the speed of the two pilot groups will be evaluated as well as the other criteria. It was not considered to be a significant factor in the evaluation of the handwriting performances of first- and second-grade students.

1. Stanley Morison, *Principles of Typography* (Cambridge: Cambridge University Press, 1967), p. 7. "Roman" is the traditional name given to handwriting and type designs derived from the ancient Roman inscriptional capitals and the miniscule hands of the Italian Renaissance. The vast majority of books, periodicals and newspapers produced in our culture use "roman" type.

"The italic, the supplementary sloping type used by printers for the purposes of contrast and emphasis, is derived from a cursive variant of the revived Caroline letter and owes its simpler form to the tendency of the hand to seek the easier course and to avoid uneconomical pen-lifts." Alfred Fairbanks, *A Book of Scripts* (Baltimore: Penguin Books, 1968), p. 16.

Manuscript and the commercial cursives that are used for handwriting instruction in most public education programs today are directly descended from the roman models. The commercial cursive letter models descend to us from the Renaissance italic hand, modified significantly by interpretation in the engraving processes of the seventeenth and eighteenth centuries and adaptation to secretarial service in commercial situations of the eighteenth, nineteenth and twentieth centuries. Manuscript models were introduced to educators by Edward Johnston in 1913. He demonstrated them as skeletal models of the roman hands. Johnston did not propose the skeletal models for adoption in themselves and was not consulted when they were selected for teachers to use.

2. Alfred Fairbank, *The Story of Handwriting* (New York: Watson-Guptill Publications, 1970), p. 75.

Edward Johnston, *Writing, Illuminating and Lettering* (1962 reprint; New York: Pitman Publishing Co., 1906), p. 203.

3. Morison, p. 6.

4. Fairbank, *A Book of Scripts*, p. 28.

5. Frank Freeman, "A New Handwriting Scale," *The Elementary School Journal* (January 1959), 219.

Leonard S. Feldt, "The Reliability of Measures of Handwriting Quality," *Journal of Educational Psychology*, No. 53 (1962), 239.

Luella C. Pressey and Sydney L. Pressey, "Analyses of Three Thousand Illegibilities in the Handwriting of Children and of Adults," *Educational Research Bulletin* (Sept. 28, 1927), pp. 270–273.

T. Ernest Newland, "An Analytical Study of the Development of Illegibilities in Handwriting from the Lower Grades to Adulthood," in *Remedial Teaching: Research and Comment*, ed. Wayne Otto and Karl Koenke (Boston: Houghton Mifflin Co., 1969) pp. 240–247.

Leslie Quant, "Factors Affecting the Legibility of Handwriting," in *Remedial Teaching: Research and Comment*, ed. Wayne Otto and Karl Koenke (Boston: Houghton Mifflin Co., 1969) pp. 270–284.

6. Herrick and Erlebacher, "The Evaluation of Legibility in Handwriting," in *New Horizons for Research in Handwriting*, ed. Virgil E. Herrick (Madison: The University of Wisconsin Press, 1963), p. 212.

7. Quant, *op cit.*

8. Fairbank, *A Book of Scripts*, p. 28.

9. Johnston, p. 238 (footnote). When the bottom half of the word is covered it usually can still be read, but not when the top half is covered.

10. The various criticisms of manuscript and cursive writing systems are gathered from several authors and from personal discussions with primary grade teachers. It is my impression that third grade teachers in particular, have a dread of taking children into commercial cursive from manuscript.

Frank Freeman, "Evaluation of Manuscript Writing," *Elementary School Journal*, (February 1936), 454.

J. De V. Heese, "Manuscript Writing," *Journal of Educational Research*, XL (November 1946), 165.

Fairbank, *A Book of Scripts*, p. 25.

Lloyd Reynolds, "Italic Handwriting," a privately published essay (1968) available through the Western American Branch of the Society of Italic Handwriting (7423 S.E. 31, Portland, Oregon).

11. While the average deviation rates of each criterion compares closely for both kinds of handwriting (within 2–3 degrees for letter slope and less than 1 millimetre for the other criteria), the incidents of deviation that were averaged to make up the traditional scores occurred on a much broader range (standard deviation rate), indicating that the traditional handwriting group performed errors that were more serious, both in excess (plus scores) and defect (minus scores) to make up the average deviation rate.

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The Prophetess Deborah and the Invention of Printing

Michael Pollak

A colophon in one of the earliest dated imprints in the Hebrew language (1475) extols the mystery and power of the newly invented printing press. Seemingly unnoticed by printing and bibliographical scholars working outside the area of Hebraica, the colophon is translated into English and its poetic composition discussed.

Two books, both of which came off the press during the year 1475, share the distinction of being the earliest dated imprints in the Hebrew language of which we know. In one of these, Jacob ben Asher's *Arba Turim*, a four-volume legal code which was printed in the shop of Meshullam Cusi at Piove di Sacco (near Padua) [1, Heb-47], there is a colophon bearing the Hebrew date 28 Tammuz 5235 (= 3 July 1475) which contains ten lines of verse extolling the mystery and the power of the newly invented printing press.[1]

The verses of the colophon to the Cusi edition of the *Arba Turim* have been reprinted and/or translated in a number of works specifically devoted to the bibliography of Hebraica or to other aspects of Jewish history, religion, and literature. I have thus been able to find, in books of Judaic interest, two translations of the poem into English, two into German, and one into Latin.[2] In general, however, the colophon to the Cusi *Arba Turim* seems to have escaped the notice of scholars not directly engaged in Hebraically-oriented studies. It is not found, as a case in point, in Pollard's well known *Essay on Colophons* [8], and I have not seen any description of it in what might be referred to as the "standard" histories of printing.

Like so many other Hebrew literary men of the Medieval and Renaissance eras, the writer of our colophon deliberately imposed upon himself a task of considerable difficulty in the design of his composition. His poem, as he planned it, was to consist of ten lines,

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Author's address: Wayside Press, Inc., 2005 Farrington Street, Dallas, TX 75207.

and each line was to end with the bisyllabic sound *e-ret.*[3] He would be compelled, therefore, to find ten suitable words ending in *e-ret* which could be fitted in, one by one, at the close of the ten lines of his poem. At the same time he would have to maintain a consistent rhythmic pattern; and, of course, he would also have to present his theme logically and intelligibly. Quite obviously, the challenge he was posing for himself demanded a superior level of poetic skill as well as a highly developed sense of the esthetics of language.

It should be stated that our poet rose to the occasion very creditably. The result of his labors turned out to be a tour de force. The metrical scheme and the imagery are ably worked out, and the rhymes are unimpeachable. Regrettably, however, the same cannot be said about the continuity and the clarity of the theme, for here the composition shows strain. It may be supposed that our poet would have been able to do much better had he not chosen to restrict himself to one basic sound for all of his rhymes.

The problems normally encountered whenever poetic material is to be translated have been compounded in the verses of the colophon to Cusi's *Arba Turim* by the somewhat disjointed arrangement in which the poet is forced to express his thoughts as he tries, also to overcome his rhyming problems. A literal rendition of the poem, it appears to me, would convey the author's intent less aptly than a more freely composed one. Accordingly, the present translation has been prepared primarily with the goal of transmitting the thread of the poet's argument in a form which could be readily understood. At the same time, the attempt has been made to salvage as much of the flavor and the imagery of the Hebrew original as possible, the criterion being that in translation the retained material should in no way detract from the overall theme of the poem.[4]

The allusions in the second half of the poem stem from a passage in the Song of Deborah, specifically from the fourteenth verse of the fifth chapter of Judges. No single explanation of this passage has ever gained universal acceptance among biblical scholars, but one interpretation has the verse implying that the temporal power of the prophetess depended in great part upon the influence being exerted in her behalf by the scribes who were associated with her, and that she therefore adopted the scribal pen as the symbol of the authority with which she had been vested. The author of our colophon uses this

interpretation as a vehicle for pointing out how much political power resides in the written and printed word. Presciently, he leaves his readers, in 1475, with the thought that the newly invented printing press would now become an avenue to power surpassing anything which had been available during the scribal period.

Here, then, in translation, is the self-assured voice of the young and lusty art of printing as it was heard by the author of the colophon to the edition of Jacob ben Asher's *Arba Turim* which was printed by Meshullam Cusi in 1475:

That Art am I which crowns all other Arts;
I am in deepest mystery enshrouded;
For though I write without a pen in hand,
The mark I make is very plain to see.

No scribe am I, and yet I made this book
By human skill, not by miracle:
The ink flowed over me, a moment passed . . .
The text appeared—unruled, but straight and clear.

Does it surprise you, then, that Deborah,
That doughty prophetess of ancient times,
Should choose, instead of me, a scribal pen
To be her emblem of authority?

Yet, had she foreseen how potent were
The churning forces coiled to spring from me,
She would have wrought from them a diadem
To symbolize her awesome majesty.[5]

חושן המשפט נשלם   שבח לאֿ עולם

ותכל מלאכת עבודת הקודש
הטור הוא הטור הרביעי
בפייבי די שקו בבית מה׳ר משלם

ביום שני עשרים ושמנה לחדש
חמשת אלפים ורל״ה למספר קביעי
המכונה קוזי יבורך מעתה ועד עולם

חזק

אני חכמה לכל חכמה עט   רת
בלי קולמוס וריטומי נ״כ   רת
בבת אחת דיו עלי עוב   רת
תמיה על דבורה הגב   רת
לו אותי ר אתה גם חת   רת

אני נסתר לכל סוד ט סב   רת
באין סופר חוברתי גם חב   רת
בלי שירטוט בתיבת מיוש   רת
בשבט סופרים היא מעושר   רת
עלי ראשה חושבתי לבית   רת

Figure 1. The colophon from the fourth volume of Jacob ben Asher's *Arba Turim*, completed at Piove di Sacco on 3 July 1475, in the shop of Meshullam Cusi and Sons. The ten lines of the poem were doubled up by the Cusi compositor in order to save space, and appear as the bottom five lines of the colophonic text. Enlarged 20%.
Photograph courtesy of The Library of the Jewish Theological Seminary of America, New York.

1. Meshullam Cusi did not live to see his *Arba Turim* completed, but died while the third volume was being processed [2, p. 2], leaving his sons to carry on his work. The colophon to the other Hebrew imprint of 1475, Abraham ben Garton's edition of Rashi's *Perush ha-Tora* [1, Heb-93], shows that it was finished on 10 Adar 5235 (= 17 February 1475). However, the fact that the *Perush ha-Tora* was completed nearly five months earlier than the *Arba Turim* does not necessarily indicate that the *Perush ha-Tora* was the first of the two works to go into production. The *Arba Turim* is a much larger book than the *Perush ha-Tora*, so that it is quite possible that it was started some weeks or months before Abraham ben Garton began to print. It may be reasonably surmised, of course, that both works were in press well before the end of 1474.

2. A translation of the poem into English was provided by Ginsburg in 1897 [3, pp. 779–80]. Another English rendition, published by Amram in 1905, appears to be a reprint from some time earlier than 1905 [4, pp. 25–26]. Loew gives a German-language translation taken from an 1840 issue of the *Literaturblatt des Orients* [5, part 2, p. 190; p. 240, note 837]. Berliner also provides a German translation, in 1896 [2, p. 2]. A translation of the poem into the Latin was made by Father J. B. de Rossi in 1795 [6, p. 7]. (See note 5 of the present study.) There may also be a translation of the verses into the Russian, in Daniel Chwolson's history of early Jewish printing, a work which was issued at St. Petersburg in 1897 and was then translated into Hebrew and published in that language at Warsaw during the same year. I have not seen the Russian edition of Chwolson's book, but our poem does appear in the Hebrew version [7, pp. 6–7]. It seems likely, therefore, that Chwolson included in the St. Petersburg edition a translation of our verses into the Russian.

3. A ten-line poem with a similar rhyming plan—this time with each line ending in the sound *rim*—is contained in the colophon to Gershom Soncino's edition of the Bible, completed at Brescia in May 1494 [1, Heb-10]. Ginsburg reprints a poem from the colophon to a Pentateuch published at Lisbon in 1491 [1, Heb-20; 3, pp. 842–43]. This poem is made up of nineteen lines, each line ending with the sound *ay-im*. It should be noted, however, that Hebrew poets who chose to write in this manner often lightened their tasks by selecting for their rhymes those sounds which occur rather frequently in the language, such as the plural endings for nouns in masculine and feminine genders. The Hebrew literature of the Medieval and Renaissance periods is rich in examples of versification in which the poet intentionally creates compositional challenges of the greatest difficulty in order to display to best advantage the virtuosity and the ingenuity of which he is capable. It was a fairly common practice, for instance, for a poet to weave his name acrostically into his work; in fact, this form of literary derring-do held a peculiar fascination for Hebrew poets of all levels of talent, from those able to write little more than doggerel to those whose verses are still held up as models of great literary achievement.

4. In this connection it should be noted that the verses of the Cusi colophon were reprinted in 1805, on the occasion of the publication of the first Hebrew book at Grodno. It was found advisable at that time to make some minor revisions in the original in order to clarify the flow of thought of the poet and make his meaning more intelligible to the reader. Two words of the text were altered, and the positions of two of the lines were shifted. The result made for a happier understanding of what the poet was trying to say [2, p. 44, note 1].

5. De Rossi's translation of our verses into Latin goes astray at one point because of his failure to recognize that *dalet-beit-vov-resh-he* spells out the name Deborah. The error was caused by the fact that there are no capital letters in Hebrew, and thus provides a melancholy illustration of the kind of trap into which even an able scholar like de Rossi can fall when the first letters of the proper names in a language cannot be capitalized. The word *dalet-beit-vov-resh-he*, standing by itself, may legitimately be translated either as the proper name Deborah or as "bee." The adjectival term utilized in the text of the poem in connection with *dalet-beit-vov-resh-he* means "great," "mighty," "heroic," "doughty," etc., and makes no sense at all when it is applied to bees. De Rossi realizes, of course, that bees do not fit into the text. Failing, however, to think of *dalet-beit-vov-resh-he* as a proper noun, he attempts to escape his dilemma by presenting a translation based on the three letters *dalet*, *beit* and *resh*. These letters represent the common Hebrew term for "talk," "discussion," "speech," etc., and appear to him to constitute the etymological base from which the puzzling word *dalet-beit-vov-resh-he* derives. In the end, he mistranslates the name of Deborah as *sermo* (he uses, actually, the ablative form *sermone*), thus destroying the effect which our poet has so valiantly and painfully striven to achieve by the devising of an allusion to the biblical prophetess.

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Research in Brief: Understanding Tabular Displays

Patricia Wright

Tabular displays can differ from each other both in the logic underlying their construction and in the way a particular principle of tabulation is displayed. Experimental studies have shown that people find some tabulation logics difficult to understand. If the user of a table is required to carry out operations other than *search* and *read*, the size of the population of competent users is markedly reduced. Tabulation schemes requiring synthetic or analytic operations on the part of the user seem to buy economy of space at the cost of comprehension. This appears to be true both of two dimensional matrices and tables involving simple arithmetic. Furthermore one of the necessary prerequisites for the successful use of matrix formats appears to be the user's familiarity with the relevant dimensions of the problem he is trying to solve, rather than his familiarity with the table itself. When information about the outcomes of complex conjunctive and disjunctive contingencies must be presented (e.g., in technical manuals) the use of a flow chart, or logical tree, is often more effective than other ways of presenting the same information.

Studies of alternative ways of displaying tabular list structures have shown that it is helpful to have:

(a) Items arranged so that they are scanned vertically, rather than horizontally
(b) Typographic distinction between different units in the table (rather than using conventional unit abbreviations after each item)
(c) Appropriate spacing within and between columns (i.e., with related pairs closer than unrelated pairs)

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c/o The Cleveland Museum of Art, Cleveland, Ohio USA 44106.
Author's address: Medical Research Council, Applied Psychology Unit, Cambridge, England.

(d) Column headings much larger and bolder than the text for large, wall-size displays (such headings do not seem helpful for tables used at normal reading distance)
(e) Appropriate print size, style of character, and contrast with background coloring.

Probably we have all at some time puzzled over railway timetables, or misread mileage charts; so we know how true it is that getting information out of some kinds of tables can be much more difficult than getting it out of others. But what is it that makes some tabulation formats difficult? What are the hallmarks of a good tabular display? Recent research has raised doubts about the wisdom of the commonly held opinion that the best table is the one with the fewest figures.

To illustrate this last point, consider the findings of a large-scale experiment using a modified market survey technique in which over two thousand people were tested [Wright and Fox, 1970]. In this experiment people were shown a small section of a conversion table—either section (a) or section (b) from Figure 1—and were asked how much two £sd amounts would be in the new currency, and also what two £p amounts were in the old currency.

Both tabular sections (a) and (b) contained the information needed to answer the questions, although section (b) required the user to carry out a simple addition (e.g., to add 40p and 1½p to convert 8/4d). Averaging across the data from all four questions, the proportion of people able to give the correct answer varied from 85% to 40% depending upon whether the person had section (a) or (b), how old they were, and their socio-economic background.

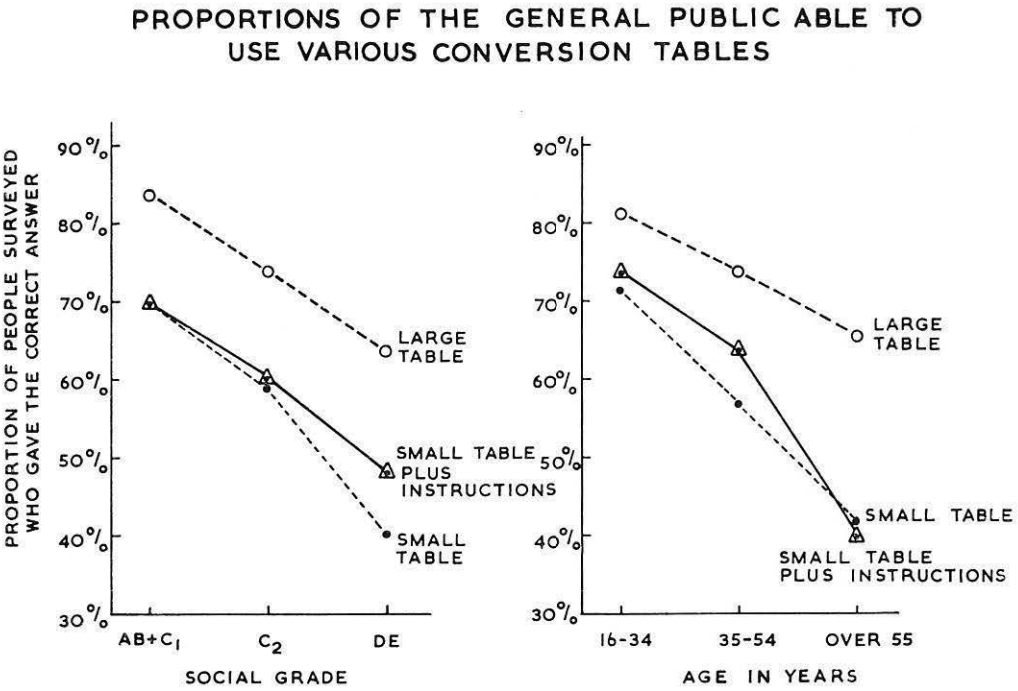
Even providing written instructions on how to use section (b), setting out the conversion as a simple arithmetic sum, was not always beneficial. The elderly people taking part in the experiment had significantly fewer correct answers when given this extra information. Perhaps they were bewildered by yet more figures. The results of this experiment are given in Figure 2.

(a)	7/4d . . . 36½p	8/4d . . . 41½p	9/4d . . . 46½p
	7/5d . . . 37 p	8/5d . . . 42p	9/5d . . . 47p
	7/6d . . . 37½p	8/6d . . . 42½p	9/6d . . . 47½p

(b)	7/-d . . . 35p	4d . . . 1½p
	8/-d . . . 40p	5d . . . 2p
	9/-d . . . 45p	6d . . . 2½p

Figure 1. Sections of the two tabulation formats used in the market survey experiment. (a) A section from a large, fully explicit table that requires the user simply to search for the correct answer. (b) A section from a smaller table where much of the information is implicit, and requires additional operations on the part of the user.

Figure 2. The results of the market survey experiment, showing the proportions of correct conversions made by different sections of the general public. The groupings along the horizontal axis correspond approximately to thirds of the adult population.



From the data shown in Figure 2, it would seem necessary to adopt the fully explicit tabulation scheme of section (a) if the conversion table was to be used by the general public. More recent studies have suggested that this remains true even when the information tabulated is non-numerical [Wright and Fox, 1972]. Tabulation schemes that involve people in doing more than simply searching for the correct answer may save space at the cost of ease of comprehension.

One tabular arrangement which on the face of it only involves a search by the user, is a matrix format. Here a double-entry table is arranged so that the user locates a particular cell within the table by reference to both row and column headings. Numerical matrices have been known to present problems for some users [Wright, 1968]. Nevertheless, there is evidence that such formats can be very efficient ways of expressing the outcome of complex conjunctive and disjunctive contingencies (the "if this . . . then, if not . . . the other" type information). Research suggests that whenever a problem is clearly structured, so that people are confident about which rows and columns they want to look up, then consulting a matrix is both speedy and relatively error free [Wright, 1971].

When the problem is less well structured—for example, when buried in irrelevant details—then an algorithm or flow chart is much less error prone than the matrix. For information that has to be used from memory neither the matrix nor flow chart seem to be optimal formats. Perhaps because of the use made by many people of verbal coding procedures when remembering material, it was found that presenting the information in the form of a list of short sentences gave better retention than non-sentential formats [Wright and Reid, 1973].

The generality of the findings from laboratory studies of tabulation formats is always a serious issue. The results just mentioned show that there is often no universally optimal way of presenting information. Characteristics of the working situation and the user population all combine to determine the most effective format. Nevertheless there is one general point that must be made. A more realistic working environment appears to enhance the superiority of whichever table is found to be better in the laboratory. This has been illustrated with reference to the comparison of the explicit and implicit tables of Figure 1. A pencil and paper test suggested that there was a difference between the tables of one

second per conversion, with the explicit Table (a) being the faster table to use. In a shopping situation, which involved handling merchandise and various other distractions, the difference between the two tabulation formats became six seconds per conversion. The lesson to be drawn is that as the working conditions become poorer so there is an increasing advantage for the easier table. Similar potentiation is found when a comparison is made between people of differing intellectual and/or numerical abilities. Small differences found between tabulation formats used by very bright people tend to become large differences when the tables are used by people of lesser ability. This point cannot be made too forcefully because when discussing alternative tabulation displays it is all too easy for intelligent people, looking at a particular table in conditions of comparative calm, to feel that variations in display have only marginal effects; but in the working environment there can be substantial benefits from using the easier of two typographic formats.

So far we have discussed tables which are based on different underlying logical principles. The choice of a particular principle determines to a large extent who will be able to understand the information being presented. There is very little that can be done typographically to rescue a tabulation scheme which is making too severe demands upon the intellectual capacity of the user. However, the converse is not true. A tabulation scheme which is in principle easily comprehended by the target population, may result in performance that is far from optimal on account of typographic and related display characteristics.

This point has been illustrated by studies of currency conversion tables, all of which were based on the principle shown in Figure 1a. It was found that such conversion tables were used more speedily if successive pairs were arranged vertically down the page (as in Figure 3b) rather than horizontally (see Figure 3a).

It was also found that differentiating the £p and £sd amounts typographically resulted in faster performance, which was then impaired if the abbreviations "p" and "d" were introduced into the table after each item. Such abbreviations were clearly unnecessary, and may have hampered the scanning process when people were locating a particular item within the table.

OLD s. d.		1	2	3	4	5	6	7	8	9	10	11
NEW PENCE		**½**	**1**	**1**	**1½**	**2**	**2½**	**3**	**3½**	**4**	**4**	**4½**
OLD s. d.	1/-	1/1	1/2	1/3	1/4	1/5	1/6	1/7	1/8	1/9	1/10	1/11
NEW PENCE	**5**	**5½**	**6**	**6**	**6½**	**7**	**7½**	**8**	**8½**	**9**	**9**	**9½**
OLD s. d.	2/-	2/1	2/2	2/3	2/4	2/5	2/6	2/7	2/8	2/9	2/10	2/11
NEW PENCE	**10**	**10½**	**11**	**11**	**11½**	**12**	**12½**	**13**	**13½**	**14**	**14**	**14½**
OLD s. d.	3/-	3/1	3/2	3/3	3/4	3/5	3/6	3/7	3/8	3/9	3/10	3/11
NEW PENCE	**15**	**15½**	**16**	**16**	**16½**	**17**	**17½**	**18**	**18½**	**19**	**19**	**19½**
OLD s. d.	4/-	4/1	4/2	4/3	4/4	4/5	4/6	4/7	4/8	4/9	4/10	4/11
NEW PENCE	**20**	**20½**	**21**	**21**	**21½**	**22**	**22½**	**23**	**23½**	**24**	**24**	**24½**
OLD s. d.	5/-	5/1	5/2	5/3	5/4	5/5	5/6	5/7	5/8	5/9	5/10	5/11
NEW PENCE	**25**	**25½**	**26**	**26**	**26½**	**27**	**27½**	**28**	**28½**	**29**	**29**	**29½**
OLD s. d.	6/-	6/1	6/2	6/3	6/4	6/5	6/6	6/7	6/8	6/9	6/10	6/11
NEW PENCE	**30**	**30½**	**31**	**31**	**31½**	**32**	**32½**	**33**	**33½**	**34**	**34**	**34½**
OLD s. d.	7/-	7/1	7/2	7/3	7/4	7/5	7/6	7/7	7/8	7/9	7/10	7/11
NEW PENCE	**35**	**35½**	**36**	**36**	**36½**	**37**	**37½**	**38**	**38½**	**39**	**39**	**39½**
OLD s. d.	8/-	8/1	8/2	8/3	8/4	8/5	8/6	8/7	8/8	8/9	8/10	8/11
NEW PENCE	**40**	**40½**	**41**	**41**	**41½**	**42**	**42½**	**43**	**43½**	**44**	**44**	**44½**
OLD s. d.	9/-	9/1	9/2	9/3	9/4	9/5	9/6	9/7	9/8	9/9	9/10	9/11
NEW PENCE	**45**	**45½**	**46**	**46**	**46½**	**47**	**47½**	**48**	**48½**	**49**	**49**	**49½**

Figure 3. Some alternative ways of displaying a large, fully explicit conversion table (Clockwise from above). (a) Items arranged so that they can be scanned horizontally. (b) Items arranged so that they can be scanned vertically. (c) Some items made larger and bolder than the body of the table to serve as landmarks when scanning.

In differentiating the two currencies, color cues were found no more effective than the contrast of bold and light typefaces. Clearly this may cease to be the case when there are more than two items to be related in a table. Nevertheless one danger in the use of color did become apparent in these studies. There is always the risk of impairing legibility if the color of the typeface and the background do not present a sufficient contrast, thereby slowing down the user and increasing the risk of simple reading errors.

Introducing landmarks or sub-headings into a table (see Figure 3c) is not inevitably beneficial. Many people seem to ignore such headings, and may even report that the information given in the heading (for example the conversion of 2/-) is not included in the table (i.e., they say that they cannot find it). However, it is possible that the size of the landmarks relative to the body of the text may be fairly critical, since this phenomenon of apparent invisibility was

OLD s. d.	NEW PENCE
1d	½p
2d	1p
3d	1p
4d	1½p
5d	2p
6d	2½p
7d	3p
8d	3½p
9d	4p
10d	4p
11d	4½p
1/-	5p
1/1d	5½p
1/2d	6p
1/3d	6p
1/4d	6½p
1/5d	7p
1/6d	7½p
1/7d	8p
1/8d	8½p
1/9d	9p
1/10d	9p
1/11d	9½p

OLD s. d.	NEW PENCE
2/-	10p
2/1d	10½p
2/2d	11p
2/3d	11p
2/4d	11½p
2/5d	12p
2/6d	12½p
2/7d	13p
2/8d	13½p
2/9d	14p
2/10d	14p
2/11d	14½p
3/-	15p
3/1d	15½p
3/2d	16p
3/3d	16p
3/4d	16½p
3/5d	17p
3/6d	17½p
3/7d	18p
3/8d	18½p
3/9d	19p
3/10d	19p
3/11d	19½p

OLD s. d.	NEW PENCE
4/-	20p
4/1d	20½p
4/2d	21p
4/3d	21p
4/4d	21½p
4/5d	22p
4/6d	22½p
4/7d	23p
4/8d	23½p
4/9d	24p
4/10d	24p
4/11d	24p
5/-	25p
5/1d	25½p
5/2d	26p
5/3d	26p
5/4d	26½p
5/5d	27p
5/6d	27½p
5/7d	28p
5/8d	28½p
5/9d	29p
5/10d	29p
5/11d	29½p

OLD s. d.	NEW PENCE
6/-	30p
6/1d	30½p
6/2d	31p
6/3d	31p
6/4d	31½p
6/5d	32p
6/6d	32½p
6/7d	33p
6/8d	33½p
6/9d	34p
6/10d	34p
6/11d	34½p
7/-	35p
7/1d	35½p
7/2d	36p
7/3d	36p
7/4d	36½p
7/5d	37p
7/6d	37½p
7/7d	38p
7/8d	38½p
7/9d	39p
7/10d	39p
7/11d	39½p

OLD s. d.	NEW PENCE
8/-	40p
8/1d	40½p
8/2d	41p
8/3d	41p
8/4d	41½p
8/5d	42p
8/6d	42½p
8/7d	43p
8/8d	43½p
8/9d	44p
8/10d	44p
8/11d	44½p
9/-	45p
9/1d	45½p
9/2d	46p
9/3d	46p
9/4d	46½p
9/5d	47p
9/6d	47½p
9/7d	48p
9/8d	48½p
9/9d	49p
9/10d	49p
9/11d	49½p

OLD s. d.	NEW PENCE
1d	½p
2d	1p
3d	1p
4d	1½p
5d	2p
6d	2½p
7d	3p
8d	3½p
9d	4p
10d	4p
11d	4½p
1/–	**5p**
1/1d	5½p
1/2d	6p
1/3d	6p
1/4d	6½p
1/5d	7p
1/6d	7½p
1/7d	8p
1/8d	8½p
1/9d	9p
1/10d	9p
1/11d	9½p
2/–	**10p**
2/1d	10½p
2/2d	11p
2/3d	11p
2/4d	11½p
2/5d	12p
2/6d	12½p
2/7d	13p
2/8d	13½p
2/9d	14p
2/10d	14p
2/11d	14½p
3/–	**15p**
3/1d	15½p
3/2d	16p
3/3d	16p
3/4d	16½p
3/5d	17p
3/6d	17½p
3/7d	18p
3/8d	18½p
3/9d	19p
3/10d	19p
3/11d	19½p
4/–	**20p**
4/1d	20½p
4/2d	21p
4/3d	21p
4/4d	21½p
4/5d	22p
4/6d	22½p
4/7d	23p
4/8d	23½p
4/9d	24p
4/10d	24p
4/11d	24½p
5/–	**25p**
5/1d	25½p
5/2d	26p
5/3d	26p
5/4d	26½p
5/5d	27p
5/6d	27½p
5/7d	28p
5/8d	28½p
5/9d	29p
5/10d	29p
5/11d	29½p
6/–	**30p**
6/1d	30½p
6/2d	31p
6/3d	31p
6/4d	31½p
6/5d	32p
6/6d	32½p
6/7d	33p
6/8d	33½p
6/9d	34p
6/10d	34p
6/11d	34½p
7/–	**35p**
7/1d	35½p
7/2d	36p
7/3d	36p
7/4d	36½p
7/5d	37p
7/6d	37½p
7/7d	38p
7/8d	38½p
7/9d	39p
7/10d	39p
7/11d	39½p
8/–	**40p**
8/1d	40½p
8/2d	41p
8/3d	41p
8/4d	41½p
8/5d	42p
8/6d	42½p
8/7d	43p
8/8d	43½p
8/9d	44p
8/10d	44p
8/11d	44½p
9/–	**45p**
9/1d	45½p
9/2d	46p
9/3d	46p
9/4d	46½p
9/5d	47p
9/6d	47½p
9/7d	48p
9/8d	48½p
9/9d	49p
9/10d	49p
9/11d	49½p

much less commonly found with wall charts than with desk-size conversion tables. The detailed parameters of its occurrence are not yet known.

People who are accustomed to reading English are accustomed to taking in information in a left to right direction, and it might be expected that well established reading habits would affect the way people use tables. It has been found that for a table such as that shown in Figure 3b, people make conversions from £p to £sd more quickly if the £p amounts are on the left; similarly conversions from £sd are faster if £sd amounts are on the left. However, this finding may not generalize to situations in which people are always making conversions in a particular direction. In the present studies people were usually given a random series of £p and £sd amounts to convert. There is some evidence from related studies which suggests that when working with only one of the currencies, people quickly learn to "look up and then read off to the left," or whatever the appropriate routine is, and the apparent bias in favor of reading off amounts to the right disappears [Wright, 1968].

Finally, all the standard typographic caveats appertaining to print size, grouping, and spacing of items are of course relevant to tabular displays. Many people cannot easily read print smaller than 6-point x-height [Poulton, 1969] and some people read more slowly when the print is larger than 12-point [Spencer, 1968]. Grouping within columns in fives is more helpful than having larger blocks of ten items [Tinker, 1960]. And it would seem to be only common sense that the spacing between adjacent items that are related should be less than that between unrelated items.

In conclusion, although there remains a great deal that is not understood about why some tabular displays present the problems that they do, nevertheless many users of tabulated information would have fewer problems if those principles which have been established were more widely applied.

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Cover: Subway Graffiti in New York City

The comments which follow have been taken from an article by Patricia Conway which accompanied photographs by Marshall Swerman (Cover): "Subway Graffiti: The Message from Underground." *Print*, XXVII (May/June 1973), 25–32. Excerpted with kind permission of the author and *Print* Magazine. © 1973 by RC Publications, Inc.

It started a couple of years ago when some undistinguished felt tip scrawls appeared on the seats, walls and doors inside subway cars. Gradually it crept out onto the platforms until the entire wall of the 103rd Street Broadway station was covered with the stuff. By that time the modest felt tips were giving way to a bolder medium—spray can paints—and the scrawls were getting bigger, more colorful and increasingly stylized. Then one morning bleary-eyed straphangers did a double take as familiar trains rumbled into view completely transformed by the drips and swirls of "Strut 5," "Sweet Skip," "King Kool 143," and several hundred of their ego-tripping friends. What may be man's oldest form of graphic expression had mushroomed into New York City's hottest contemporary art movement: the graffiti explosion.

The critical mass in this explosion is a nucleus of mostly black and Hispanic teenagers from the upper Manhattan ghetto of Washington Heights. Stalking the stations in after-school hours and prowling the yards at night, these kids are engaged in what they regard as more of an in-group sport than an esthetic exercise. What they're really doing, though, is expropriating the social and economic privileges of those officially sanctioned graffitists, the corporate advertisers. Competing for a captive audience of several million, these unlikely account execs represent the world's most important clients: themselves. The space is free (if they don't get caught), their budgets are the price of a can of spray paint (if they bother to pay for it, which most of them don't) and the product is their own identity.

Eschewing the usual obscenities, political slogans and declarations of eternal affection ("John + Mary 4 ever"), these grassroots media men

are plastering the city with their personal logos—name and street number combinations, some of which are as carefully chosen and painstakingly executed as any Madison Avenue blitz. Styles range from small, unembellished monochrome signature to six-foot-high multicolored bubble letters decorated with stars, stripes, dots and squiggles. Outlining is a popular device because it reinforces shape, and there are also a lot of drip patterns (the "wet" look) and an occasional 3D effect. The layering of colors (frequently pastels) can get pretty complex, and many logos fuse letterform with pictorial motifs like hearts, crowns, arrows, comet tails and stick figures. A few logos are so elaborate, so highly stylized that they don't read like names at all, but rather like scraps of some exotic calligraphy. There's an informal code of conduct that frowns on writing over someone else's logo (a rule honored as much in the breach as in the observance) and a complicated procedure for selling or handing down names from one graffitist to another.

Although schools, housing projects, public monuments and buses are regular targets for these graffitists, it is within the self-contained environment of the subway that their "art" has reached its fullest flower. . . . Truly the apotheosis of graffiti, the rolling stock supergraphics work their way discreetly around and under windows (out of consideration for riders who might like to see where they are?) or march defiantly across the full height of cars (it can get a little dark inside, especially if the artist who "hit" the car favors black paint). Sometimes these extravaganzas achieve an almost architectural quality; in motion, the effect is positively kaleidoscopic. . . .

Of course, not everyone is an enthusiast, and even those people who are sympathetic to the sociological implications of graffiti may not agree that it's art. While the purveyors of radical chic are lionizing the spray paint crowd and most legitimate artists think the subways have never looked better, many New Yorkers find the current wave of graffiti an assault on their sensibilities and a threat to the last vestiges of social order in that beleaguered city. Mayor John Lindsay, who has set up a special Anti-Graffiti Task Force and recently signed a bill that makes carrying an open spray paint can in public a crime punishable by fines up to $500 or imprisonment up to three months, labels graffiti "an act of vandalism" and "a dirty shame." . . . The anger and virulence which graffiti have stirred in normally unflappable New Yorkers is weirdly disproportionate to the situation and almost without precedent in recent memory. . . .

There's been a lot of speculation about why these kids feel the need to write their names all over the place, but very little analysis of the public hysteria which this phenomenon has provoked. Psychologists diagnose

graffiti as "an act of aggression" and "an attempt by insignificant people to impose their identity on others." Robert Reisner calls it "a twilight means of communication between anonymous man and the world." But in a vast, impersonal and abrasive city like New York, who doesn't feel "anonymous," "insignificant," or "aggressive" now and then—particularly when trapped in an environment as relentlessly inhuman as the subway? . . .

If nothing else, the subway graffiti are a testimony to the monumental failure of TA officials and their design consultants to make the system legible. Visually, what these kids have created is more coherent than the hodgepodge of dilapidated, poorly located directional signs and paid advertising that makes a trip through the Union Square station a nightmare of wrong turns, missed exits and general disorientation.

Whether, when the last logo has been eradicated by super-solvent and the last offender clapped in jail, the writing of graffiti proves to have been a true art form or just the inspiration for another commercial design fad, there's a message in it that city officials and their professional consultants cannot afford to ignore. Somebody up in that ghetto thinks enough of himself to tell the world who he is and how little respect he has for the degraded public environment he's forced to live in. Imagine what would happen if this message were leaked to all those law-abiding, middle-class taxpayers and they, too, suddenly realized that the subway doesn't belong only to TA chief Dr. Ronan and Preparation H—that the subway belongs to them, to the kids up in Washington Heights and to millions of others who are entitled to something a lot better than what they're getting.

Patricia Conway is a freelance writer, photographer, urban planner and daily rider of the New York subway. She is currently a planning consultant to John Carl Warnecke and Associates, architects. Marshall Swerman is a freelance photograph whose work has been published in this country and abroad.

Book Review

Allen Hutt. *Fournier: The Compleat Typographer.* London: Frederick Muller Ltd, 1973. £4.50.

This is the first of a series of books (Ars Typographica Library) under the editorship of James Moran that should do great credit to the publishers—Frederick Muller. This year should see the appearance of *Eric Gill* by Roy Brewer and *J. H. Mason* by Leslie Owens.

The Fournier family busied themselves with printing from the seventeenth to the nineteenth century. How "compleat" was the Fournier of this book: le jeune, 1712–1768? He was clearly one of the world's most skilled type designers. In his Paris foundry—before he was 30—he cut over 4600 letters and displayed them in a distinguished specimen book. Among them were the first types to be made in comprehensive ranges of related sizes, and they resulted in a popular advancement of the "modern" style. The Fournier letter was a transitional face—not a complete innovation—rather more of an old face polished up. The greater merit he brought to his type was not stylistic, but that of superlative craftsmanship; he could and probably did do, the whole complex operation of typemaking himself.

Fournier's printer's flowers and the use he made of them would alone have ensured his fame. Fournier advised Benjamin Franklin on typographical matters, and La Pompadour became his patronne with the commission of a minute type for a tiny psalm book. A man of the Enlightenment, he was an unrelenting and lively controversialist, and a historian of his craft (he contributed thirteen pages to Diderot and D'Alembert's *Encyclopedie*). Fournier's *Manuel Typographique* post-dated Moxan's *Mechanick Exercises* by 100 years, describing the hand-cutting and founding of type with equal lucidity. It remains the authorative work; it is extraordinary that it has not been republished in France when in England it has been produced both in translation and in facsimile, Fournier was a rationalist working within the climate of his time; he drew a "table of proportions" for printing types and did a lot to standardize type-body measurements in a previously anarchic situation. This was only a stepping

stone to the Didot system which shortly followed. The printing of satisfactory music by letterpress had exercised Leopold Mozart and Dutch founders for a generation before Fournier applied himself to the problems, and in truth here he played second fiddle to his correspondent Brietkopf in Leipzig—but the number of types required was reduced by 100.

All this Allen Hutt is pre-eminently qualified to comment on, besides being known to us as a master of typographical matters, he is a life-long student of France in the eighteenth century. Hutt shows greater fastidiousness in his interpretation of the original source documents than Beatrice Warde and D. B. Updike, but he is neither a pedant nor a populizer. However, all Hutt's crisp and spirited style cannot lend color to Fournier's happy and unruffled personal life. Fournier le jeune does not have the fascination of his eccentric contemporary and typographic peer, John Baskerville, and he has been less fortunate in the modern cuttings that have copied him. I suspect that the mechanical qualities of the originals have hardened in the revivals—from precise and intellectual to the charmless and impersonal. The choice of Monotype Barbou 178 rather than Fournier 185 gives color and distinction to this book; both types were based on Fournier letters, but regretfully, very little Barbou is in current use.

Colin Banks, Banks and Miles, London

The author of this book, Allen Hutt, died in August, 1973.

As well as for *Fournier*, he will be remembered by designers and printers for *Newspaper Design* (1960 and 1967, Oxford University Press) which became the axis on which the look of the newspaper of today turned; *The Changing Newspaper*, a review of 350 years of developments on both sides of the Atlantic, just published by Gordon Fraser Limited, London; and for numerous articles.

Politicians and trade unionists have equally high regard for *British Trade Unionism* and *Post-War History of the British Working Class*. As editor for 20 years of *The Journalist*, he represented the practical newsman everywhere.

I shall remember him for his urgent enthusiasm, manifest in a cloud of cigarette smoke, fingers stabbing at the latest front page, oblivious to his tie dragging through his coffee. Never out of humour or opinion—Rabelaisian and left-wing—a good friend of this magazine and welcome wherever printers and designers gathered, he was given the rare distinction of Royal Designer for Industry in 1970. C.B.

Correspondence

The editors welcome comments on articles, reviews, and letters that have appeared in past numbers. Communications should be addressed to the Editor, c/o The Cleveland Museum of Art, Cleveland, Ohio, USA 44106.

To the Editor:

Your article, "The Orthographic Practices of Elias Molee," by Henry R. Stern (Spring 1972) is of particular interest to me, because Molee was a Norwegian and I have been interested in Norwegian-American history during most of my life. As a linguist I long ago noted Molee as a person of interest because of his several books on the subject of language planning and reform. Since I have also written on subjects in this area, I feel a special sympathy for Molee. To be sure, I disagree with his general idea that one can radically reform languages along rational lines. We simply don't know enough about language or about disseminating the results of linguistic planning to operate successfully in this field. However, as an expression of the idealistic trend of many people in modern times, Molee's practice was indeed an interesting historical phenomenon.

Although I was aware of Molee and intended to write about him some day, I have not in fact done so. It is therefore interesting that Professor Stern should have discovered him independently. I happen to own several of the books he mentions. In fact, I note that I have two copies of Molee's first book, *Plea for an American Language* from 1888. I do not own *Germanik English* from 1889 nor *Nu Teutonisch*. Unfortunately Professor Stern does not give adequate bibliographical information about these two books.

There are many interesting aspects of Molee's work which are not brought out in the article, since it is devoted primarily to his orthography. The subject could be considerably expanded by exploring his background, noting that a number of the words used by Molee are Norwegian, such as "ferkortels." A collection of Molee's letters is to be found in the Wisconsin Historical Society in a collection of letters to Professor Rasmus B. Anderson. I have seen these but have never exploited them for scholarly purposes. Perhaps Professor Stern would be interested.

Einar Haugen
Victor S. Thomas Professor of Scandinavian and Linguistics
Harvard University, Cambridge, Mass. 02138

To the Editor:
There ought to be a law against the barbarous abuse of letterforms represented by the accompanying monstrosity. Since some of these misbegotten shapes actually do look like bona fide Hebrew characters, the person to whom these are familiar actually has to wrench himself from "misreading" them as such! My negative reaction is perhaps reinforced by visions of the Nazis' yellow patch with the word "Jude" in the same kind of pseudo-Hebrew letterforms. Perhaps it is also my own lack of penmanship artistry that makes me adamantly opposed to all flourishes and embellishments and more or less in favor of sans-serif types, especially if the roman alphabet is one day to become THE world alphabet. On the part of some students of linguistics and phonetics, a disproportionate apperception of serifs occasionally results in a swastika-like edh and a theta reminiscent of the Old-Hickory shoulder patch of the 30th Division. The lack of serifs can, of course, go too far, and I can't swallow a lower-case l undistinguishable from an upper-case I (not to mention the [letter] l/1 [number] problem; cf. the special "l" on library typewriters). If tabloids had existed at the time of the American Revolution, what would the headline "King George III ill" have looked like?!

[Editor's note: King George III lll]

But even *with* serifs, the third person singular masculine pronoun in

French at the beginning of a sentence looks disconcertingly like a Roman II! This is a specific point for international typeface designers to work on. German sign printers often solve it by carrying the I-J identity from fraktur to antiqua, so that on the Mercedes-Benz connecting buses, the first letter was not altered when the legend was changed from Idlewild to JFK.

Louis Marck
202 West 81st Street, New York, N.Y. 10024

Editor's Note: Louis Marck is a persistent critic of letterform aberrations. Who will deny that he has a point? But other readers, too, undoubtedly have pet peeves of their own about the way our letterforms are mishandled in the mass media, on signs, in advertising materials, etc. Send a note with your own letterform gripes to *Visible Language*—preferably with a clipping of the actual example, or a sketch. While we may not be able to clean up entirely our information media, we will at least see that the appropriate person is informed—and it may help to get it out of your system!

To the Editor:
In reference to your editorial in the Spring 1972 number of *Visible Language*, I would like to make the following observations on what you say:

It is not entirely true that "by far the prevailing theory among linguists is that (1) language and speech are virtually synonymous, and (2) writing is a secondary representation of speech" (p. 104). I believe this to be the prevailing theory in America, certainly, thanks to Bloomfield and his followers; but it hardly is in the rest of the world. It runs emphatically counter to the beliefs of the Scandinavian (and other) glossematicians; it is not believed by members of the famous "Prague school", notably Josef Vachek; nor by the followers of J. R. Firth in Britain; nor, I suspect, by many linguists in India. It looks as if I was espousing the "primacy of speech" theory in your quotation from me in the footnote on page 107; but that was actually written over 35 years ago, in a different climate. I don't think I would write anything like that now; or at least I would be more careful about how I worded it. In fact I find I *have* been more careful, as this quotation written thirty years later will, I hope, show: "The aural medium came first, and in this genetic sense it is primary compared to all other mediums, including potential ones which do not yet exist. Can it be said that the aural medium is primary in any other than a genetic sense?

Probably not. Once another medium, a visual one for example, has been created, it will assume full autonomy as a vehicle for language." In my lectures on the subject I always insist to students that "the *medium* of written language represents the *medium* of spoken language; but written *language* does not represent spoken *language*." Your Editorial is very salutory, though I don't think it would be necessary in this country to insist so much since many—perhaps most—phoneticians and linguists here would agree with you. I have written fairly recently on the subject in Chapter I of *Elements of General Phonetics*, and longer ago in Chapter II of *Problems and Principles in Language Study*.

I might mention, by the way, à propos of your remark on page 103 about the linguist and the letter designer getting together, that both Eric Gill and Stanley Morison were interested in the design of special phonetic characters; and indeed *The Monotype Recorder* once published an article by me on the subject (called "Augmenting the Roman Alphabet").

I was interested to read about Elias Molee, about whom I had never heard. The author of the article, though, does not seem to be aware that the obvious source of most of Molee's new letters is the Phonotypy of Isaac Pitman and A. J. Ellis, which was quite well known in America at that time.

David Abercrombie
Department of Linguistics
George Square, Edinburgh EH8 9LL, Scotland

Editor's Note: on request, Prof. Abercrombie provided the following references:

For a glossematic point of view I recommend: H. J. Uldall, "Speech and Writing," *Acta Linguistica*, Vol. IV, pp. 11–16, Copenhagen, 1944. This actually was a paper he gave in 1938.

A good representative of the Prague School attitude is J. Vachek, "Some Remarks on Writing and Phonetic Transcription," *Acta Linguistica*, Vol. V, pp. 86–93, Copenhagen, 1945–49. The following is a brief quotation from this article: "Speech utterances are of two different kinds, i.e. spoken and written utterances. The latter cannot be simply regarded as official projections of the former."

A representative Firthian is Professor T. F. Mitchell, of Leeds University, and I highly recommend his book *Writing Arabic* (Oxford University Press, 1953). All our students read the introductory part of this, whether they are interested in Arabic or not. I also recommend Mitchell's Inau-

gural Lecture, published by Leeds University Press in 1965, entitled *On the Nature of Linguistics and its Place in University Studies*. In this he speaks of "the Bloomfieldian fallacy in linguistics of regarding writing as derived from speech. . . ."

Uldall, Vachek, and Mitchell, incidentally, are (or were) all phoneticians as well as general linguists.

This number of *Visible Language* has been composed in "Monotype" Baskerville type and produced by W & J Mackay Limited, Chatham, England, on Beaublade Nimrod Cartridge, 100gm². The layout is based on the original design by Jack Stauffacher of the Greenwood Press, San Francisco.

Résumé des Article

Traduction: Fernand Baudin

Ce que l'on voit et ce que l'on en infère *par William E. Hoffmann*

La perception—c.à.d. la vision—se fait par inférence ou sémiotiquement. Lorsque quelqu'un voit un objet, ce qu'il perçoit agit comme un signal qui est interprété dans la conscience du lecteur. Ce signal est comparable à des prémisses dont le lecteur tire les conclusions. La thèse a deux articulations. (1) Toute perception est une relation entre un objet perçu, un intermédiaire et une conscience. Quelques faits concernant la perception au niveau des sens inférieurs sont connus et exposés. Que la perception est influencée par l'intermédiaire est démontré par des exemples où des stimuli identiques ont provoqué des réactions différentes. (2) Cet élément intermédiaire peut être le signal interprété dans la conscience, ou toute autre combinaison de prémisses qui mène à une conclusion. Quelques idées de Charles Sanders Peirce concernant la perception et les signaux sont présentées et commentées. Notamment celles qui se rapportent à la perception, à son interprétation ainsi qu'à la classification des signes. Il y a une grande similarité entre l'univers interprété comme système de signes et le système de signes que nous appelons language visible. En d'autres termes: apprendre à lire, c'est prendre conscience.

Technique de l'espace *par David Kindersley*

Un bon espacement était autant dire impossible en typographie en raison de la base nécessairement rectangulaire des caractères métalliques. L'intervention d'un artiste-lettreur eût été nécessaire à chaque lettre. La photocomposition et l'informatique au contraire permettent une intégration parfaite des lettres et des espaces. En typographie, la lettre et son espace étaient inséparables. Un espacement optique tiendra subtilement compte du centre optique de chaque lettre et des tensions internes qui s'opèrent dans l'oeil lorsqu'il perçoit les formes des lettres. L'auteur décrit son appareil à espacer et l'utilisation que l'on pourrait en faire dans les recherches sur la lisibilité.

La lisibilité des écritures: comment la mesurer objectivement *par C. L. Lehman*

Il est question d'une méthode rationnelle applicable à l'écriture latine dans ses versions droite et penchée: degré d'inclinaison, hauteur et espacement des lettres, formation des boucles. Dans notre aire culturelle toute imperfection par rapport à ces critères réduit la lisibilité dans la mesure précise où les imperfections s'écartent de la séquence visuelle convenue. L'article décrit aussi les moyens de mesure et le programme pour le traitement électronique de ces données. Il rapporte en outre les premiers résultats d'une étude comparative entre la "script" actuellement enseignée et une italique en vue d'une réforme éventuelle dans l'enseignement.

Deborah et l'invention de la typographie *par Michel Polak*

Le colophon d'un des premiers livres imprimés en hébreu (1475) souligne le pouvoir et le caractère mystérieux de la nouvelle invention. Il est apparemment inconnu des bibliographes et des historiens de l'imprimerie. Il est traduit et commenté en anglais.

Kurzfassung der Beiträge

Übersetzung: Dirk Wendt

Sicht, Zeichen und Bedeutung von *William E. Hoffmann*

In diesem Aufsatz vertrete ich die These, daß Wahrnehmung—und das impliziert Sehen—inferentiell oder semiotisch ist. Wenn eine Person einen Gegenstand sieht, wirkt die Reizung durch diesen Gegenstand auf die Funktionen des Wahrnehmenden als ein Zeichen, das in der bewußten Reaktion des Wahrnehmenden interpretiert wird; die Reizung wirkt als eine Prämisse, aus welcher der Wahrnehmende eine Schlußfolgerung zieht, die eine bewußte Reaktion darstellt. Die Argumentation besteht aus zwei grundlegenden Schritten: (1.) Wahrnehmung ist eine dreigliedrige Beziehung zwischen dem wahrgenommenen Gegenstand, einem vermittelnden Element, und einer bewußten Reaktion; gewisse Tatsachen über unsere Wahrnehmung mit den niederen Sinnen werden berücksichtigt, und Fälle unterschiedlicher Reaktionen aufgrund identischer Reize werden als Begründung dafür genommen, daß die Wahrnehmung mittelbar ist. (2.) Dieses vermittelnde Element hat die Form eines Zeichens, das durch die bewußte Reaktion interpretiert wird, oder einer Menge von Prämissen, für welche die bewußte Reaktion eine Schlußfolgerung darstellt. Einige der Gedanken von Charles Sanders Peirce über Wahrnehmung und Zeichen werden entwickelt—insbesondere sein Begriff eines "Percepts" und eines Wahrnehmungsurteils, und seine Kategorisierung der Zeichen. Es besteht eine bedeutende Ähnlichkeit zwischen der wahrnehmbaren Welt, aufgefaßt als ein System von Zeichen, und dem System von Zeichen, das wir gewöhnlich als sichtbare Sprache verstehen. Ebenso wie wir lesen lernen, lernen wir wahrzunehmen.

Zwischenraumgestaltung *von David Kindersley*

Die richtige Anpassung der Buchstabenzwischenräume war geradezu unmöglich mit den metallenen Buchstabenträgern in rechteckiger Form, wie die typographische Technik es erforderte; der Künstler oder Buchstabengestalter mußte sich auf Buchstaben für Buchstaben einzeln konzentrieren. Die Entwicklung von Lichtsatz- und Computertechniken ermöglicht nun wieder die angemessene Koordination von Zwischenraum- und Buchstabengestaltung. In der Typographie gehören Zwischenraum und Buchstabe zusammen. Eine optisch ausgeglichene Textspationierung erfordert Beachtung der Feinheiten des optischen Mittelpunktes und der inneren Kräfte, welche die Wahrnehmung dieser Buchstaben durch unsere Augen beeinflussen. Der Verfasser beschreibt seinen Optical Letter Spacer und diskutiert seine Anwendungsmöglichkeiten in der Lesbarkeitsforschung.

Lesbarkeit von Handschriften: eine Methode zur objektiven Beurteilung *von C. L. Lehman*

Zur objektiven Bewertung von Handschriften werden eine Methode und ihre Begründung dargestellt, die auf Lesbarkeitskriterien für das lateinische Alphabet und ihre schräge Version, die Kursiv, aufgebaut sind: Schreibwinkel, Buchstabenlänge, Buchstabenzwischenraum, Form der Punzenräume. Ungenaue Ausführung der Buchstaben hinsichtlich dieser Kriterien setzt die Lesbarkeit in unserer lateinisch lesenden Kultur herab, proportional zum Ausmaß der Abweichung vom visuell geordneten System. Es werden Meßverfahren und Flußdiagramme für Computer-Verarbeitung vorgestellt sowie vorläufige Ergebnisse einer Vergleichsuntersuchung zwischen der allgemein gelehrten Druckschrift und einer einfachen Kursiv-Handschrift, aus denen sich möglicherweise Änderungen in der Unterrichtsplanung und Lehrpraxis ableiten lassen.

Die Prophetin Deborah und die Erfindung des Druckens *von Michael Pollak*

Ein Kolophon (Schlußinschrift alter Druckwerke) in einem der ältesten Druckschriften in hebräischer Sprache (1475) lobpreist das Geheimnis und die Macht der jüngst erfundenen Druckpresse. Das Kolophon war anscheinend unbemerkt von Druckerei- und bibliographischen Wissenschaftlern und wird ins Englische übersetzt; seine ursprüngliche poetische Formulierung wird diskutiert.

The Authors

William E. Hoffmann is an assistant professor of philosophy at Ithaca College (Ithaca, NY 14850). He received his Ph.D. from the University of Georgia in 1971; the ideas discussed in his article receive more detailed treatment in his dissertation, *Perception and Signs*. Dr. Hoffmann's current teaching and research interests include epistemology, philosophy of language, and philosophical psychology. His article, "Some Problems with the Theory of Appearing," will be published in *Agora* in 1973.

David Kindersley (Chesterton Tower, Chapel Street, Cambridge, England) is a designer of letters for many media—calligraphic posters to street-name alphabets. An apprentice to Eric Gill, he is best known for his stone cutting and, most recently, his invention of the Optical Letter Spacer. He is a consultant to Letraset International.

Charles L. Lehman is coordinator of instructional materials in Tigard Public Schools (13137 S.W. Pacific Highway, Tigard, OR 97223). He has taught calligraphy for over ten years at all levels in Portland area schools. Mr. Lehman has studied with Dr. Lloyd Reynolds of Reed College and Arnold Bank of Carnegie Institute of Technology; he is an active member of the Western American Branch of the Society of Italic Handwriting. His research is concerned with evaluation and comparison of alternative basal systems of handwriting instruction in elementary schools.

Michael Pollak is president of Wayside Press, Inc. (2005 Farrington Street, Dallas, TX 75207), and has been active in the printing field for approximately twenty-five years. His articles in *Library Quarterly* and *Gutenberg-Jahrbuch* have dealt with the history, economics, and technology of the printing industry during its formative years. Mr. Pollak's *The Discovery of a Missing Chinese Torah Scroll* which identifies a manuscript at Southern Methodist University as one of the Pentateuchal scrolls installed in the synagogue at Kaifeng, Honan Province, in 1653—was published by Bridwell Library earlier this year.

Patricia Wright is a member of the Medical Research Council's scientific staff (Applied Psychology Unit, Cambridge, England); she is also a college lecturer in psychology at Churchill College, University of Cambridge. Dr. Wright's research is concerned with many aspects of written communication, including psycholinguistic studies of how people deal with verbal material, and human factors studies relating to the presentation of numerical information. Recent publications have appeared in the *Journal of Applied Psychology*, *Journal of Verbal Learning and Verbal Behavior*, *Ergonomics*, *Machine Design*.

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