A Fresh Look at the Sign System
of the Braille Code

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A Fresh Look at the Sign System

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Abstract

"A Fresh Look at the Sign System of the Braille Code" analyzes English braille as a written code from a linguistic viewpoint. The analysis was undertaken as a step toward teaching braille to young children. From the analysis a regrouping and fresh characterization of braille units evolved. This regrouping is discussed in the article proper and then presented in an outline.
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Background

Reading has long been acknowledged to be a critical factor in the educational progress of children. The task of learning to read is never a simple one regardless of the medium through which the skill is acquired. However, children who read print have access to materials which are specifically designed to minimize the difficulties of the learning task. This is accomplished through the control and sequential presentation of vocabulary, the written or printed symbols, components of the reading skills, and concepts. However, somewhat surprisingly, no such control has been exercised in the development of learning and reading materials for visually handicapped children who must use braille as their reading medium. The standard practice in publishing braille materials to teach reading is to transcribe primary print readers into braille. This practice creates a number of problems for beginning braille readers.

One major problem arises from the differences in representing words between print and the shorthand braille code. Contraction and abbreviation of words in the braille code increases the number of elements to be mastered as compared to print, thereby altering and reordering the
composition of controlled reading vocabularies. Less obvious is the difference in the structural relation of basic elements between the alphabetic letters and punctuation of print and the units of braille. Concepts used in print readers are often highly visual (e.g., stress on colors) or irrelevant to the direct experience of the beginning braille reader (look at the moon). Print readers rely heavily and increasingly on pictorial content to provide context. Workbooks accompanying print readers are highly pictorial and exploit geometric or tubular displays as clarifying devices, practices which seriously impede their reproduction in legible tactile formats to which blind children can make meaningful responses. As a result, many blind children have experienced great difficulty and delay in learning to read.

There is no dearth of documentation to support the assertion that much of the difficulty young visually handicapped children encounter in learning to read can be ascribed to the fact that reading materials used by these children have traditionally been transcribed from print editions. As Lowenfeld, Abel, and Hatlen (1969) and Rex (1970) point out, many children have successfully learned to read using these materials. However, Rex reports that to a great extent teachers must supplement these texts with their own specially created materials. The literature describes a number of difficulties arising from the direct transliteration of print readers into braille. One very obvious deficiency is the elimination of the cues to meaning arising from the elimination of pictures. Ninety percent of 101 beginning reading teachers who responded to the survey of Bleiberg (1970) believed that there was a visual
emphasis in the series they used. This resulted in great measure from the use of pictures to give context. Eighty-three percent of the teachers expressed dissatisfaction with the resulting content of the readers. Blieberg concluded that, "The books presently in use do not meet the needs of blind children who are learning to read. The content of the books should have less emphasis on visual imagery and more emphasis on the senses that blind children use, e.g., touch, smell, hearing, and taste" (p. 136).

Other problems arise from the belief that the learning of braille reading may present a more difficult intellectual task than does the acquisition of print reading (Nolan and Kederis, 1969, p. 46). Ashcroft (1960) made the following remarks regarding reading materials: "Instructional materials for reading development level and experience of the students. Materials in which there are many multiple-cell contractions, short form words, and lower cell contractions seem to cause special difficulties for children reading braille. Conventional print readability evaluation procedures may overestimate the readability of materials transcribed into braille" (p. 87).

The source of another major problem in braille reading is the limited number of patterns or shapes that can be imposed on the six dot cell. Partly because of this, the same shape is used repeatedly in different orientations, and may assume different meanings depending upon the context within which it appears. This often presents major learning problems to beginning readers (Bleiberg, 1970; Rex, 1971). This potential for ambiguity in the code is doubtless responsible for reading
errors, vertical alignment errors, and horizontal alignment errors described by Ashcroft (1960). These problems, again emphasize the need for special materials which minimize difficulties specific to the braille code. Elimination of punctuation and controlled presentation of braille code elements might be a step towards alleviating these obstacles.

Other problems are simply neglected by the use for primary braille reading instruction of print materials which ignore difficulties arising from the use of contractions in braille. One such problem is the "dual spelling of words such as "in," "was," "to," etc., which appear in both contracted and uncontracted form" (Rex, 1971, p. 3). Still another problem arises from identical configurations of differing heights within the cell which coexist "When lower-cell forms are used, or similar two-cell contractions" (Rex, 1971, p. 4). Bleiberg (1970) states that, "Pupils should be introduced to the contractions that are easiest to read and write and gradually progress to the lower sign contractions, initial letter contractions, and the final letter contractions. Repetition of the contractions should be stressed" (Bleiberg, 1970, p. 3). But which contractions are easiest; and by what criteria?

Pertinent research by Nolan and Kederis (1969) has claimed that the perceptual unit in braille reading appears to be the braille character and not the braille word. Therefore, some have claimed that
the whole-word approach to teaching braille reading needs to be de-
emphasized. As Chall (1967) suggests for all readers, a stronger phonic approach is needed. However, to achieve this for braille readers, it has been asserted that materials must be designed to avoid the "non-phonetic aspects of the code which the use of contrac-
tions frequently imposes" (Rex, 1971, p. 4). It will be seen from our discussion below that this last stipulation does not follow as a logical necessity of the "phonic" requirement. We must recognize rather that the "phonics" of braille are differently based from those of print English.

Following a review of the research literature on braille, Cline and Cardinale (1971) strongly urged the creation of a series of basal readers designed for braille students sequenced to agree with the research findings on reading errors and perceptual factors in reading. Also, development of these materials was strongly recommended by the APH Primary Braille Reading Consulting Group (Caton, 1970). While these materials would not necessarily replace braille transcriptions of print reading series, they would serve at least as a valuable adjunct to these materials.

We see, then, that in the recent dozen years or so the field has not been without progress in recognizing the need for an instructional approach to braille reading that accords a proper place to the
specific characteristics of braille and the situations in which it is used. The work which has given rise to the analysis presented below has proposed to build on the foregoing views in two ways: (1) It is proposed that earlier work does not go far enough in recognizing the truly specific characteristics of the braille code. (2) A total analysis and method is proposed which would be more consistent with (1).

We further insist on analyzing and explicating braille throughout without appeal to the characteristics and setting of sighted print—an intrusion irrelevant to our task and too often invoked.

Toward An Internal Analysis

It has long been recognized that a major problem in the teaching of braille reading arises from differences between the representations of natural spoken language in print and in the braille code. These differences have tended to be depicted in terms of additions or subtractions; that is, people have been occupied with contractions as being somehow shorter by subtraction from the full print form, and the like. Attention has also concentrated on the particularities and tactile difficulties of shapes of the dot configurations within cells; this is clearly important in itself, yet has little to do with the functions which have been allotted to various character groups. Less obvious, however, is the fundamental difference in internal structure between many aspects and subsections of the braille code and those of a full font of type. A further important point which will be stressed in what follows has to do with the nature and status of relations, in
an abstract sense, which obtain between braille and print. That is to say, there are clear and partly simple relations which hold between print and the braille code; for after all, the braille code was devised on the basis of print, or writing. But frequently the learner of braille is not already in possession of a knowledge of print or writing.

Problem Areas

After reflecting on questions such as these, we have arrived at the conclusion that two large and essential problems confront us at this time:

1. The present lack of a thorough and relatively abstract internal analysis of the braille code stands in the way of our ability to confront effectively and confidently many of the major decisions involved in designing adequate learning materials. While we do not minimize the high intellectual fascination that such a formal analysis holds, we have been impelled to carry out the analysis outlined below by practical concerns related to the design of course material. The analysis which follows, therefore, shows some signs of this practical aim, and the ordering of elements both in the analysis and in the following discussion is, to a considerable extent, influenced by our sense of practicality in teaching and course design.
2. In scrutinizing materials and practice employed to date in teaching braille, and even those explanatory materials which authoritatively present the braille (English Braille American Edition, American Printing House for the Blind, 1958), we are impressed by the prevailing tendency to analyze the code and explicate problems via elements, processes, assumptions, and customs which are based on visual experience. Even though all concerned are well aware of the situation of the blind student, and particularly of a young person who has never had the opportunity to be exposed to print, much of the discussion and explanation is carried on as if all members of the dialogue had a degree of experience with the rudiments of printed or written English. So, for example, in materials of discussion directed to a blind student the braille unit which conveys the dental spirant sound which is at the beginning of a word such as thin is usually talked about as though it were obvious that it should be spelled in conventional English with the letters t and h. Of course no teacher of braille remotely considers that the word thin actually starts out with the two sounds th, i.e. t + h. However by mentioning the letter combination th to a person who has never seen this rather bizarre spelling the teacher can give an initial impression only of irrelevancy at best. Readers of print
happen to think that \textit{th} in such a case is not bizarre only because we are used to it by long association with this arbitrary result of the history of our orthography.

We propose, therefore, to deal with both the above problem areas by presenting, as compactly as possible here, the result of a fresh and completely internal analysis of the braille code. In this analysis the characteristics of visual print are never used as internal elements of the system to be analyzed. Rather, the features of visual print are segregated as a separate system external to the braille code, i.e., as a set of elements with which the braille elements may be contrasted and for which relations may later be defined between the two. Our analysis both characterizes the internal braille code and states the relations between braille and print. We return shortly below to a more precise statement of just how this mode of analysis is to be conducted.

Major Steps in Ordering

To keep clearly in view our ultimate practical aim, in light of the problems discerned above, we take it that our goals for the devising of teaching materials should follow these major steps:

1. A relatively complete internal analysis of the braille code, to be conducted along lines just mentioned above and elaborated below. We say "relatively complete" in order to isolate major issues; to see which direction one must move; and finally so as not to overload the analysis and presentation here with endless detail or rarely occurring nonessential
elements. We therefore restrict the analysis here to the normally used major part of literary braille, and we content ourselves below with giving as examples during the course of our discussion only representative or crucially interesting instances for most of the classes discussed. A moderately exhaustive list of the resulting categorization is appended at the end so as not to clutter the main argument; see Appendix A.

2. Design of the most direct and reasoned route towards mastery of the elements and their combinations, and of a compact and maximally simple notation to carry out such discussion. This means that all teaching materials must be ordered for the presentation of all elements for which a principled ordering can be determined. This is not simply a question of leaving nothing to chance; it is a matter of proceeding logically from the known to the less known.

3. The introduction of visual elements, which would include visual print and writing. As mentioned above these elements must be kept clearly and discriminatingly in mind for purposes of the analysis pursued under number 1 above. But for our present discussion, we are not here concerned with the problem of correct introduction of these visual elements as a goal of the learning and teaching process.

4. A careful consideration to be given finally to the correct phasing and intercalation of the activities specified under numbers 2 and 3: in short, the effective teaching of braille
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and the appropriate teaching of print. Again, this task falls beyond our present purpose.

As has just been observed, numbers 3 and 4 fall outside the scope of the present study. Number 2 depends crucially on number 1 above, and the publication Patterns: The Primary Braille Reading Program represents the first essay towards fulfilling the objectives of number 2. The discussion which follows, therefore, addresses itself to the objectives of number 1 only.

Braille and Print Writing: Their Mutual Relation

If no English speaker used any mode of representation for English other than braille, the task of analysis of braille would be no different, in essence, from that task which would be adequate for graphic analyses of one or another writing system now or formerly in use in the world. Of course details would differ. The writing and printing of English is essentially an alphabetic enterprise. The mixed representation which braille employs consists of symbols for letters, for syllables, and for whole words. Consider these examples: the letter b in the braille word boy, the syllable er in the braille word exercise, and the whole braille word people. An entire world of English speakers using only braille would present us with the straightforward task of correlating the braille system, internally formulated, with the grammatical and semantic facts of the English language. Thus, this job would be merely more complex than, yet analogous to, that of
correlating conventional English spelling with the way our words are put together. But braille users do not constitute the entire English speaking population; nor is it expected that those who use braille will fail also to master conventional print English.

This fact imposes a separate dimension on the analysis with a corresponding task for analyst and teacher, a dimension which arises from two principal facts of language use which have impinged upon the character and function of braille.

1. Historically, braille is of course not independent of print English, since it has been devised over time with print English preceding chronologically, and lurking in the background as a partial model.

2. Braille will moreover be learned by students who wish to convert with maximum efficiency that knowledge and skill into a competence in English print so they can type.

If our analysis of braille is to take these two aspects into consideration, the resulting formulation which states the relations of the internal braille system considered together with the structure of print English will be complex in a special way: The formulation will discriminate more classes of elements and functions than would be the case if only the braille system or only the structure of print were being considered separately.

At every state of this analytic process we must ask ourselves:

1. what forms are distinguished by what elements and what combinations in terms of braille shapes and
2. how each of these forms is correlated with, i.e. equivalent to or not equivalent to or partially equivalent to, elements and features and combinations of print English.

We see immediately from this that there are two important aspects to every determination which we make for a braille element: There is the configuration, if you will, of the braille element itself (so and so many cells consisting of such and such arrangements of dots), and there is the element or elements of print English with which this braille shape is found to be correlated.

In the theory of signs as elaborated in the technical literature of linguistics such a relation is known as a "sign relation," and the combination of the signifier (the braille configuration in this case) and the signified (the print English) is known as a sign. To invoke an analogue, this value, or function, stands in relation to the signifier in this instance much as a meaning does in relation to its signifier which we call a word (no matter whether a braille word or a print word). Thus, what we are calling value here is much akin to the notion of meaning; but for the present we will not use the latter term in this sense lest we cause confusion with a different type of sign relation, namely that of linguistic semantics, with which we are not here concerned.

This consistent correlation of print values with the discriminated braille elements may be called for convenience a value system or sign system in the sense just specified. It is in such an analysis, as well
as the details of its execution, that our approach differs fundamentally
and to the greatest extent from earlier formulations and presentations
of the braille code.

A New Approach to the Braille Code: The Internal Analysis

It is necessary first to discriminate certain primes of braille.

Cell. The term cell has been used in more than one sense in the liter¬
ature to date. If we are to keep our discourse clear and build system¬
atically to an adequate and nonconflicting grasp of the more complex
notions, we must restrict our use of these primes to but a single
clearly understood sense in each case. We define cell as an abstract
space twice as high as it is wide in which there are six positions,
arranged in three rows and two columns in which dots may appear.

Shape. We have pointed out above that it is necessary to distinguish
a braille configuration from the correlation of such a configuration
with a given value. Moreover it is necessary to be able to speak of
such a configuration when it occupies but a single cell. We therefore
define as a shape a single configuration made up of one to six dots and
occupying a single cell. Notice that so long as a shape is defined in
this fashion it does not yet have any necessary value, i.e. meaning, and
therefore, is not a sign in the sense of sign theory alluded to above.

Dot. We have mentioned above the notion of dot somewhat offhandedly,
but it would be well to be more precise: a dot is the element of which—
shapes in a cell are composed. The dots of a braille shape occur physi-
cally as bumps or bosses.
Braille Unit. We now require a term for any shape or shapes taken together in correlation with its (or their) value, i.e., meaning. It would be convenient and non-offensive to ordinary English if the word character could be used for this notion, especially since that is the established English term for the element of Chinese Writing that closely resembles in function this braille element. But unfortunately this term has already been employed for some time by users of braille in a deceptively similar but ambiguous sense; unless users of braille were to find it desirable to alter their terminology, it will be necessary to find some alternate term for this pivotal notion in the present analysis. For this purpose the term braille unit has been proposed by us.

A single braille unit may consist of one or more shapes, as for example tion. Braille units fall into three major types, which are defined and commented on below: letters, modulations, and grams.

Letters. Letters are either alphabetic such as the letter b, or nonalphabetic such as 2.

1. Alphabetic letters (or letters proper) have print-alphabetic values; that is to say, these braille units match occurrences of ordinary letters in print. For example, the shape (\( . \)) has the value of i.

2. We call nonalphabetic letters (1) numbers, the decimal point, and fraction bar, and (2) certain other braille units with abstract letter-like segmental function, such as asterisk and apostrophe.
The numbers, of course, take the number sign and then the shapes with the resulting number value may be thought of as letters of a numerical alphabet, an alphabet consisting of twelve shapes (counting the decimal and fraction bar) and which spell number words. The asterisk may be viewed as a rather odd unpronounceable letter, while the apostrophe often has the implied meaning "letter left out." The reason for classing these last two as if they were letters or numbers resides in the fact that they have sequential segmential properties in linear order just like conventional letters, and that the characters which they match in the print text consist regularly of single segmental print shapes.

Modulations. Modulations are of two rather different sorts: punctuation, for example the question mark; and register, for example italics. The thing that these two have in common is that they "do things" to, i.e. have effects on, other elements--the segmental elements--in the chain.

Punctuation, in fact, has print values which are themselves sequential in position; but these braille units differ from others in having domains of effect which extend at times to considerable distances to the right and the left of their sequential position. Some punctuation looks back; examples are the period and non-Spanish exclamation point. Other punctuation encloses; examples are the hyphen and the dash.
Those which look back have as a domain of their force what has gone before; those which enclose both warn us of their application and close their domain; those which link affect things on both sides.

Register is the term applied to those braille units which include what have traditionally been called composition signs; these braille units look forward, and may also automatically specify where the scope or domain terminates. Examples of such braille units are capital, italic, letter and number signs. These elements always have the effect of modifying the basic segmental values of what follows; thus, they change the dress of some elements, such as lower case into capitals, or change what we think of as type style, such as italic, or change letters into numbers, or change the abstract reading of an element, such as the letter sign. Registers have the unique property of finding no separate segmental counterpart in print.

Grams. Grams are of three kinds: phonograms, such as the ance in dance; morphograms, such as the ance in reliance; and logograms, such as the words rather, the, friend, mother, and immediate. The distinction between grams and the two preceding is that unlike modulations they are segmental in value, but unlike letters they have no single counterparts in a type font. Because of this last property these are the braille units that later will give rise to bidirectional problems in writing and spelling.
A phonogram is a braille unit having a phonetic value that would be written in print by more than one alphabetic symbol. Phonograms include one shape phonograms such as th, ch, gh, the ing in sing, the ea in read, the ed in bed, the ar in bar. Phonograms also include multi-shapes as the ation in nation, the ound in sound, the ong in long, the ence in fence, the ity in pity, the ness in Tennessee, and the less in bless.

A morphogram is a braille unit having the value of an element in a word, such as an inflectional ending, prefix, or suffix. Examples are the s in words, the ing in looking, the ed in looked, the ance in avoidance, the ation in admiration, the in in inconsistent. Note that the shape(s) that make up ing, ed, ance, etc. appear as phonograms or morphograms depending on their function in words, i.e. their "value."

A logogram is a braille unit made up of one or more shapes having the value of an English word (conventionally, a chain of letters between spaces) with either limited reflection or no reflection at all of phonetic values in the word. There are two principal configurations of logograms: single-shape logograms and multi-shape logograms. Single shapes comprise letter words and wordlets. A letter word is a logogram that has a shape which is the same as that of a letter. Examples are but, can, do, rather. Wordlets comprise all other logograms carrying a word value. Examples are and, the, shall, still, there, ought, young, those, enough, cannot, paid, declare, was, to.
It should be observed that logograms do not lose their status as
such when they are derived by affixes. Thus spirit remains a logogram,
in this case, a compound letter word(let), when it occurs as part of
the derived adjective spiritual. Such a definitional provision avoids
the need for pedantically encumbering the analysis of renaming hosts of
wordlets "morphograms" because they may form parts of longer derived
words.

Results to Date

This internal analysis of the braille code has been undertaken
for a practical aim: as an essential step in devising cogent materials
for the teaching of braille reading to children who have never read
print. It is on the basis of this analysis that the teaching materials
now published in Patterns: The Primary Braille Reading Program (Ames-
tican Printing House for the Blind, 1980,) have been prepared. As a
teaching aid, the categories and definitions discussed above in this
article have been summarized in that publication as follows. Specific
examples in the various categories of this Outline of Braille Terms are
given in Appendix A.
A. Prime Notions
1. **Cell** A cell is an abstract space, twice as high as it is wide within which six equi-
distant dots can be placed.
2. **Shape** A shape is a single configuration made up of one to six dots. Therefore any cell can be filled by a shape.
3. **Dot** A dot is the element of which shapes in a cell are composed; dots of a braille shape occur physically as bumps or bosses.
4. **Braille unit** A braille unit comprises any shape(s) taken together with its/their value (meaning or function). Example: go = 1 shape, 1 braille unit; ation = 2 shapes, 1 braille unit. Braille units may be subdivided into three major types: letters, grams, and modulations.

B. Braille Units
1. **Letters** These are either alphabetic or non-alphabetic.
   a. **Alphabetic letters** (or letters proper) have a print-alphabetic value.
   b. **Non-alphabetic letters** comprise
      (1) **numbers** and the decimal point. Numbers may be thought of as letters of a numerical alphabet (11, counting the decimal) which spell number-words.
      (2) **other** braille units with abstract letter-like function (asterisk, apostrophe).
2. **Grams** There are three kinds of grams: phonogram, morphogram, and logogram.
   a. **Phonogram**—a braille unit having a phonetic value that would be written in print by more than one alphabetic symbol. Phonograms include one-
      shape phonograms such as th, ch, gh, the ing in sing, the ea in read, the ed in bed, the ar in car. Phonograms also include multi-shapes such as ation in nation, the ound in sound, the ong in long, the ance in dance, the ity in pity, the ness in Tennessee, and the less in bless.
   b. **Morphogram**—a braille unit having the value of a word element i.e. inflectional ending, prefix, or suffix. Examples are the s in words, the ing in looking, the ed in looked, the ance in avoidance, the ation in admiration, the in inconsistent. Note that the shapes that make up ed, ing, ance, ity, etc., may appear as phonograms or morphograms, depending on their function in words.
   c. **Logogram**—a braille unit made up of one or more shapes having the value of a word with either a limited reference or no reference to the phonetic value in the word. There are 2 kinds of logograms: letter words and wordlets.
      (1) **Letter word**—a word sign that has a shape that also can be a letter. The words but, can, do, it, also have letter values.
      (2) **Wordlet**—one or more shapes carrying a word value but never a letter value. The words and, for, and with are examples of one-
   shape wordlets. The words day, name, had, word, know, one, character, through, these, are examples of multi-shape wordlets as are the abbreviational logograms known as short-form words for example about, after, (2 shapes), braille, herself, and together (3 shapes).

3. **Modulations**
   Modulations are of two kinds: punctuation, and register. These have values that do things to letters and grams.
   a. **Punctuation**. Within punctuation there are those which
      (1) **look back**—period, non-Spanish exclamation.
      (2) **enclose**—commas, parentheses, quotation marks.
      (3) **link**—hyphen, dash.
      Those which look back have as the domain of their force what has gone before; those which enclose both warn us of their application and close their domain as (1) does; those which link affect things on both sides.
   b. **Register**. This includes composition signs, looks forward, and may automatically specify where the scope terminates; such braille units are capital, italic, letter, number, and termination sign. These modify the basic segmental values of what follows; thus they have no separate segmental counterpart in print.
The above categories resulted from the analysis which has been outlined, and were then used as the framework and reference grid for constructing the instructional materials which have meantime been prepared and published. Additionally, these categories form a vehicle for explicit and unambiguous communication in the teaching situation between teacher and student and in the professional situation between teacher and teacher. It is with this in mind that terms for the categories have been devised with a minimum of jargon and a maximum of self-explaining ordinary-language clarity, while drawing on commonly used models in linguistic terminology for precision. Any somewhat technically flavored terms are intended not for primary use with the children, but as tools for teachers in their own transactions.

Preliminary results in the classroom and on the first rounds of testing show that the concepts and terms which have proved especially useful and effective with students as well as teachers include *shape*, *braille unit*, *wordlet*, and *letter word*.

Refining the Notion "Logogram"

The analysis given above was the minimum necessary to construct instructional materials of the desired clarity, sensitivity, and adequacy. It is possible—although this remains to be shown by experimental data—that the degree of refinement carried out above is both
sufficient and the maximum tolerable for certain primary aims. That is to say, it may be that further refinement in the discrimination of functional features may so proliferate categories and interrelations as to occlude the useful broad lines and important discriminations for certain major purposes. We certainly would advocate no such self-defeating result. Nevertheless, it is both possible and instructive to consider a further breakdown of the category logogram:

A. **Letter word** remains as defined above: a logogram with the shape of a letter.

B. **Wordlet** may now be subcategorized as:

1. **Sound word(let)**, a logogram that has a shape which is the same as that of a phonogram. Examples are *child*, *shall*, *this*, *out*, *enough*, *still*, *which*.

2. **Compound letter word(let)**, a multi-shape logogram with a letter shape preceded by one of a limited number of preposed (or prefixed) shapes. Examples are *day*, *here*, *mother*, *name*, *one*, *part*, *time*. Some of these are derived not from the simple letter, but from the letter word: *cannot*, *ever*, *had*, *know*, *many*, *young*.

3. **Compound sound word(let)**, a multi-shape logogram with a phonogram shape preceded by one of a limited number of preposed (or prefixed) shapes. Examples are *those*, *through*, *whose*, *where*, *character*, *ought*. 
The prefix in (2) and (3) is a shape with dot 5 with or without dot 4. It is possible to classify (1), (2), and (3) under A above, because they include shapes of letters or phonograms, and for this reason word(let) is written with a parenthesis. The set of (1), (2), and (3) may therefore be regarded as derived wordlets.

4. Simple wordlet, a single-shape non-derived logogram: and, for, with, of, the.

5. Compound wordlet, a multi-shape logogram with no simple derivation, e.g. there, these, their, of which a large subset is.

6. Sound keyed wordlet (traditionally known as short-form word), a compound wordlet who shapes recall portions of its initial, and perhaps final, letters and sounds. Examples are about, across, letter, such, must, little, braille, afterward.

7. Lower wordlet, a simple wordlet whose shape does not occupy the top dot positions, of which there are two kinds: separate--was, were, be, his, in, enough; and attached--to, by.
Analogously to (2) and (3) we may also discriminate among morphograms:

**Compound letter morphogram**, a multi-shape morphogram with a letter shape preceded by one of a limited number of preposed (or prefixed) shapes. Examples are ance, ful, sion, tion, ation, less, ness, ity.

**Compound sound morphogram**, a multi-shape morphogram with a phonogram shape preceded by one of limited number of preposed (or prefixed) shapes. Thus, throughout, throughway.

The prefix in the last two subtypes is a shape with dot 6 with or without dots 4 or 5. Note that all such braille unit prefixes are basically dot 5 or dot 6 shapes.

The notion of the **logogram** is probably the most easily grasped of these three for a native speaker of English with no technical linguistic training. The difficulties arise rather with the number of fine grained idiosyncrasies which crop up and the problem of deciding how far an overt analysis should go or when the analytic and learning effort ceases to yield worthwhile results. Decisions on these last matters will ultimately best be made on the basic of classroom and user experience. Our concern for the time being has been focused mostly upon making as many distinctions as seem necessary to bring out all categories of organization and function within the braille code, and making these distinctions available along with the reasoning that justifies them.
References


Footnotes

1 In this discussion when we mention "the (braille) code" we refer to the variety known as "literary braille."

2 Our analysis below presents a different way of viewing the relations traditionally called "contraction."

3 We refine this notion below.

4 It will be seen below that our view of logograms induces a reassessment of the inevitability of selective and systematic whole-word approach.

5 Represented in the International Phonetic Alphabet by a Greek Theta (Θ).

6 See for example the classic exposition, Ferdinand de Saussure, Course in General Linguistics, 1916 (translated by Wade Baskin, 1959 (p. 65-7). It is interesting to note that this much exploited theoretical relation of modern linguistics represented in origin an adaptation from medieval grammatical theory.

7 In conversation about the work reported on Victor H. Yngve has drawn our attention to a paper of his which discusses Braille in a linguistic context: "Automatic machine translation: potentialities for braille encoding," in Proceedings of the International Congress on Technology and Blindness, Volume I William Byrd Press, 1983), Section III, pp. 393-402. Though the state of the art has changed considerably since the date of that paper, Yngre discusses interestingly and succinctly the fundamentally linguistic considerations that make braille encoding (i.e. the conversion of print into braille test) an analog of
the problem faced by attempts at machine translation of languages and
a hugely difficult problem in precise and complete formalization (i.e.
automation). It is worth pointing out that the task which Yngve pro-
poses is very different from that which we have addressed.

We have been concerned to establish taxonomically entitles which
we all braille units, their functions and functional classes. These
braille units may be viewed as partial parallels to phonemes and mor-
phemes in certain versions of "Structural linguistics." An important
use for braille units lies in their serviceability as a basic notion
and calibration in the teaching of braille and the design of teaching
and learning materials. Our taxonomy at the present time is still in
a rudimentary stage; though this state--however provisional in detail--
is a fundamentally essential step in understanding this sign system.

Ultimately, we must explore the degree to which (and conditions
under which) morphograms should be collapsed and hierarchized under
phonograms, on the one hand, and logograms, on the other. We have
alluded informally to this question by remarking above on the non-pro-
liferation of morphograms through the combination of logograms with
affixes. Tests toward these aims are already under way.

Now the question which concerns Yngve is to put it in the frame
of reference which we have defined above, the complex of semantic,
syntactic and phonological (i.e. syllabic) factors--all of these being
purely linguistic factors--that governs the choice between letters and
grams when going from print to braille. This is acknowledged to be a
complex and difficult (nearly insoluble) problem, in algorithmic terms.
It should finally be noticed prominently that this problem of print-to-braille conversion is a different one from that of going from internal language to braille, which is of course the process observed in and important to the blind user of braille. It is this last consideration which is one side of the coin central to our own interests and work.
Appendix A

Outline of Braille Terms--Examples

1. Letters

a. Alphabetic letters (26)

b. Non-alphabetic letters (12)

(1) 0-9
decimal point
fraction bar

(2) Other braille units with abstract letter-like function

accent sign
apostrophe
asterisk
ellipsis
hyphen or dash--when used to indicate missing letters in words

2. Grams

a. Phonograms

ally (Sally) en (pen)
ance (dance) ence (fence)
and (sand) er (certain)
ar (car) ever (several)
ation (nation) ff (duffle)
bb (rubber) for (forrest)
ble (table) ful (awful)
cc (occur) gg (suggest)
ch (chair) gh (ghost)
com (come) here (adhere)
con (contrary) in (pin)
dd (paddle) ing (sing)
dis (dispel) ity (city)
ea (read)
ed (red)
b. Morphograms

<table>
<thead>
<tr>
<th>Word</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>after</td>
<td>(afterlife)</td>
</tr>
<tr>
<td>ally</td>
<td>(mathematically)</td>
</tr>
<tr>
<td>ance</td>
<td>(avoidance)</td>
</tr>
<tr>
<td>and</td>
<td>(multiplicand)</td>
</tr>
<tr>
<td>ar</td>
<td>(secular)</td>
</tr>
<tr>
<td>ation</td>
<td>(admiration)</td>
</tr>
<tr>
<td>be</td>
<td>(befriend)</td>
</tr>
<tr>
<td>com</td>
<td>(commiserate)</td>
</tr>
<tr>
<td>con</td>
<td>(confuse)</td>
</tr>
<tr>
<td>dis</td>
<td>(disengage)</td>
</tr>
<tr>
<td>ed</td>
<td>(rubbed)</td>
</tr>
<tr>
<td>ence</td>
<td>(providence)</td>
</tr>
<tr>
<td>er</td>
<td>(zipper)</td>
</tr>
<tr>
<td>ful</td>
<td>(wonderful)</td>
</tr>
<tr>
<td>here</td>
<td>(cohere)</td>
</tr>
<tr>
<td>in</td>
<td>(indecent)</td>
</tr>
<tr>
<td>ing</td>
<td>(singing)</td>
</tr>
<tr>
<td>ity</td>
<td>(rarity)</td>
</tr>
<tr>
<td>less</td>
<td>(useless)</td>
</tr>
<tr>
<td>ment</td>
<td>(ornament, monument)</td>
</tr>
<tr>
<td>ness</td>
<td>(openness, oneness)</td>
</tr>
<tr>
<td>sion</td>
<td>(aversion, confusion)</td>
</tr>
<tr>
<td>some</td>
<td>(loathsome)</td>
</tr>
<tr>
<td>through</td>
<td>(throughout, throughway)</td>
</tr>
<tr>
<td>tion</td>
<td>(reaction, prediction)</td>
</tr>
<tr>
<td>th</td>
<td>(seventh)</td>
</tr>
<tr>
<td>there</td>
<td>(therefore)</td>
</tr>
</tbody>
</table>


c. Logogram

(1) Letter word

<table>
<thead>
<tr>
<th>Word</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>as</td>
<td>like will</td>
</tr>
<tr>
<td>but</td>
<td>more it</td>
</tr>
<tr>
<td>can</td>
<td>not you</td>
</tr>
<tr>
<td>do</td>
<td>people</td>
</tr>
<tr>
<td>every</td>
<td>quite</td>
</tr>
<tr>
<td>from</td>
<td>rather</td>
</tr>
<tr>
<td>go</td>
<td>so</td>
</tr>
<tr>
<td>have</td>
<td>that</td>
</tr>
<tr>
<td>just</td>
<td>us</td>
</tr>
<tr>
<td>knowledge</td>
<td>very</td>
</tr>
</tbody>
</table>

(2) Wordlet

<table>
<thead>
<tr>
<th>Word</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>about</td>
<td>always cannot ever know</td>
</tr>
<tr>
<td>above</td>
<td>and character father herself</td>
</tr>
<tr>
<td>according</td>
<td>be child first himself</td>
</tr>
<tr>
<td>across</td>
<td>because children for itself</td>
</tr>
<tr>
<td>after</td>
<td>before conceive friend thyself</td>
</tr>
<tr>
<td>afternoon</td>
<td>behind conceiving good myself</td>
</tr>
<tr>
<td>afterward</td>
<td>below could great yourself</td>
</tr>
<tr>
<td>again</td>
<td>beneath day had oneself</td>
</tr>
<tr>
<td>against</td>
<td>beside deceive here ourselves</td>
</tr>
<tr>
<td>almost</td>
<td>between deceiving him themselves</td>
</tr>
<tr>
<td>already</td>
<td>beyond declaring his yourselves</td>
</tr>
<tr>
<td>also</td>
<td>blind declaring immediate</td>
</tr>
<tr>
<td>although</td>
<td>braille either in</td>
</tr>
<tr>
<td>altogether</td>
<td>by enough its</td>
</tr>
</tbody>
</table>
3. Modulations

a. Punctuation

(1) look back

<table>
<thead>
<tr>
<th>Colon</th>
<th>Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comma</td>
<td>Question mark</td>
</tr>
<tr>
<td>Exclamation point</td>
<td>Semicolon</td>
</tr>
</tbody>
</table>

(2) enclose

<table>
<thead>
<tr>
<th>Bracket or brace (in pairs)</th>
<th>Comma (in pairs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parenthesis (in pairs)</td>
<td>Quotation marks, single (in pairs)</td>
</tr>
<tr>
<td>Quotation marks, double (in pairs)</td>
<td></td>
</tr>
</tbody>
</table>

(3) link

<table>
<thead>
<tr>
<th>Bar</th>
<th>Long dash</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bracket or brace (one)</td>
<td>Hyphen</td>
</tr>
<tr>
<td>Dash</td>
<td></td>
</tr>
</tbody>
</table>

b. Register

<table>
<thead>
<tr>
<th>Capital sign, single</th>
<th>Letter sign</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital sign, double</td>
<td>Number sign</td>
</tr>
<tr>
<td>Italic sign, single</td>
<td>Termination sign</td>
</tr>
<tr>
<td>Italic sign, double</td>
<td></td>
</tr>
</tbody>
</table>