# Amodal Morphology. Applications to Brahmic Scripts and Canadian Aboriginal Syllabics

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*Abstract.* The discovery of grammar in sign language in the late twentieth century led to the realization that grammar is amodal. Increasingly, writing is being considered a third (admittedly derivative) modality of language, with written signs possessing grammar. Most such work has thus far focused on phonological structures such as graphic syllables and feet, but this paper argues that written signs also have morphology. Morphological analyses of Chinese characters (Hànzì) and of Maya glyph blocks are cited, and new analyses of Brahmic scripts and Canadian Aboriginal Syllabics are presented. Just as the modality of sign languages affects the expression of their grammar, the written modality of scripts affects their grammatical expression. Specifically, they are designed to be processed spatially and as such have some morphological characteristics in common with sign languages. The consonant and vowel schemas of the Canadian Aboriginal Syllabics family of scripts are interpreted here as analogs of the so-called ion-morphs of American Sign Language.

## 1. Introduction

The first two decades of the twenty-first century found an increasing number of scholars (e.g., Baroni (2015), Meletis (2020), Myers (2019), and Primus (2004)) arguing that writing is a true—if derivative—modality of language and that scripts have grammars that can insightfully be analyzed with linguistic tools.[1] This is despite obvious differences between writing and primary language such as the universality and automatic acquisition of primary language and the relatively recent invention of writing (for summaries of the arguments against writing being language see, e.g., Daniels (2018, pp. 183–187) and Gnanadesikan (2021b, pp. 106–108)). In aiming to resolve the tension between the differences between primary

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language and writing systems on the one hand and their similarities on the other, I have elsewhere argued that "language is indeed cognitively special but that this specialness lies not so much in being unique but in being overpowering" (Gnanadesikan, 2021b, p. 118), with the result that over time writing becomes language, both phylogenetically (historically) and ontogenetically (in the life of a literate person).

The argument for writing as a modality of language has been made plausible by a foundational discovery of the twentieth century, namely that the human capacity for language is essentially amodal. That is, (primary) language can be either signed or spoken, with signed languages having the same complexity of grammar as that found in spoken language. The discovery of complex grammar in sign language was not a foregone conclusion for researchers at the time. In an admission that is startling to read in hindsight, Edward Klima and Ursula Bellugi state in their classic book *The Signs of Language* that they "did not begin by assuming that A[merican] S[ign] L[anguage] had a grammar..." (Klima and Bellugi, 1979, p. 3). However, "American Sign Language turned out to be in fact a complexly structured language with a highly articulated grammar, a language that exhibits many of the fundamental properties linguists have posited for all languages. But the special forms in which such properties are manifested turn out to be primarily a function of the visual-gestural mode" (ibid., p. 4).

Once the amodal nature of language is accepted and its implications absorbed, the discovery of grammatical structures in scripts should perhaps not be surprising. Indeed, as James Myers has stated, "[A]n amodal capacity for grammar would not only explain sign languages but would also predict that grammar should appear beyond both speech and sign..." (Myers, 2019, p. 22). However, just as signed languages were found to have special properties because of the visual-gestural mode in which they operate, written languages can be expected to be influenced by their modality in their choice and expression of grammatical structures.

Searching for written correlates of grammatical structures found in spoken languages has been a productive line of research in recent years. Thus a number of studies have found correlates of phonological structures in writing systems, such as graphic features (Primus, 2004), graphematic syllables (Fuhrhop, Buchmann, and Berg, 2011; Myers, 2021), and graphematic feet (Evertz, 2018; Evertz and Primus, 2013). This paper argues that there are also correlates of morphological structures in writing systems. In making this argument I follow Beatrice Primus, who has described the letters of the Roman alphabet as "made of syntagmatically concatenated smaller units. Loosely speaking, they resemble morphemes rather than phonemes" (Primus, 2004, p. 240). A second point of resemblance between written signs (or graphemes) and morphemes is that they are both signs, with a signifier and a signified, unlike phonemes, which are meaningless except in combination

(Meletis, 2020, p. 202). As a result, finding morphological structure in written signs should perhaps not be too surprising. In this paper I argue that not only are there correlates of spoken morphological structures to be found in the structure of written signs, but there are also correlates of specifically sign language structures. This claim also stands to reason, given both the amodality of language and the shared visual nature of the signed and written modalities.

Before continuing, it is best to consider briefly what is meant by morphology in spoken language. Morphology as a study is "the branch of linguistics that deals with words, their internal structure, and how they are formed" (Aronoff and Fudeman, 2011, p. 1). As part of the mental grammar, it is "the mental system involved in *word* formation" (ibid., 1, bold in original). Morphemes can be stems or affixes. Affixes include prefixes, suffixes, infixes, and circumfixes. Morphology can be inflectional (which produces a word whose basic meaning is not changed from the core meaning of the stem) or derivational (which does change the core meaning of the stem and may change the lexical category of the resulting word). Derivational morphology may be accomplished via compounding, affixation, or zero derivation. Other minor ways to derive new lexemes include blending/portmanteaus, acronyms, clipping, and backformation (ibid.). In considering the existence of morphological analogs in writing, the important abstraction to make is to replace the concept of *word* in the foregoing paragraph with *sign*. Words are signs, with a form and a meaning, and often with internal structure (morphology). Written signs are also signs, with a form and an interpretation, or meaning—and often with internal structure. Once the abstraction of *word* to *sign* made, the morphological analysis of written signs can begin.

The rest of this paper is structured as follows. Section 2 reviews Myers' (2019) analysis of morphemic structure in Chinese characters, while Section 3 reviews the conventional analysis of the structure of Maya glyph blocks, which can also be seen as being essentially morphemic. Section 4 applies a morphemic analysis to the scripts of the Brahmic family, arguing for stem-and-affix structures and compounds in the complex aksharas of those scripts. Section 5 presents the concept of ion-morphs in American Sign Language formulated by Fernald and Napoli (2000) and applies this concept to the analysis of scripts in the Canadian Aboriginal Syllabics family, notably Carrier. Section 6 concludes.

## 2. Previously Identified Morphology in Script: Chinese characters

The characters of Chinese script (Hànzì) are famous for encoding syllable-sized morphemes in Chinese (Myers, 2019, p. 2), leading to typological classifications of the script as morphographic (Daniels, 2018,

p. 85) or morphosyllabic (DeFrancis, 1989, p. 115).[2] Most characters in the script are complex, usually composed with a so-called radical or semantic component, which provides a clue to the semantic field of the morpheme, and a phonetic component, which gives a clue to the pronunciation of the syllable. Myers (2019) analyzes these complex Hànzì characters as having morphemic structure, with the semantic radicals being akin to affixes.

For example, the character < 妈 > *mā* 'mother' (using here simplified characters as used in mainland China) has two components although the character as a whole represents a monomorphemic word. One component, the so-called radical, is < 女 > *nǚ* 'female', which gives a clue to the semantic class of the represented morpheme. The other component is < 马 > *mǎ* 'horse', which gives a clue to the pronunciation of the syllable. Such composite characters are usually referred to as semantic-phonetic compounds, but as Myers analyzes them, they are structurally composed of a stem and affix. The semantic radical plays the role of an affix (or affix-like morpheme correlate, despite the apparent implications of root-hood inherent in the traditional term *radical*), as it belongs to a closed class of signs, is semantically bleached, and often occurs in reduced, bound form (ibid., § 2.3.1). A composite character can itself form the phonetic component of another character. In other words, an affixed character may take further affixes, just as a stem-affix structure in a spoken language may take additional affixes. Myers identifies the semantic radicals/affixes as inflectional on the grounds that they are the only character components that display any (although limited) agreement: in the rare cases where a morpheme is disyllabic and represented with two characters, the radicals of the two characters will match (p. 64).

Myers also identifies compounds among complex characters, such as < 杲 > *gǎo* 'bright', which is composed of < 日 > *rì* 'sun' and< 木 > *mù* 'tree'. In such a case, neither one of the character components is reduced with respect to the other, and they belong to a more open class and display less semantic bleaching than semantic radicals. Thus Myers identifies such composites as compounds (ibid., § 2.3.2). Another morphological structure that Myers identifies in composite characters is reduplication, for example in < 多 > *duō* 'many', which is composed of two instances of < 夕 > *xī* 'evening' (ibid., § 2.3.3).

The morphological analysis of Hànzì characters is entirely independent of both the morphological nature of the Chinese language (which in fact employs very little inflectional morphology) and of the morphographic nature of how the script encodes the spoken language. Rather, bi- or polymorphemic characters stand for lexical items which have

2. As used in Japanese, however, the characters encode morphemes that are not necessarily syllable-sized. In the Japanese use of kanji, the characters more clearly represent morphemes rather than syllables (Joyce, 2011).

no internal morphological structure. Thus the morphological structure here is entirely a characteristic of the *script* and implies nothing about the *language* (in which complex morphological structures, usually compounds, are represented with sequences of characters). For clarity I refer to the graphic analog of morphology in the script as G-morphology henceforth and the lexical morphology in the language as L-morphology.

As the use of inflectional morphology in Hànzì demonstrates, the presence of a grammatical feature in G-morphology does not depend on its existence in the L-morphology of the corresponding spoken language. In other words, the human instinct for grammar directly influences the form of writing systems independently of its influence on primary (spoken or signed) language.

## 3. Previously Identified Morphology in Script: Maya glyph blocks

The classic Maya script is an extinct morphosyllabic script of Mesoamerica whose signs are conventionally referred to as *glyphs*. The individual signs may stand for lexical morphemes (of shape CVC or CVCVC) or for syllables (of shape CV), which may function as phonetic complements or as the sole spelling of either lexical morphemes or grammatical affixes. A single sign or two or more signs combined together form a *glyph block*, whose major constituent is known as the *main sign* (Law and Stuart, 2017, pp. 130–133). Smaller, narrower signs arranged around the edges of a main sign are conventionally known as affixes (Montgomery, 2002, pp. 43–45), though perhaps with no theoretical grapholinguistic intent. Glyph blocks are often, but not always, arranged in double columns (from left to right) in texts.

The smaller signs known as affixes in the Maya script may occur to the left, right, top, or bottom of the main sign and are known as prefixes, postfixes, superfixes, and subfixes accordingly. The order of reading is usually (but not invariably) prefix, superfix, main sign, postfix, subfix. Glyph blocks may contain only syllabic signs, only morphographic signs, or (as is often the case) some combination of the two. Figures 1 through 3 show examples of the composition of glyph blocks.

If we consider the main signs to be graphic stems and accept the affixes as true graphic affixes, then a morphological analysis of Maya glyph blocks is already done. There is some relationship between the L-morphology of Classic Mayan and the G-morphology of glyph blocks in that "a single glyph block rarely contains incomplete portions of two different morphemes" (Law and Stuart, 2017, p. 130). However, a single word can span more than one glyph block, and a single glyph block may

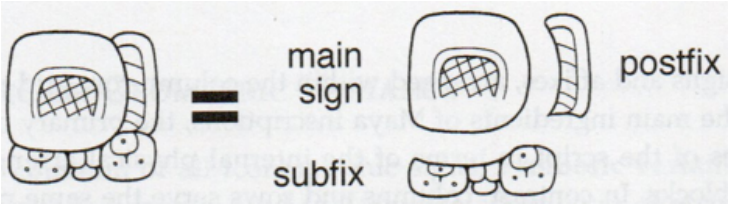


FIGURE 1. An example of a Maya glyph block composed of three syllabograms (from Montgomery (2002, p. 43), used with permission). The main sign reads /pa/, the postfix reads /ka/, and the subfix reads /la/, for a complete reading of *pakal* 'shield'.

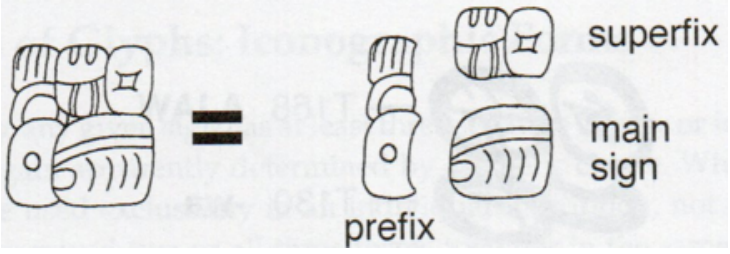


FIGURE 2. An example of a Maya glyph block composed of two syllabograms and a morphogram (from Montgomery (2002, p. 43), used with permission). The prefix reads /ti/, the superfix reads *AJAW* (a morphogram), and the main sign reads /le/, for a complete reading of *ti ajawle(l)* 'in office'.

contain a whole phrase (as in Figure 2). The main sign is often a morphogram (as in the left two examples in Figure 3) but it may also be a syllabogram (as in Figure 1 and 2 and the rightmost example in Figure 3). The G-affixes are often syllabograms but can also be morphograms, especially numerals. Significantly, main signs (G-stems) do not necessarily represent L-stems and the G-affixes do not necessarily represent L-affixes. In other words, the G-morphology is not a mere reflection of the L-morphology. Instead, it is an analog of morphology, independently produced by the human language faculty.

What is not so clearly analogous to L-morphology in the structure of Maya glyph blocks is the presence of superfixes and subfixes in addition to the more familiar prefixes and postfixes (which could just as easily have been called suffixes). However, the addition of more affix types is merely the expression of affixation in two-dimensional space. Unlike a spoken signal, which unfolds in one-dimensional, unidirectional time, a written message is two dimensional. Rather than considering the different structures that arise from differences in modality between speech and glyphs as evidence against the linguistic nature of scripts, we should


FIGURE 3. Three ways to write *usiij* 'vulture' in Maya glyphs, with a simple glyph block on the left, a complex glyph block with a morphographic main sign and three syllabic phonetic complements as G-affixes in the middle, and a complex glyph block with purely syllabic spelling on the right (from Law and Stuart (2017, p. 131), used with permission).

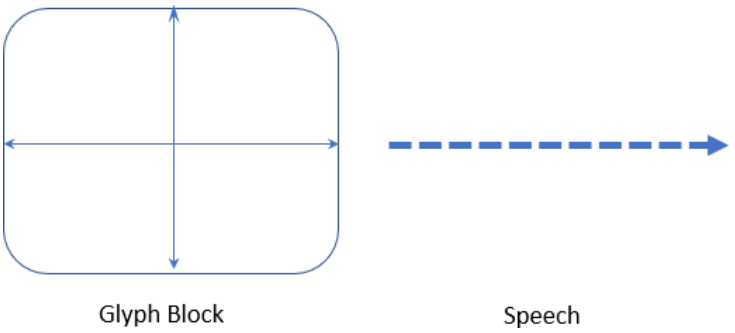


FIGURE 4. A schematic representation of the two-dimensional arrangement of Maya glyph blocks as compared to the one-dimensional, unidirectional arrangement of speech

in fact expect a difference in modality to affect the expression of grammar, as it does in the difference between signed and spoken language.

Glyph blocks may also display morphological structures that are less common but still well known from L-morphology: fusion, analogous to blends in L-morphology (like *smog* or *brunch*), and infixation. A glyph block composed with infixation is shown in Figure 5.

The two writing systems discussed in this section and the previous one are heavily morphographic, with Hànzì characters usually representing monosyllabic morphemes (when used in Chinese) and individual Maya glyphs representing either a syllable or a morpheme. Although the G-morphological structures of the written signs presented in this section do not reflect the L-morphological structure of the words of the relevant languages, it is perhaps no great stretch for readers of these scripts to think of the structure of the complex signs in these scripts in

FIGURE 5. Infixation in Maya glyph blocks. The main sign is a morphogram reading *CHUM* and the infix is a syllabographic phonetic complement reading /mu/ for a full reading of *chum* 'zero' (from Montgomery (2002, p. 42), used with permission).

terms of morphology—as witnessed by the traditional terminology of affixes in Maya glyph blocks. The next two sections, however, expand the concept of G-morphology to more fully phonographic scrips—the Brahmic scripts of South and Southeast Asia and the Canadian Aboriginal Syllabics script family of North America—where morphology is perhaps less expected but arguably just as present.

## 4. Morphology in Script: Brahmic Scripts

The Brahmic scripts are a family of scripts used in South and Southeast Asia which includes Devanagari (used for Hindi, Nepali, and Marathi), Bengali, Gujarati, Oriya, Gurmukhi (used for Punjabi), Tibetan, Tamil, Kannada, Telugu, Malayalam, Sinhalese, Burmese, Thai, Lao, and Khmer, as well as numerous unofficial and/or historical scripts in the area. Although there is a certain amount of variation in the design and use of these scripts, they share descent from the ancient Brāhmī script and the design feature of the akshara as an organizing unit. Simple, primary signs (aksharas) either represent consonants, often accompanied by a default or "inherent" vowel, or initial vowels. Vowels other than the default vowel (when not initial) are written as satellites above, below, to the right, to the left, or surrounding the consonantal sign (Gnanadesikan, 2021a).

Table 1 illustrates Devanagari as used for modern Hindi (Bright, 1996b; Snell and Weightman, 1989). The first four rows list the simple aksharas, with the independent vowel letters (V) in the first row and the consonants (Ca, with inherent vowel) in the second through fourth rows. The fifth row illustrates the addition of satellite vowel signs to consonants to form complex CV aksharas, and the sixth row illustrates the combination of consonants to form complex CCa aksharas. The final row illustrates complex aksharas that both combine consonants and add a satellite vowel sign (CCV).

Considering the structure of Devanagari and related scripts through the lens of morphology, the consonants (and independent vowels) can

TABLE 1. Devanagari as used for modern Hindi, accompanied by the conventional transliteration. The first four rows list the simple aksharas of the script while the last three rows give a sample of complex aksharas that include satellite vowels, conjunct consonants or both.

| अ | आ | इ | ई | उ | ऊ | ऋ | ए | ऐ | ओ | औ | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | ā | i | ī | u | ū | ṛ | e | ai | o | au | | |
| क | ख | ग | घ | ङ | च | छ | ज | झ | ञ | | | |
| ka | kha | ga | gha | ṅa | ca | cha | ja | jha | ñ | | | |
| ट | ठ | ड | ढ | ण | त | थ | द | ध | न | | | |
| ṭa | ṭha | ḍa | ḍha | ṇa | ta | tha | da | dha | na | | | |
| प | फ | ब | भ | म | य | र | ल | व | श | ष | स | ह |
| pa | pha | ba | bha | ma | ya | ra | la | va | śa | ṣa | sa | ha |
| क | का | कि | की | कु | कू | कृ | के | कै | को | कौ | | |
| ka | kā | ki | kī | ku | kū | kṛ | ke | kai | ko | kau | | |
| ब्य | क्र | क्ल | ल्क | ट्ट | प्र | श्ल | स्क | स्व | स्म | न्य | ष्ट | त्त्व |
| bya | kra | kla | lka | ṭṭa | pna | śla | ska | sva | sma | nya | ṣṭa | ttva |
| ब्या | क्री | क्ले | ल्कु | ट्टू | प्नि | श्लो | स्कृ | स्वै | स्मा | न्यौ | ष्टि | च्छे |
| byā | krī | kle | lku | ṭṭū | pni | ślo | skṛ | svai | smā | nyau | ṣṭi | cche |

be seen as stems and the satellite vowels as affixes. Because of the two-dimensional nature of the written modality, the vowel affixes can appear anywhere around the consonant stems, including above or below them (as in <के> /ke/ and <कु> /ku/), not just before or after the stems as in spoken prefixes and suffixes. In other words, the structure of Devanagari aksharas resembles the structure of Maya glyph blocks, with a main sign and optional prefixes, superfixes, postfixes, and subfixes.

Can we assign the affixes to the category of inflectional or derivational? Arguably, yes. Because the vowel affixes do not alter the fundamental identity of the consonantal main sign, or stem, we can consider the satellite vowel affixes to be inflectional affixes. Considered in this way, the inherent vowel is analogous to a default inflection which may occur without the addition of an affix in L-morphology to express categories such as singular number or nominative case. Thus, rather than being a typological oddity, the inherent vowel is in good morphological company.

Derivational morphology may be seen in another aspect of the script. In order to write phonemes that were not part of the Sanskrit inventory but which have been added as the result of historical change or lexical borrowing, Hindi adds a diacritic dot. Since this dot alters the identity of the consonant, it can be considered a derivational affix.

TABLE 2. Derivational morphology in Devanagari. Adding the diacritic dot to the aksharas on the left produces those on the right, with changes to the value of the consonants.

| | | | |
|---|---|---|---|
| क | ka | क़ | qa |
| ख | kha | ख़ | kha (/xa/) |
| ग | ga | ग़ | ga (/ɣa/) |
| ज | ja | ज़ | za |
| ड | ḍa | ड़ | ɽa (/ɽa/) |
| ढ | ḍha | ढ़ | ɽha (/ɽʰa/) |
| फ | pha | फ़ | fa |

Devanagari also provides examples of compounding. These are the cases in the last two rows of Table 1, in which two or more consonants are represented by a complex akshara. When, for example, <ब> /ba/ and<य> /ya/ combine, the result is <ब्य> /bya/. The left-hand member of the consonant conjunct is usually somewhat reduced (a notable exception being conjuncts ending with <र> /ra/, which reduce the right-hand member), yielding what we can describe morphologically as a right-headed compound. As expected under this analysis, the left-hand (non-head) member does not receive default inflection (the inherent vowel) but the right-hand member (the head) does if it does not take an inflecting affix (i.e., vowel sign). Thus there is a single default vowel for the conjunct, rather than two.

Other Brahmic scripts provide examples of other morphological structures and processes. In the Kannada script, used for the Kannada language of South India, the conjunct consonants form left-headed rather than right-headed compounds. When two consonants are joined to form a complex akshara in Kannada, the first one remains full size and is the attachment point for satellite (affixed) vowels, while the second one is reduced (Bright, 1996a). Many conjunct consonants represent geminate (double) consonants, but when the two consonants are distinct, it is clear that it is the second one that is reduced and the first one to which the vowel is attached.[3] Examples are shown in Table 3, where the first row displays some simple consonantal aksharas (with default vowel), the second line shows those same consonants with an affixed vowel (the /e/ vowel is a small curl added at the top of the consonant), and the third line shows conjunct consonants, with and without an affixed vowel.

3. As is commonly the case in Brahmic scripts, consonant clusters of which the first element is /r/ are written differently than other clusters, so conjuncts representing rC clusters in Kannada are an exception to the left-headed generalization given above (Bright, 1996a).

TABLE 3. Examples of simple (top row) and complex aksharas in Kannada. The middle line shows CV aksharas, while the third line shows aksharas with conjunct consonants.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| ತ | ta | ಯ | ya (/ja/) | ಜ | ja (/ʤa/) | ಞ | ña (/ɲa/) |
| ತೆ | te | ಯೆ | ye | ಜಾ | jā | ಞಾ | ñā |
| ತ್ಯ | tya | ತ್ಯೆ | tye | ಜ್ಞ | jña | ಜ್ಞಾ | jñā |

TABLE 4. The sign <ಕ> /ka/, shown alone (top row, far left) and with each satellite vowel added

| | | | | | |
|---|---|---|---|---|---|
| க | கா | கி | கீ | கு | கூ |
| ka | kā | ki | kī | ku | kū |
| கெ | கே | கை | கொ | கோ | கௌ |
| ke | kē | kai | ko | kō | kau |

In the Tamil script, used for the Tamil language of South India and Sri Lanka, we see circumfixes, the operation of stem-conditioned allomorphy, and two distinct levels of affixation. In Tamil script there are no conjunct consonants, unlike in Devanagari (or Kannada). The vowels are, as in Devanagari, added to the left, to the right, above, or below the consonant, with the additional detail that some satellite vowels have two parts, one of which appears to the left and one of which appears to the right of the main consonant sign. The sign <ಕ> /ka/, with the addition of the various vowels signs, is shown in Table 4 (Steever, 1996).

As shown at the bottom right in Table 4, the signs for the vowels /o/, /ō/ and /au/ are circumfixes, with one part of the vowel written before and one part written after the consonant main sign. Circumfixed vowels are common in Brahmic scripts, occurring in Oriya, Bangla, Malayalam, Sinhala, Burmese, Khmer, Lao, and Thai (Gnanadesikan, 2021a). Some other Brahmic scripts (such as Kannada) that do not place any vowels to the left of a consonant still have two-part vowels, with one part written above and one part written to the right of a consonant. Circumfixes are rare in L-morphology, and it has been suggested that they are best analyzed as a simultaneous application of a prefix and a suffix. Whatever their ideal analysis, however, they do occasionally occur (Aronoff and Fudeman, 2011, p. 3). And whatever their ideal analysis (two morphemes or one), an analogous analysis can be applied to the Tamil circumfixed vowels. The fact that circumfixed vowels are quite common in Tamil and many other Brahmic scripts can be seen as a case of modality influencing the expression of grammar. Writing is not as unidirectional as speech, in that a sign or word that has been written or read is still present when the next word or sign is being written or read. Lookback is thus easily accomplished in the written modality, unlike in speech.

Easy lookback would understandably make disjoint signs less dispreferred than they are in speech. Thus G-morphology presents us with structures familiar from spoken, lexical morphology but with added options for affix placement (including above and below) and greater comfort with disjoint signs

Another feature of Tamil aksharas is allography of vowel signs triggered by the shape of the consonant, which in a morphological analysis is stem-conditioned allomorphy. The satellite sign for the vowel /u/ has three different allographs, depending on the consonant sign (G-stem) to which it attaches. As shown in Table 5, the sign representing the vowel /u/ can be a curve that starts on the bottom right of the main sign, passes under the main sign and emerges on the left. Or it can start on the bottom right of the main sign, pass under the main sign and reverse course to emerge back on the right. A third option is for it to be simply a short vertical line under the right-hand side of the main sign. The Cu aksharas in Table 5 are accompanied by their unaffixed Ca stems in parentheses to allow comparison of the affixed and unaffixed forms. While it is difficult to state fully and exactly the properties of the stems that condition the allomorphy, some generalizations are clear. The downward curving tail on <த> /ta/, <ந> /na/, and <ற> /r̲a/ triggers the reversing allomorph (second row). Stems whose right edge is a vertical line without an overhang (i.e., <ங> /ṅa/, <ப> /pa/, <ய> /ya/ ,and <வ> /va/, but not <ன> /n̲a/ due to the overhang) all share the subfixed vertical line (third row).

Table 5. Allography in the satellite sign for the vowel /u/ in Tamil. The basic Ca aksharas are shown in parentheses after each Cu akshara for comparison.

| | | | | | | |
|---|---|---|---|---|---|---|
| கு (க)<br>ku | டு (ட)<br>ṭu (/ʈu/) | மு (ம)<br>mu | ரு (ர)<br>ru | லு (ழ)<br>l̲u | ளு (ள)<br>ḷu (/ɭu/) | |
| ஞு (ஞ)<br>ñu (/ɲu/) | ணு (ண)<br>ṇu (/ɳu/) | து (த)<br>tu | நு (ந)<br>nu (/n̪u/) | லு (ல)<br>lu | று (ற)<br>r̲u | னு (ன)<br>n̲u |
| ஙு (ங)<br>ṅu (/ŋu/) | சு (ச)<br>cu (/ʧu/) | பு (ப)<br>pu | யு (ய)<br>yu (/ju/) | வு (வ)<br>vu | | |

The allography in Tamil script shown in Table 5 is analogous to allomorphy in affixation such as the English plural allomorphy exemplified by *dogs*, *cats*, and *horses*, in which the English plural takes the form [s], [z] or [əz] depending on the voicing and/or sibilance of the final segment of the stem. Like the English plural, the Tamil script /u/ affix is sensitive to the shape of the stem.

The G-affix representing /ū/ has similar allomorphy. Other vowel affixes have historically had allomorphy as well, but it has largely been eliminated. It is significant that the affixes that continue to display al-

lography/allomorphy are ones that are tightly connected to their stems. Tamil vowel affixes can be divided into two groups: those that are graphically connected to their stems and those that have a space. Looking back at Table 4, it can be seen that the affixes for /u/, /ū/, /i/ and /ī/ are tightly connected to the main sign while the rest do not touch the main sign. While it may be tempting—because of the gap—to consider these latter vowel signs as something other than proper affixes, they are nevertheless dependent, bound signs that do not occur without an accompanying consonantal main sign (with the exception of the second half of the <◌ௌ> /au/ sign, which happens to be homologous with the simple akshara ள /ḷa/). I would argue that the difference between the two types of vowel signs can be accounted for by considering the Tamil script as containing two levels of affixes. This division of the morphology into two levels is a phenomenon familiar from English morphology, in which Level 1 (or primary) affixes such as the prefix *in-* occur closer to the stem and involve more allomorphy than Level 2 (or secondary) affixes such as the prefix *un-* (Aronoff and Fudeman, 2011, p. 86). In Tamil script, the /u/, /ū/, /i/ and /ī/ signs are the tightly bound Level 1 affixes, and the others are the less tightly bound Level 2 affixes.

In summary, the Brahmic scripts provide many opportunities to see analogs of morphology in the structure of written signs, including stem-affix structures, stem-conditioned affixal allomorphy, both derivational and inflectional affixes, both left- and right-headed compounds, and a division of the affixes into two levels.

## 5. Ion-Morphs in American Sign Language and Carrier Syllabics

The analogs to morphology that have been presented in this paper so far have been analogous to the morphology of spoken language. However, if we remember that morphology, like other parts of grammar, is essentially amodal, we should expect to find correlates not just of spoken morphology but of *signed* morphology. This section shows that such analogs do in fact exist.

In signed languages, affixation is rare and other morphological relations dominate (Johnston, 2006). American Sign Language (ASL), for example, has been found to have only one affix (Liddell and Johnson, 2011, p. 329). However, that does not mean that there are no systematic relations between words. One notable property of the lexicon of ASL is the existence of lexical families whose members are related via commonalities in how the signs are made. For example, a lexical family of signs will share two or three of the four manual articulatory parameters (hand configuration, movement, place of articulation, and orientation) while varying one or two of the parameters. Thus the lexical family that includes FAMILY, CLASS, TEAM, GROUP, ASSOCIATION, and SOCIETY

shares movement, orientation, and place of articulation but varies the hand configuration (Fernald and Napoli, 2000). Some of these signs are shown in Figure 6 (by convention, glosses of signs are shown in small capitals).

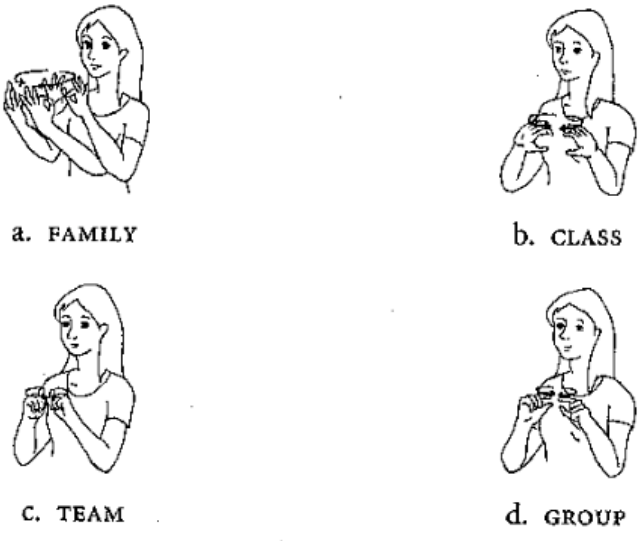


FIGURE 6. Part of the lexical family of signs relating to social groups in ASL (from Fernald and Napoli (2000, p. 20), used with permission)

The members of these lexical families cannot be derived from each other via a process of affixation. In other words, no one member of the lexical family is a basic sign to which material is added to derive the other lexical items in the family. Fernald and Napoli (ibid.) analyze these lexical families as being related to each other via the existence of abstract, incomplete lexical units that compose with other such partially specified lexical elements to form complete signs. They term these incomplete units *ion-morphs*. Lexical families share an ion-morph. A sign may belong to multiple families in intersecting dimensions and share ion morphs with more than one set of lexical items. Thus MOTHER and FATHER form a lexical family varying only in place of articulation, but MOTHER is also related to GIRL, sharing with it every parameter except hand configuration, and also to GRANDMOTHER, sharing with it every parameter except movement. Thus MOTHER contains three partially overlapping ion-morphs, sharing one with FATHER, one with GIRL, and one with GRANDMOTHER.

The concept of ion-morphs is somewhat similar to that of templatic morphology (also called root-and-pattern morphology), as seen for ex-

ample in Semitic languages, in which the consonants of a stem are mapped to a template and the vowels, which belong to a different morpheme, are interleaved with the consonants (McCarthy, 1981). So, for example, a root of the shape $C_1C_2C_3$ might be realized as $C_1iC_2C_2aC_3$. However, as Fernald and Napoli (2000) point out, such templates crucially impose an order on consonants and vowels, while the ion-morphs of an ASL sign are articulated simultaneously, without relative order.

The difference between signed and spoken morphology is directly related to the difference in their modality. Fernald and Napoli (ibid.) suggest several reasons for the preference for ion-morphs over affixes in ASL. These include the greater bandwidth of visual processing as compared to auditory processing and the relative slowness of the manual articulators as compared to the oral articulators. Taken together, these factors make morphs that are articulated simultaneously preferrable to ones articulated in sequence in sign languages. In principle, a language might use neither ion-morphs nor derivational morphology, but as Fernald and Napoli point out, using lexically related signs rather than unrelated signs for lexemes with similar semantic content helps signers who may not know a particular sign to guess its meaning. This is a particular boon to learners of sign languages, who are often (because of being born to hearing parents) older when they begin learning to sign than hearing children are when they begin learning to speak a spoken language.

The concept of ion-morphs provides a key to the analysis of a family of scripts that have not yet found a comfortable home, typologically speaking. *Canadian Aboriginal Syllabics* is a cover term for a family of scripts which have been used for various indigenous languages of Canada, including Cree, Inuktitut, Ojibwe, and Carrier, among others. The first members of the script family were Cree and Ojibwe "syllabics," invented in 1840 by the missionary James Evans. Adoption, adaptation, and additions in subsequent decades resulted in a family of scripts used to write various languages in the Athabaskan, Algonquian, and Eskimo-Aleut language families Nichols (1996).

Generally speaking, in these scripts the shape of a main sign indicates its consonantal value, and the orientation of the sign (sometimes with an additional diacritic) indicates the value of the following vowel. Smaller signs represent consonants that are not followed by vowels (Nichols, 1996; Poser, 2011). Table 6 shows a selection of the CV signs that are used to write CV sequences in Carrier, an Athabaskan language spoken in central British Columbia, Canada. This particular member of the script family was adapted from earlier variants for the Carrier language by Father Adrien Gabriel Morice in 1885. In Carrier it is known as ᑐᐞᐯᐸᐃ *dulkw'ahke* 'frog feet'. Initially popular and considered easy to learn, its use declined in the 1920s due to residential English-medium education (Poser, 2003; 2011).

TABLE 6. Some of the CV signs in Carrier "syllabics." Consonants are represented by the shape of a sign, and vowels are represented by its orientation and/or by the addition of a dot or small line. Voiced, voiceless, and glottalized consonant families are related by modifications of the shape. Adapted from Poser (2003; 2011), using IPA transcriptions rather than the Carrier Linguistic Committee's Romanization system.

| | | | | | |
|---|---|---|---|---|---|
| ᐯ hu | ᐸ ha | ᐱ ho | ᐳ hʌ | ᐴ he | ᐵ hi |
| ᑌ du | ᑕ da | ᑎ do | ᑐ dʌ | ᑑ de | ᑏ di |
| ᑐ tu | ᑖ ta | ᑏ to | ᑎ tʌ | ᑌ te | ᑍ ti |
| ᑓ t'u | ᑕ t'a | ᑐ t'o | ᑎ t'ʌ | ᑌ t'e | ᑏ t'i |
| ᒎ gu | ᒐ ga | ᒪ go | ᒣ gʌ | ᒥ ge | ᒧ gi |
| ᒣ ku | ᒡ ka | ᒪ ko | ᒣ kʌ | ᒪ ke | ᒪ ki |
| ᒣ k'u | ᒡ k'a | ᒪ k'o | ᒣ k'ʌ | ᒪ k'e | ᒪ k'i |

Concentrating first on the first two rows of Table 6, one can see that the shape of a sign represents the consonant value in the CV sequence, and that the sign's orientation and/or the addition of an internal small line or dot represents the vowel. The Cree language, whose syllabics system inspired the Carrier system, has only four vowel qualities (as well as length), so adapting the system to Carrier required adding extra ways to represent vowels beyond 90-degree rotation.

Carrier also has many more consonants than Cree does, Carrier having 41 native consonants and three further ones that occur only in loanwords, while Cree has ten native consonants and two that occur only in loanwords (Poser, 2011, p. 50). In order to meet the demand for additional consonants, an additional degree of relationship was added to the Carrier script. Comparing the second, third, and fourth rows of Table 6 with the fifth, sixth, and seventh rows, it can be seen that, for a class of plosive consonants that differ only in laryngeal values, the voiced member will be written with a symbol that is open at one end, the voiceless member will be written with a straight closing line, and the glottalized member will be written with a slightly V-shaped closing line.

Other family resemblances exist between the signs used to write other sets of similar consonants. Table 7 shows the signs for CV signs in which the C is a lateral consonant. These signs share a bowl shape with various modifications. An interesting feature revealed by the lateral signs is that the relationship between signs that share a consonant is not purely rotational. Thus the relationship between <ᘪ> /t'lu/ and <ᘬ> /t'la/ is not exactly one of a ninety-degree rotation, as the position of the small vertical line that occurs on the top righthand side of /t'lu/ (but also on the top righthand side of /t'la/) demonstrates.

Consonants that are not followed by a vowel are written differently than the main CV signs. The list of consonants that may appear before another consonant or may close a syllable in Carrier is about half as

TABLE 7. The CV signs for syllable initial lateral consonants in Carrier. Adapted from Poser (2003; 2011)

| | | | | | |
|---|---|---|---|---|---|
| ᑌ lu | ᑕ la | ᑎ lo | ᑐ lʌ | ᑑ le | ᑐ li |
| ᑌ ɬu | ᑕ ɬa | ᑎ ɬo | ᑐ ɬʌ | ᑑ ɬe | ᑐ ɬi |
| ᑎ tlu | ᑕ tla | ᑎ tlo | ᑐ tlʌ | ᑑ tle | ᑐ tli |
| ᑎ dlu | ᑕ dla | ᑎ dlo | ᑐ dlʌ | ᑑ dle | ᑐ dli |
| ᒍ t'lu | ᒐ t'la | ᒪ t'lo | ᒣ t'lʌ | ᒣ t'le | ᒣ t'li |

TABLE 8. Some of the smaller signs that are used for isolated consonants (consonants not followed by vowels). Adapted from Poser (2003; 2011)

| | | | | |
|---|---|---|---|---|
| ᶜ m | ᶟ n | ᵕ ŋ | ″ x | ‴ ɣ |

long as that of those that may occur in CV sequences. These consonants are written with smaller signs which stand only for a single, isolated C. These isolated C signs are unrelated to those that are used to write the same consonant before a vowel. However, even among the isolated Cs, systematic relationship can be observed in the signs for phonologically related consonants, such as when nasals are related by rotation or velar fricatives are related by a change in angle. Some of the isolated consonants are shown in Table 8.

Systematic relationships between signs that represent phonologically related phonemes are a significant feature of the Han'gul script, used for Korean. The representation of phonological features in Han'gul is pervasive enough to have led Sampson (2015) to consider it a "featural system" (representing phonological features of segments) rather than an alphabet (representing phonological segments). While many other grapholinguists disagree with Sampson's typological placement of Han'gul (Sproat, 2000, pp. 136–138), the script remains justly famous for its inclusion of phonological features in its representation of language. Like Han'gul, the Carrier script also represents relationships between phonological segments (in other words, phonological features) with systematic relationships between signs (such as the line added to <ᑌ> /du/ to derive <ᑎ> /tu/). However, not all of the relationships between signs can be reduced to the addition of something (a stroke or dot, say) to a simpler shape. Specifically, the vowels are not represented by *adding* anything. Instead, the vowels and the consonants are each incomplete abstractions, and it is only when they come together that they make a complete sign. In other words, consonants and vowels in Carrier (and in other Canadian Aboriginal Syllabics scripts) are *ion-morphs*. In Carrier, there are additional relationships between consonants that are represented as well. Like the ASL sign for MOTHER, which participates in several lexical families, a Carrier sign like <ᑌ> /du/ participates

in several graphical families: that of dV signs, that of Cu signs, and that of CV signs whose C is an alveolar stop.

The scripts of the Canadian Aboriginal Syllabics family have thus far occupied an uneasy typological space between syllabaries and alphabets. Despite the traditional term "syllabics," they are not syllabaries, as Poser (2003) has carefully explained in the case of Carrier. The values of the consonants and vowels are both represented, and thus Poser states that Carrier is an alphabet. On the other hand, English *Wikipedia*[4] declares the scripts to be abugidas, on the false assumption that the terms *abugida* and *alphasyllabary* are "essentially synonymous" (note 17). In fact, the definitions of *abugida* and *alphasyllabary* are distinct, and they delimit different sets of scripts, as pointed out by Bright (1999) and Gnanadesikan (2017). An abugida is "a writing system in which the basic shapes denote a consonant plus /a/ and the other vowels are designated by attachments to the basic shape" (Daniels, 2018, p. 156). An alphasyllabary "writes each consonant-vowel sequence as a unit... in which the vowel symbol functions as an obligatory *diacritic* to the consonant" (Bright, 1996b, 384, italics in original). In fact, the scripts of the Canadian Aboriginal Syllabics family do not meet either definition. There is no default /a/ vowel, and the vowels are not written with dependent signs that attach to the consonant signs (although the vowels /e/ and /i/ do involve the addition of small lines or a dot). In earlier work I have called this family of scripts "fully vowelled *ākshарik* segmentaries" while admitting that "[i]t is an open question ... whether the spatial arrangement of the vowels—in the sense that they overlap in space with the consonants rather than being diacritic on the consonants—is an important typological distinction to make" (Gnanadesikan, 2017, p. 29).

The analogy with signed ion morphs may help clarify the typological place of Carrier and related scripts. As Poser (2003) has stressed, Carrier represents all its consonants and all of its vowels. It is therefore a fully vowelled segmentary, in the terminology of Gnanadesikan (2017). However, typologists have concerned themselves not just with *which* phonological units a script represents but *how* (spatially) they do so. In other words, they have concerned themselves with matters that are, from the point of view of this paper, morphological. Morphologically speaking, an alphasyllabary, or akshara system, is one in which consonants are main signs (stems) and the vowels are affixes. The CAS scripts have ion-morph arrangement, in which there are no affixes but there are simultaneously realized relations between signs. They are therefore not alphasyllabaries/akshara systems but rather their own morphological type, ion-morph segmentaries.

It should not surprise us to find sign-language-like morphology in scripts. Script shares with sign many of the features that Fernald and

4. https://en.wikipedia.org/wiki/Canadian_Aboriginal_syllabics

Napoli (2000) adduce to explain the preference for ion-morphs in ASL. Script is produced much more slowly than spoken words. Thus it shares with sign a slower rate of articulation than oral language possesses. Both sign and script are processed visually, where the greater bandwidth allows for more concurrent information than in the auditory channel, offsetting at least somewhat the slower rate of articulation. The benefits, particularly to older learners, of having signs with related meanings have related forms is also relevant to writing, which is also often learned later in childhood or even adulthood. Indeed, when the Carrier script was new, it was known for being easy to learn. Literacy spread quickly from person to person with informal teaching, and "[f]or several decades there appears to have been mass literacy in syllabics" (Poser, 2011, p. 1).

## 6. Conclusions

This paper has revolved around three essential points. First, grammar is amodal. The essentially amodal nature of the human language capacity implies that even secondary communication systems such as writing can be expected to exhibit grammar. Specifically, this paper has examined a number of analogs to morphology that may be found in the structures of the world's scripts. Among heavily morphographic writing systems, Chinese Hànzì and Maya glyphs have previously received analyses that argue for (in the case of Hànzì) or imply (in the case of Maya glyphs) that composite written signs have morphological structure.

Phonographic scripts also display morphology, and in fact it is important to keep in mind that the morphology of the words of a language (the lexical or L-morphology) is a separate system from the morphology of the graphic signs of a writing system (the graphical or G-morphology). The aksharas of Brahmic scripts are analyzed in this paper as consisting of consonantal main signs (stems) with vowel affixes. In all, inflectional affixes, derivational affixes, stem-triggered allomorphy, levels of affixation, and compounding are identified in akshara-based scripts.

In the Canadian Aboriginal Syllabics (CAS) group of scripts, there are families of CV signs, related in one dimension by shape and in the other dimension by orientation. Generally speaking, the vowel representation (orientation) and the consonant representation (shape) cannot be separated in the way that the consonants and vowel signs can be in Brahmic scripts. These families of signs are analogous to the lexical families of ASL, in which signs for semantically related concepts share most but not all of their manual articulatory parameters. The abstract, partial sign that is shared across a lexical family has been termed an ion-morph. The individual consonants and vowels of CAS may be considered graphical ion-morphs, as in ASL. In the Carrier script, expanded

from the original Cree system, additional features of the signs indicate features such as laryngeal contrasts, adding a further dimension of relatedness between signs and thus further ion-morphs.

The second point is that modality influences form. Comparison between sign languages and spoken languages shows that the expression of grammar is influenced by the modality of the language; the human language faculty is able to adapt to the modality at hand. Written language shares with signed language the feature of being spatially arranged. We should therefore expect to find some grammatical structures in written signed language than like spoken language. The spatial arrangement of writing allows for superfixes and subfixes in the case of the Brahmic scripts and Maya glyph blocks in addition to the prefixes and suffixes (and infixes and circumfixes) found in spoken language. It also allows for the nonconcatenative nature of signs in Canadian Aboriginal Syllabics, analogous to the ion-morphs of sign language.

The third point is that the expression of grammar in a script is independent (at least to some extent) of the language for which the script is used. The overpowering nature of the human instinct for grammar results in grammatical features in scripts (such as inflection in Hànzì or ion-morphs in CAS) that are recognizable from primary (spoken or signed) language but are not found in the specific primary languages for which the scripts are used. Thus, writing systems tap into grammatical faculty directly and not just via the primary language.

This paper is merely one of many (some of which are cited in the Introduction) that have argued in recent years for writing as a modality of language and for the applicability of grammatical analysis to written signs. By applying already-accepted differences in modality to the study of writing, some apparent differences between writing and spoken language have been resolved. It will be interesting to see how far the linguistic analysis of script can take us and what a truly amodal model of grammar would look like.

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