Illustration 1

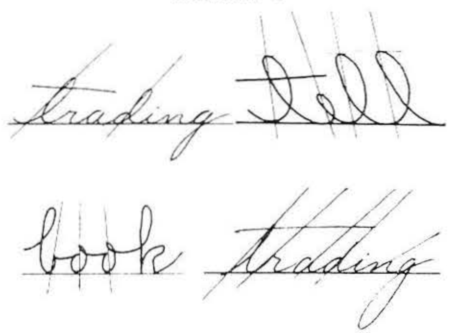
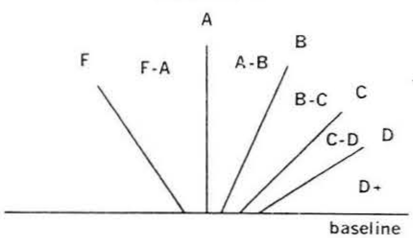
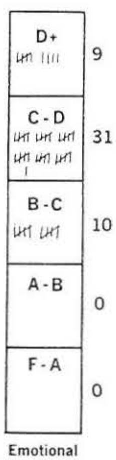


Illustration 2



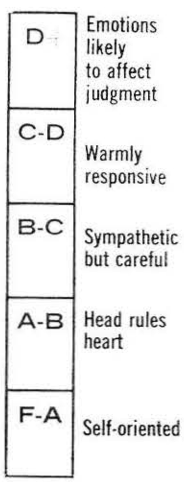
The Slant Guide

Illustration 3



Emotional Thermometer

Illustration 4



The slant of the upstrokes in your hand-writing is a dead giveaway to your "emotionality," according to the International Graphoanalysis Society. To take your own emotional temperature, find a sentence or two you wrote a day or so ago (it's better to use old writing, preferably on unlined paper). You'll need about 25 words. Draw a "base line" under the lines of writing. From this base line draw in lines following the angle of slant of 50 consecutive "upstrokes" (Illustration 1). Ignore the curves of the letters—make a straight line. Take a piece of transparent paper and make a tracing of the Slant Guide, (Illustration 2). Lay this guide on top of your marked-up writing. Each upstroke will fall somewhere between the lettered lines. Tabulate your marked strokes in a graph thermometer similar to Illustration 3. Most likely you will have strokes falling in three or more areas. Then check your "emotional score" by comparing the grouping of marked strokes in each area against Illustration 4.

Excerpted with permission from information received from the International Graphoanalysis Society, 325 W. Jackson Blvd., Chicago, Ill., 60606.

Recognizing the Marks on Paper

R. M. N. Crosby

Relatively little is known about how a child learns to read—i.e., what processes go on in his mind. In dealing with how the beginning reader learns to differentiate graphic symbols, this article considers several related problems: How does pre-school experience hamper the child in his initial discrimination of letter-like forms? How does a child learn to differentiate between letters? And between words? What is the correlation between reading and writing? Several reading research programs are discussed.

How does a child learn to read? That millions accomplish the difficult task every year does not negate the fact that little is known about how the child does it. We strongly suspect that if an intelligent child who is neurologically, culturally, and emotionally normal were left entirely to his own devices, but properly motivated to learn to read, he would discover how to do it himself. If given a few simple instructions, he would learn much more rapidly.

The vast majority of normal children will learn to read despite the methods of instruction used. It logically follows that if ideal teaching methods are used, the same child may learn more easily and at an earlier age. More importantly, the minority of children who are dyslexic may be helped over this necessary educational hurdle.

Some readers may be surprised that educators, psychologists, and physicians do not know how a child learns to read. True, it is known that if a child is taught by a look-say method, phonic method, linguistics, augmented roman alphabet, or some combination of these in a basal-reader, individualized, or experience approach to teaching, he learns to read—or most of them do. But no one knows what goes on in a child's mind. How does he differentiate between letters? How does he translate the graphic symbol into sound? How does he group letters into combinations and words and sentences so the reading process becomes more rapid and automatic?

While our knowledge of how a child learns to read is far from complete, it is vastly extended as the result of a study performed at Cornell University, *A Basic Research Program on Reading*,[1] done in co-operation with the Office of Education of the U.S. Department of Health, Education, and Welfare. The two-and-a-half-inch-thick report which stemmed from the four-year study was released in 1963. Director of the project was Professor Harry Levin. Other faculty members, all psychologists, who performed and supervised the research, in which graduate students participated, were Eleanor J. Gibson, Alfred L. Baldwin, James J. Gibson, Charles F. Hockett, Henry N. Riccuiti and George J. Suci.

This is an excellent study. The research attempted was basic and the hypotheses tested were well thought out. The experiments to test the hypotheses were carefully designed and control groups were used to give an accurate measurement of the findings. Several studies were incomplete in their findings. We can only hope that the Cornell researchers or others will continue the work to a definitive conclusion. But the fact remains that the Cornell study was a highly scientific examination of how a child learns to read and, as such, a major contribution to the knowledge of reading and a tribute to Cornell University and its faculty. Unfortunately, copies of the full report are difficult to obtain. There is, however, an excellent evaluation of the findings by Eleanor Gibson in *Science*.[2]

We place great emphasis upon this study because it was obviously predicated upon knowledge of the neurological process of reading. The researchers had an awareness, for example, that reading is translating graphic symbols into sound, and the findings of the well-designed experiments provide the best indication so far of precisely how the child goes about this process. There are thousands of experimental studies which have been done to try to explain normal reading processes. The great majority of these are single isolated studies with little connection to the central problem, less applicability to teaching theory, and almost no neurological information. Many of these studies are poorly conceived and performed with inadequate control. It is neither necessary nor possible for this article to contain

a critical review of this literature. The interested reader may find many excellent references in the Cornell study and may pursue the various subjects involved in the several indices available.

In her *Science* article, Dr. Gibson makes this statement: "Once a child begins his progression from spoken language to written language, there, are, I think, three phases of learning to be considered. They present three different kinds of learning tasks, and they are roughly sequential, though there must be considerable overlapping. These three phases are: learning to differentiate graphic symbols; learning to decode letters to sounds ('map' the letters into sounds); and using progressively higher-order units of structure." The Cornell researchers set up experiments to explore each of these three stages.

Learning to differentiate each printed letter or number used in English is the first step in learning to read and it is not very easy. The same letter comes in various styles, such as capital and lower case, printed and cursive. There are a wide variety of typefaces, including *italic*, and a considerable range of sizes. When the letters are made by hand, as by a teacher, the variations both in printing and handwriting are endless and all of them vary in innumerable ways from printed letters.

Preschool Training

The greatest difficulty for the beginning reader is that his preschool experiences may not have prepared him to discriminate between letters. For one thing, the child must discover the concept that an object (a letter) is not always the same regardless of its position. Nothing in his previous experience has prepared him for this. He knows, for example, that a golf club is a golf club no matter what its position or setting is. It's a golf club in his father's hand on the eighteenth fairway, in the golf bag in the closet, in the sporting goods store, whether new or damaged backward or forward, upside down, horizontal, or wrapped around a tree in his father's frustration. No matter what one does with it, a golf club is always a golf club.

Then, in the sixth year of his life, the child goes to school and is shown something that roughly resembles a golf club—the letter d. Only now he has to understand that if the letter is moved, it becomes a b or a p or a q or, if the handwriting is imprecise, an h or a g—all of which are different things. Similarly, a word is not always the same regardless of its position. Saw, reversed, becomes was. Dog becomes god, cat becomes tac, rat becomes tar, and so on.

A child's preschool training hampers him in learning to read in another and more serious way. He has had relatively little experience with linear objects. He exists, prior to going to school, largely in a three-dimensional world of toys, balls and bats, knives and forks, water glasses, and other objects which have depth and shape he can touch. He has had relatively less experience with two-dimensional linear objects, which is what letters and numbers are. He is simply less accustomed to functioning and conceiving of a linear world.

Even the limited experience he has had in working with linear objects has not particularly prepared him to work with letters. He has colored, painted, and drawn cats and dogs, people, and other figures. With few exceptions, the letters in the English alphabet don't resemble cats and dogs and people. Letters consist of curved and straight lines in various combinations. Even the reading-readiness studies he has in kindergarten are not particularly helpful, for there he usually learns to differentiate between cat and pumpkin faces and other objects. It must be said that the preschool training of children might be more helpful if the child worked more with letter-like forms, rather than drawings of objects. It might help accustom him to the forms of letters that he will be using in learning to read in the first grade.

The initial task to be accomplished in learning to read is differentiating and identifying (not necessarily by name) the letters of the alphabet. This is a basic departure from the manner in which the child learned to speak. Although he differentiated between the sounds of English, he was not required to identify them. He didn't have to know that he was uttering a long a sound or a short e sound or any other, nor that the sound was part of his language. But in reading it is vital that he identify the letters, *even with the look-say method of reading*. He must discriminate at least the first and last letter of the word. When identifying the word cat, he is not required to identify the c and t by name, but he has to know that they are not d and a or other letters. He has to be able to distinguish the shapes of letters and discriminate them from others. In writing letters, the ability to discriminate is even more essential.

Perception

In neurological terms, the child, when he discriminates between letters (or the shapes of any objects), is using visual perception. The term *perception* is given a variety of different meanings by those who use it. The psychologist gives the term a broad meaning, to encompass anything a person becomes aware of in his environment. The dictionary defines perception as anything known of an object; the seeing or hearing of it; direct acquaintance with anything through the senses. Psychologists R. M. Mowbray and T. Ferguson Rodger[3] define *disordered perception* as the inability to organize stimuli in a meaningful fashion. *Stedman's Medical Dictionary* says perception is "the mental process by which the nature of an object is recognized through the association of a memory of its other qualities with the special sense, bringing it to consciousness."[4]

We use perception in a narrower sense—defining it as the ability to be aware of and conceive of a pattern or shape. This is a higher-order sensory function and involves interpretation and integration of the basic information of sight, hearing, touch, etc. In visual perception this is the recognition that a triangle, the end of a tent and a capital A are the same shape; in auditory perception, the recognition of a tune or melody played in a different key; and in touch, the ability to correctly identify by touch alone the textures of velvet and denim. In reading, visual perception means the ability to differentiate between the letters d and b, for example; auditory perception means the ability to differentiate between the sounds of the words leaf and leave.

Two major comments ought to be made about perception. First, it is difficult to know how a child fails to perceive. For example, if a child has a disorder of visual perception and he is asked to draw a triangle and renders it poorly so that it resembles an oval—does he do it because his brain is unaware that a triangle is composed of three straight lines connected by three angles? Or does his brain receive this information but is unaware of its significance, causing him to neglect this information? We don't know the answer.

Second, perception is learned. This has been shown by research with persons blind from birth who have regained their sight through surgery. Psychologist D. O. Hebb has written a fascinating account of this research:[5]

The idea that one has to learn to see a triangle must sound extremely improbable, and so I shall now present the evidence to this effect more systematically. We have seen that the perceptions of the congenitally blind after operation are almost completely lacking in identity. Senden reports cases in which there was an immediate perception of differences in two figures seen together, but also one definite instance in which even this was not possible. Thus the patient sometimes saw differences between a sphere and cube, sometimes not. Color has been found to dominate form persistently in the first vision of these patients. Eleven months after operation the color names learned by a patient in hospital were retained, but the little that had been learned of form was forgotten. An egg, potato, and cube of sugar were seen by a patient repeatedly, until naming was prompt, but then were not recognized when put into colored light; the cube was well named when it was seen on the table or in the investigator's hand but not recognized when suspended by a thread with a change of background.

Such patients, when learning has proceeded far enough, manifest the characteristic generalizations of the normal person, so the initial difficulties are not put down to structural defects of the sensory apparatus.

Riesen has fully confirmed the conclusion that ordinary visual perception in higher mammals presupposes a long learning period. His observations concerning the almost complete visual incapacity of chimpanzees reared in darkness, and the slowness of learning, are of the greatest importance. They show that Senden's similar results with man are not due to some inadequacy of the clinical tests, nor peculiarly human.

Hebb then writes:

The course of perceptual learning in man is gradual, proceeding from a dominance of color, through a period of separate attention to each part of a figure, to a gradually arrived at identification of the whole as a whole: an apparently simultaneous instead of a serial apprehension. A patient was trained to discriminate square from triangle over a period of 13 days, and had learned so little in this time "that he could not report their form without counting corners one after another. . . . And yet it seems that the recognition process was beginning already to be automatic, so that some day the judgment 'square' would be given with simple vision, which would then easily lead to the belief that form was always simultaneously given" [Hebb is quoting Senden]. The shortest time in which a patient approximated to normal perception, even when learning was confined to a small number of objects, seems to have been about a month.

It is possible then that the normal human infant goes through the same

process, and that we are able to see a square as such in a single glance only as the result of complex learning. The notion seems unlikely, because of the utter simplicity of such a perception to the normal adult. But no such argument can be valid, since Lashley has shown that subjective simplicity and immediacy may be very deceptive as an index of physiological simplicity. There are moreover residual traces of learning in normal perception, and hints of its complexity.

Gellerman reports that chimpanzees and two-year-old children recognized a triangle that had been rotated through 120° from the training position, but (in the one protocol that is given) responded selectively only *after* a head rotation; and persistent head rotation continued in the later discriminations. Older human subjects do not need to make the same receptor adjustment to recognize the figure in two positions, and so this generalization may be a learned capacity, simple as it seems to us.

This research into the nature of perceptual learning, which Hebb has summarized so well, is of the greatest importance in the teaching of reading. The distinctive shapes of letters and numbers do not leap into recognition as they do with an adult. The child must examine the figures to detect their distinguishing characteristics. For example, when identifying a square, he actually counts the corners.

This was shown by an experiment related by Hebb,[6] as follows:

The subject is shown a diagram such as

x e a q
r l i s
o f z g
d y u p

and studies it until he has, apparently, an image of the whole square and can "look at" it and read the letters off, one by one. If he really has such an image, it will not matter in what direction he is asked to "read." Actually, it is found that the subject cannot reproduce the letters as fast from right to left as from left to right, or promptly give the four letters, p, z, l, x, that make up the diagonal from lower right to upper left. So what seems a simple, immediately given image of the whole is actually a serial reconstruction of parts of the figure. An "image" of triangle or square is simpler, longer practiced, but may be fundamentally the same. The perception of such figures also may involve a temporal sequence.

Thus, the normal child must *learn* to discriminate the shapes of letters, whether he is being taught by a phonic or a look-say method.

Identifying Letters

At this point it is proper to consider the difficulty which the normal child has in identifying letters. The Cornell study sought to discover how a child differentiates one letter from another.

It was obvious to the Cornell scientists that letters of the alphabet could not be used to discover how the child learns them. The children being tested might know one or several letters. They would at least have a familiarity with them. To avoid this difficulty, the researchers prepared a group of letter-like forms consisting of straight and curved lines such as those used in letters. Then, 12 variants were prepared of each standard letter-like form. In some of the variants the forms were rotated or reversed (as letters are); or curved lines were used instead of straight ones; or there were breaks in the lines that did not exist in the standard form; or there were perspective transformations in which the standard figure was slanted backward or forward.

Then the Cornell psychologists asked a group of children, ages four through eight, to pick out copies of the standard form from a group that included all of its transformations. The youngsters were to select only the exact copies of the standard form. The errors made by the children were scored and the errors classified according to the type of transformation.

Results of the test showed that the visual discrimination of children improved from ages four to eight, but that some discriminations between forms were harder to make than others and that improvement in discrimination varies from form to form. For example, errors for perspective transformations were very numerous among four-year-olds and still numerous among eight-year-olds. This was not considered critical because English letters do not normally contain perspectives, that is, the letters are all made to appear flat. At least in the primary grades, there is no attempt to give the letters the appearance of depth.

Of greater significance were these results: changes of break or close, such as between a c and an o, are easiest for children. Even the youngest tested made relatively few errors and none of the eight-year-olds made a mistake.

Errors for rotations and reversals—d and b, p and q, M and W, c and u—were very high among the four-year-olds, but dropped to nearly zero by age eight.

Errors for changes from line to curve—v and u, for example—were relatively numerous (depending on the number of changes) among the youngest children but showed a rapid drop among the older ones, almost to zero for the eight-year-olds.

The Cornell researchers then tried the same transformations of real letters on the five-year-old group and found that the same confusions resulted. This indicated that problems in discrimination apply generally and not just to the specific forms drawn for the experiment.

Some comments can be made concerning the results of this experiment. First, a child's ability to distinguish one letter from another improves with age. By age eight he is an expert, making hardly any mistakes at all. But the child of eight is usually in the third grade. What of the first-grader who is having trouble discriminating one letter from another? Is he receiving proper help from his teacher? Teachers work quite hard on reversals and rotations, but do they realize that line-to-curve distinctions also cause difficulty? The answer to these questions is somewhat important, for the Cornell study showed that at age six the children tested made about 18% errors in rotation and reversal and 26% in line-to-curve transformations.

How does a child differentiate one letter from another? If the answer to this question could be obtained, it would open a new avenue of teaching, in which instruction can be given to the child to help him distinguish one letter from another, thus eliminating some of the time-consuming trial and error of self-discovery.*

*The use—he would say abuse—of self-discovery learning in reading instruction has been criticized by psychologist Roger Brown in an article "A Dispute about Reading" in the book *Human Learning in the School*,[7] as follows:

"The need for phonetic attack on new words is generally recognized by educators of the look-and-say persuasion, but for one reason or another they believe the necessary generalizations should be incidentally learned or, if directly taught, postponed until the second or third grade. What are the reasons for this belief? Dolch and Bloomster have said: 'It is true that the use of phonetics means the use of generalizations, *that generalizations are best learned inductively*, and that sight words are the basis of inductive reason-

The Cornell experimenters formed two hypotheses concerning how children might discriminate letters. In one it was assumed that the child builds up a kind of model of each letter and then compares until he makes a match, or, in the other, that he discovers how letters differ and recognizes them by distinctive features.

To test which hypothesis was correct, the psychologists worked with a group of kindergarten children, training them to discriminate between letter-like forms similar to those used in the earlier experiment. Then the children were divided into three groups. Group one was given new forms to learn, forms which varied in new ways from the same standards of discrimination they had already learned. Group two was given new sets of forms which differed in the same ways as the forms they had already learned. The third group was a control given both new standards and new dimensions of difference to discriminate.

It was inferred that better performance by the first group would suggest that discrimination learning proceeded by construction of a model of the standards against which the variants could be matched. If the second group performed better it would suggest that distinctive differences had been detected by the children.

ing.' (Italics my own.) The italicized portion of this sentence is hardly a common-sense observation. Why does the scientist write out his laws, the chef his recipes, the professional golfer his instructions for the novice, if not to spare the rest of us inductive labor? We benefit from the experiences of our predecessors by reading the generalizations reformed. It may be that the Darwinian Theory of Evolution is best learned inductively—best in the sense of most unforgettably. But if it had to be learned that way, most of us would live without a theory of evolution. On the face of it, a generalization is more rapidly and certainly learned when it is explicitly stated. In addition, there are experimental results to show that incidental learning is slow and uncertain by comparison with directed learning. The educator, who would claim that phonetic generalizations are better learned by incidental induction than by direct formulation with examples, assumes the burden of proof. His claim does not conform to popular belief, nor has it been demonstrated in the laboratory. If you really want your pupil to learn a phonetic rule, it seems sensible to tell him the rule."

Results showed that both groups one and two performed better than the control group, and that group two performed best, making 39 errors to group one's 69. "We infer from these results," Dr. Eleanor Gibson wrote in *Science*, "that, while children probably do learn prototypes of letter shapes, the prototypes themselves are not the original basis for differentiation. The most relevant kind of training for discrimination is practice which provides experience with the characteristic differences that distinguish the set of items. Features which are actually distinctive for letters could be emphasized by presenting letters in contrast pairs."[8]

The experimenters made an effort, unfortunately not completed, to determine which features a child distinguishes. It seemed to indicate that children distinguish between curved and straight lines and between the obliqueness of a line, as in A, K, N, and Z. It is to be hoped these experiments can be continued until it is known precisely which features of letters help a child distinguish it from another.*

The Cornell study seems to indicate that a teacher would be wise to drill students on discriminating between letters as well as identifying them.

*We would like to suggest that some experimenters develop what might be called an *Initial Perceptual Alphabet* (IPA), a concept similar to the *Initial Teaching Alphabet* (ITA). ITA is an attempt to circumvent the phonetic irregularities of the English alphabet by creating letter figures for each of the common phonetic elements in the language, 44 in all, so that each ITA letter represents one English sound. After learning by this method, the child later transfers easily to a regular alphabet. We consider this a most appealing addition to the theory of reading instruction. We are suggesting that a similar technique be used to circumvent some of the visual confusions in the alphabet, such as the b and d, p and q, m and w, u and v. If another form were substituted for one of the confusing letters—there is no reason that squares, triangles and other geometric forms cannot be used—it would simplify the visual aspect. The child, after benefiting from his IPA exposure, could then be transferred to the regular letter forms.

Reading and Writing are Related

Another team of psychologists at Cornell sought to determine the correlation between reading and writing. The hypothesis was stated well by the researchers, James J. Gibson and Harry Osser:

> In the acquisition of language it is clear that a child never learns to understand speech without at the same time learning to speak. The circularity of speaking and hearing has always been recognized and the degree to which the auditory feedback controls the process of uttering words has recently been studied experimentally. What has not been so clear is that a child never learns to *read* without at the same time learning to *write*. Reading and writing are different terms and often seem to be thought of as different school subjects. Nevertheless, the visual feedback which controls the manual art of writing is quite analogous to the auditory feedback which controls the vocal art of speaking. Just as one cannot speak without hearing one's speech, so one cannot write without, in a peculiar sense, reading one's writing.

Gibson and Osser pointed out that what a child must learn in order to read and write is that "speech sounds can appear, and can be *made* to appear on a visible surface."

Is it useful in the classroom to have the child write letters as a means of helping him to discriminate and identify them? Gibson and Osser sought to discover this by having 20 children, four to six years of age, punch out letters on a typewriter. Some of the children used a typewriter that contained a ribbon, thus permitting them to see the letters they made. The remainder used typewriters without ribbons and thus received no visual reinforcement of their efforts.

Results showed that those children who used typewriters with ribbons performed significantly better than those who merely punched a typewriter key. The results are interesting in that they showed that merely by looking at letters the child made with a typewriter helped his discrimination of them. It is unfortunate, however, that typewriters were used in this experiment. If another group of children had written or printed the letters by hand, it is likely that they would have shown even greater reinforcement of their ability to discriminate. There is abundant evidence that tactile perception provides an avenue of learning. Helen Keller used this method exclusively. Schools experimenting with the teaching of dyslexic children with severe visual and auditory imperception are

obtaining good results by teaching children to read by means of tactile perception, that is, having them feel letters and write them in sandboxes or on blackboards. (Grace Fernald[9] has done the most significant investigation of the efficacy of tactile methods of teaching reading.)

We believe there is great value in teaching reading and writing simultaneously, rather than as separate subjects in the curriculum. Writing the letters aids the child in distinguishing and identifying them. He is using visual perception when he sees the letters, auditory perception when the teacher speaks them, and tactile perception when he writes them on paper or the blackboard. The normal child thus is using three broad avenues to language comprehension. This three-pronged learning process is of value even after he has learned the first step in reading and can distinguish and identify letters. Writing, as well as seeing and hearing, help him to learn the spelling patterns and then the sentence structures which are characteristic of English. In short, writing is a most valuable tool in the teaching of reading.

Identifying Words

The importance of teaching children to discriminate one letter from another very early in the instructional program was illustrated in another Cornell experiment. Performed by Gabrielle Edelman, this investigation produced results which have far-reaching significance for the practicing classroom teacher.

Miss Edleman sought to discover the cues by which a nonreader or beginning reader identifies a word he has never seen, whether the same cues are used to recognize a long word and a short word, whether nonreaders and beginning readers use the same cues, and whether boys and girls use the same cues. Two groups were selected; 50 kindergarteners and 50 first-graders, each chosen at random from public schools and each divided equally among boys and girls.

The children were shown a card on which was printed a nonsense word, for example, cug. Then the youngsters were shown response cards in random arrangement. They were to point to the word on one of the response cards which was identical or most resembled the word they had seen on the first card. The response cards were arranged so as to determine (1) whether the children cued on the basis of shape by selecting arp, which has the same shape as cug but all the letters changed; (2) by the first letter by selecting che, which has the same first letter as cug but different second and third letters and the shape changed; (3) on the basis of the second letter by selecting tuk, which has the same second letter as cug but the first and third letters and the shape are different; or (4) on the basis of the final letter by selecting ilg, which has the same third letter but the first two and the shape are changed. A similar system was worked out for five-letter nonsense words. In both the three-letter and the five-letter tests, the response cards were presented in varying order so no cue could be based on sequence. There were eight combinations of each three-letter word and 52 combinations of each five-letter word.

The results were different depending on the size of the word and, surprisingly, on the sex of the participants. The first letter of both the long- and short-word forms was the cue most utilized by nonreaders (kindergarteners) and beginning readers (first-graders). The last letter is also an important cue, especially for kindergarteners, and more so in short words than in long ones. Boys tend to recognize words on the basis of the first more than the last letter. Girls, while using both first and last, place greater emphasis on the second letter than boys do, as shown by the following table:

Five-Letter Words

Cues:	SHAPE	FIRST	SECOND	THIRD	FOURTH	FIFTH
Kindergarten	330	1673	540	755	518	1365
1st Grade	80	2497	757	693	287	930
Boys	214	1886	589	780	445	1208
Girls	196	2284	708	614	360	1087

(*The figures represent the number of times children recognized words on the basis of certain cues.*)

Gabrielle Edelman concluded from her experiment that "theories which propose that nonreaders and/or beginning readers recognize words as wholes by their shape have not been supported in this study. The shapes of words, offered as a cue next to letter cues, was rejected in favor of letter cues . . . in this experiment." She pointed out that the first letter is the most important cue in whole-word recognition

and that the last letter is next in importance. She theorized that this phenomenon may lie in the primacy of the first letter and the recency of the last, or simply that the first and last letters, since they are bordered on one side by white space, stand out more than those letters embedded in the middle of a word.

The major implication for the teaching of reading [according to Miss Edelman, a view which we share] is that the basic belief on which the whole-word method of teaching reading lies (i.e., the belief that children recognize words by their shape) is incorrect. Educators may believe the child is attending to the whole word, when he is actually utilizing certain letter cues. Helping pupils learn the letters well so that they may use letter cues to the best of their ability would be an important teaching improvement.

This information about the manner in which a normal child recognizes and identifies the graphic symbols on a page is of the greatest possible importance in teaching of reading. It offers, we believe, some insights into the problems of the normal child in learning to read and to some ways teachers can assist this child over these hurdles.

But our primary purpose in including this material is to show the monstrous task that confronts the dyslexic child with poor visual perception. If he does not correctly perceive the shape of the letter d, for example, just try to imagine his difficulty in differentiating the letter from a b, p or q. If he does not correctly perceive the shape of an m, how can he distinguish it from a w? And making such distinctions is the absolutely essential first step in reading. This child, even if his impairment is a mild one, needs a great deal of time-consuming help in surmounting the first step in reading.

This article is a reprint of chapter 5 in R. M. N. Crosby (with Robert A. Liston), *The Waysiders: a New Approach to Reading and the Dyslexic Reader*. New York: Delacorte Press, 1968.

1. The Cornell University study, *A Basic Research Program on Reading*, consists of 22 separate papers which are not sequentially numbered, so that page references would be of little significance. Because copies of the full report are difficult to obtain, additional references will be listed for each paper, if published elsewhere. The papers discussed in this chapter are:

Gibson, Eleanor J.; Gibson, James J.; Pick, Anne D.; and Osser, Harry. "A Developmental Study of the Discrimination of Letter-Like Forms" (also published in *J. Comp. Physiol. Psychol.*, 55:897–905, 1962).

Gibson, Eleanor J., Osser, Harry, Schiff, William, and Smith, Jesse. "An Analysis of Critical Features of Letters, Tested by a Confusion Matrix."

Pick, Anne D. "Improvement in Visual Discrimination of Letter-Like Forms" (also published in *J. Exp. Psychol.*, 69:331, 1965). Gibson, James J., and Osser, Harry. "A Possible Effect of Learning to Write on Learning to Read."

Edelman, Gabrielle. "The Use of Cues in Word Recognition."

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Relative Legibility of Leroy and Lincoln/MITRE Fonts on Television

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The legibility of standard Leroy alphanumeric symbols was compared with that of a new font, the Lincoln/MITRE, on a television monitor at resolutions of 8, 10, 12, and 14 lines per symbol height. The new font was not superior in legibility to the Leroy font at any of the values of resolutions tested. While the findings for the new font were negative, insights were gained about how to improve symbol design for more legible television displays. It was recommended that these new design techniques be evaluated in future work on television displays.

Television is a valuable display device for systems use because of its versatility, ease of signal transmission, reliability of image reproduction, ease of maintenance, and comparatively low cost. In addition, the ability of television to combine different data inputs into a single composite display is well known. Nevertheless, the acceptability of television for many military and industrial systems applications depends upon its ability to display symbols which can be accurately and quickly identified by the viewer.

This ability has seldom been determined through objective performance tests that provide estimates of accuracy and speed (legibility) of symbol identification. Even though television is widely used for entertainment, education, and communication, the research which might have solved some of the legibility problems has been directed elsewhere instead. Commercial TV studies lean to such problems as picture quality, flicker, color quality, and in educational TV, to evaluations of television as an instructional device. When television is used as a means of communication in system settings, symbol legibility is often determined by subjective opinions, preferences, or even guesses.

There is a need to conduct comparative studies of different fonts for developing standards to guide the designer and manufacturer of