ASL signer Kevin Clark

A Linguistic Comparison

Two Notation Systems for Signed Languages

Stokoe Notation & Sutton SignWriting

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TABLE OF CONTENTS

I. Introduction

II. Describing Language
1. Schematics
2. Feature Matrices
3. Alphabets

III. Scripts
1. Logographic
2. Alphabetic
3. Featural

IV. Origins
1. William Stokoe
2. Valerie Sutton

V. Comparison
1. Movement
2. Handshape
3. Location
4. Orientation
5. NMGSs

VI. Structure
1. Taxonomy
2. Iconicity
3. Ordering
4. Four Dimensions
5. Reading & Writing
6. Grammar
7. Learnability
8. Evolution

VII. Conclusions

VIII. References

Abstract

While signed languages have traditionally been treated as unwritten or even unwritable, there have been many attempts to create writing systems for them. Two of the best known, Stokoe Notation, developed by a linguist, and Sutton SignWriting, developed by a movement notator, are here discussed and compared on such points as their creation, evolution, and the mechanics of how they operate. Theoretical issues are discussed such as iconicity, symbol ordering, literacy, and the problem of representing space in two dimensions.

Many of these issues are shown to pose insurmountable obstacles for approaches based on traditional linguistics, such as the Stokoe system. Problems are seen to arise not from the nature of signed languages themselves but due to restrictions imposed by traditional theoretical assumptions, which stem from the study of oral language.

The movement notation approach taken by Sutton SignWriting is not bound by such restrictions, and is shown to be feasible and to have met with some acceptance.

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INTRODUCTION

The goal of this paper is to use concepts from linguistics in comparing two systems designed for writing signed languages. These are Stokoe Notation and Sutton SignWriting®, hereafter SN and SSW respectively.

Stokoe Notation (SN), was devised by linguist Dr. William Stokoe in 1960 and published in his groundbreaking book *Sign Language Structure*. Used by researchers ever since, SN is now the best known, although various groups of researchers have made changes to suit their particular needs and no standard version ever developed. Hence it cannot be considered a single system, but as a whole family of similar linguistic notation systems.

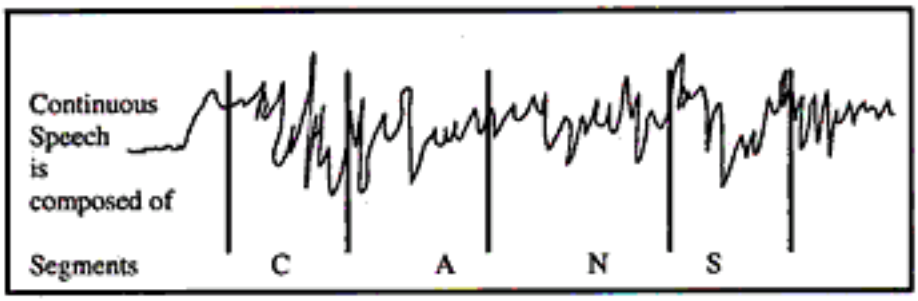
Sutton SignWriting (SSW), was invented by movement notator Valerie Sutton in 1974, when researchers at the University of Copenhagen asked her to adapt her invention Sutton DanceWriting to record the movements of signed languages. At the University, Sutton recorded the gestures of hearing people, comparing them with Deaf people using Danish Sign Language. Through this work, "SignWriting" evolved as part of an overall movement notation system, which also includes DanceWriting, SportsWriting, and MimeWriting. It too should be considered not in isolation but as part of a larger system, keeping in mind its interaction with these other parts of the complete Sutton Movement Writing System.

DESCRIBING LANGUAGE

To give a context, this section will look at what it is that writing systems are expected to do, the different ways they do it, and ways of classifying them.The word "language" is used in many ways. We talk of the language of poetry or love, of body language, computer languages, the language of the bees, and the birds. Linguists have worked hard to determine exactly what makes human communication systems different from these other types. They have drawn up a list of characteristics that a system must have in order to be accepted as a human language. A main characteristic is double articulation, meaning that the structure of human language has several levels. The highest levels are composed of meaningful words and sentences, and the lowest levels are composed of small parts that have no meaning at all. However, these small parts can be put together in combinations that do have meaning. This same double articulation is seen in writing. (Coulmas 1984, 59).

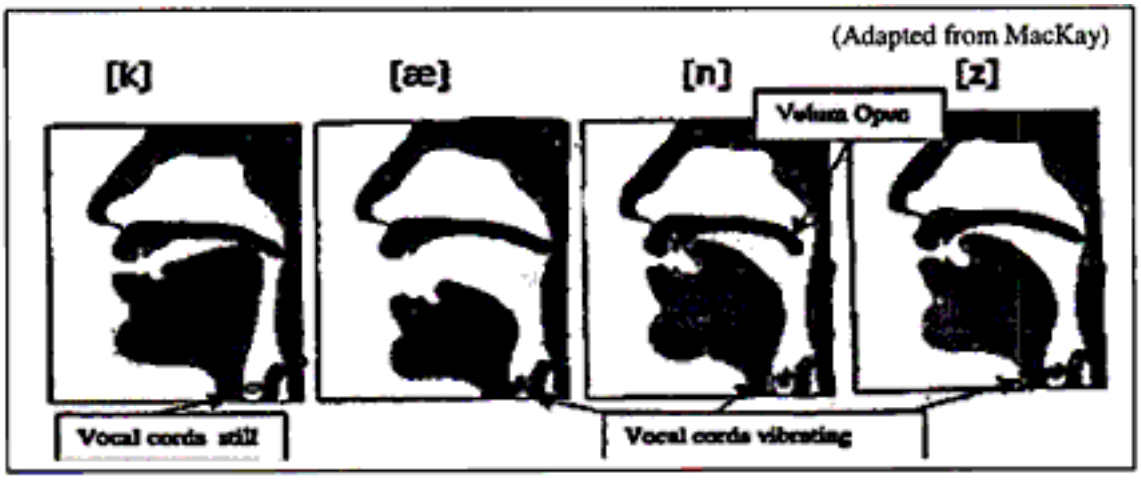
Language also occurs in a time sequence. We see or hear it as a continuous stream, but when we talk about it we can break it up into segments like the speech sounds shown in Figure 1. The job of a writing system is to describe these segments.

Figure 1



One way to describe language segments is by pictures, or schematic diagrams, showing the positions of the articulators - the lips, tongue, velum and other parts of the body that are used to produce language - as in Figure 2.

Figure 2



Notice that there are certain things that must be included in each diagram. The tongue's position must be drawn in, the vocal cords must be included to show if they are still or vibrating, and the velum must be shown (It opens for [n] sounds - see Figure 2.). Each of these things determines a certain "parameter," and to describe a segment we have to include all the parameters. For example to make an [u] sound, the lips are round and the tongue is up, but for an [o] sound, the lips are still round but the tongue is low. Lip Rounding and Tongue Location are the parameters that must be shown.

For really detailed study linguists use a phonetic feature matrix (see note A). Features in this sense are the specific settings of the parameters. For example, generally the vocal cords can either be vibrating or not, so there are two possible settings. We say Voicing is a parameter, and it has two possible features, voiced and voiceless.

> **Note A:** A common misunderstanding is that phonemes are sounds. Actually a phoneme is a theoretical construct; no one has ever uttered a phoneme. "At first glance it might seem inappropriate to use terms based on sound-phoneme and phonology--to refer to soundless languages. The earliest work avoided the problem by coining the term chereme. By today it has been demonstrated conclusively though that these units are organizationally and functionally equivalent at every level of linguistic structure. The terminology refers to the pattern of organization of the linguistic signals rather than to the formal properties of the signals themselves. The organization of the symbols is the same whether instantiated in the oral-aural or visual-gestural modality. Today it has become standard to use traditional terminology for sublexical structure regardless of modality" (Valli & Lucas 255). Presenters at linguistic conferences no longer feel any need to justify the use of the terms. Like it or not it is now proper to speak of the phonetics and phonology of Sign.

In most languages the parameter of tongue position includes about six locations in the mouth, so there are six possible features to choose from. To describe a segment, a feature matrix lists all the parameters, with the specific feature for each one described in anatomical terms as in Figure 3. In actual use it gets much more complicated, but all it really does is give the same information as the schematics. It is really impossible to "read" feature notation (Kim 150).

Figure 3

Parameters :	[k]	[æ]	[n]	[z]
	----------Features----------			
Manner of Movement :	Stop	Vowel	Nasal	Fricative
Location:	Velar	Low Front	Uvular	Alveolar
Voice:	Voiceless	Voiceless	Voiced	Voiced

A simpler way to describe speech segments is with an alphabet. For this, a set of symbols is chosen and used as names for the segments as we did above with [u] and [o]. Along the top of Figure 3 we can see the names given to each segment by the International Phonetic Alphabet. Our own Roman alphabet is shown in Figure 1. So these are three ways of describing segments of language: alphabets, schematics, and feature notation. All three of these do the same job of describing particular segments of language.

TYPES OF SCRIPTS

A notation is any set of symbols used to denote things, including mathematics. A writing system is a notation for representing the structure of a language; alphabets and syllabaries are writing systems. A script is the particular collection of symbols used to make a writing system visible. Our Roman Alphabet is a script, as are SSW, SN, the Japanese syllabary, and Chinese Characters. An orthography is specific to one language. Spanish, German and French are all written in the same script but have different orthographies. Both SSW and SN are scripts, used to write any number of signed languages. People call them alphabets, but technically this is not correct. Different types of scripts are classified by what level of language they match their symbols to. Chinese writing matches its symbols with the word level, using a symbol for each morpheme. We call this a logographic script. Below the word/morpheme level is one built of smaller parts called phonemes (in spoken languages these are the sound segments). Alphabets assign symbols to this level. Below that is the level built of the even smaller phonetic features. Feature notation assigns symbols at this level, and that is what both SSW and SN do, as Figure 4 illustrates.

Figure 4

	Logographic	Speech Notation **Alphabetical**	Featural Notation **Stokoe Notation**	Featural Notation **Sutton SignWriting**
Words full meaning	她	She's	G⊥	
Morphemes some meaning	她	She + s	G⊥	
Phonemes affects meaning		sh - e - z	G⊥	
Features no meaning			Handshape G Orientation: ⊥ Movement: ⊥	Handshape:  Orientation:  Movement: 

Logographic Chinese writing has no symbols for anything smaller than the morpheme, alphabets have no symbols for anything smaller than a phoneme, but both SN and SSW have symbols even for features: they are not alphabets.

Linguist Geoffrey Samson coined the term "featural" for this type of script. Although no script known to him was based entirely on this principle, he cites Pitman shorthand and the Korean alphabet-Hangul-as having featural elements (Sampson 40). He points out that Hangul "has been described as perhaps the most scientific system of writing in general use in any country" (Reischauer 1960, p. 435), or more simply as 'the world's best alphabet (Vos 1964, p. 31)- (Sampson 121).

Nearly all scripts not only represent units, they also "delimit" larger units. SN and SSW, like English, delimit words as groups of symbols separated from other such groups by blank spaces (Henderson 16). In this sense they are logographic. Also, SSW is in a very real sense pictographic, i.e. the symbols are recognizable pictures of the things represented. It differs in a fundamental way from any other pictographic writing though---the SSW pictograph is a picture not of the thing, but of the word that stands for the thing. This is not a possibility with spoken language, since you can't draw pictures of sound waves.

Finally, I want to distinguish between two uses of writing systems, which I call technical and popular. A popular writing system lets us write down what we want to communicate and have others read it back and understand. We are not too concerned if it leaves things out, since we can use our knowledge of the language to fill in the gaps. For linguistic researchers this isn't good enough. They want a technical notation that shows more detail, and that reflects the internal structure of the language. Also, since linguists work with languages they don't know themselves, they want a system that will allow them to read what is written and reproduce it even when they don't know the language they are reading. To expect any one notation to meet all these conflicting sets of requirements is completely unrealistic. In this paper I will focus on SN and SSW as popular scripts rather than as specialized tools for research.

SSW, as noted, was originally designed for research, and is still being used for this in many countries. In a slightly different form it is also being used as an ordinary writing system, in publications and ordinary correspondence (Sutton 1997b, 3), so it is both a popular and technical script.

SN has come under fire for not being technical enough. Researcher Ronnie Wilbur wrote in 1987, "Stokoe Notation is still used today as a convenient shorthand for writing signs, although linguists cannot use it for many purposes because it does not provide symbols for many phonetic details, such as uneven rate of signing, tenseness or laxness, sharp or soft manner of movement, or facial expression and other non-manual components that are crucial to the actual formation of a sign" (Wilbur 20).

However SN was not really intended as a technical system in the first place. William Stokoe himself says in the *Dictionary of American Sign Language on Linguistic Principles*, (hereafter the DASL), that "For the reader who knows American Sign Language, the symbolic notation will suffice. However, for those who use the dictionary as an aid to learning the sign language the symbols alone may not be enough, and therefore he includes text explanations" (Stokoe et al xxv). Clearly then SN was not designed as a technical script. Nor was it a popular script, as it recorded only isolated single words. It was created for a particular, specific purpose-to describe ASL linguistically-and for that it worked very well.

ORIGINS

Any writing system stresses some parts and ignores others, and therefore is an analysis, one that reflects the biases and assumptions of its creator. Thus, part of analyzing any script, it is important to examine how and why it was created.

William Stokoe

Stokoe's goal was not to write sign language, which others had done before (Fischer 287), but to prove that American Sign Language was a real language. He says his 1960 *Sign Language Structure* was "originally written to bring the language used by several hundred thousand Americans to the attention of language scientists, who had ignored or misunderstood it" (Stokoe 1978 i). The scientists, and everyone, had believed that signing was just "pictures in the air," not built up of parts like spoken language. Stokoe showed this was not true by using traditional methods of linguistics to isolate segments in ASL and to identify their parameters. For example, only certain hand shapes were used, turning up over and over again in different combinations. He showed that Hand Shape was a parameter in sign language.

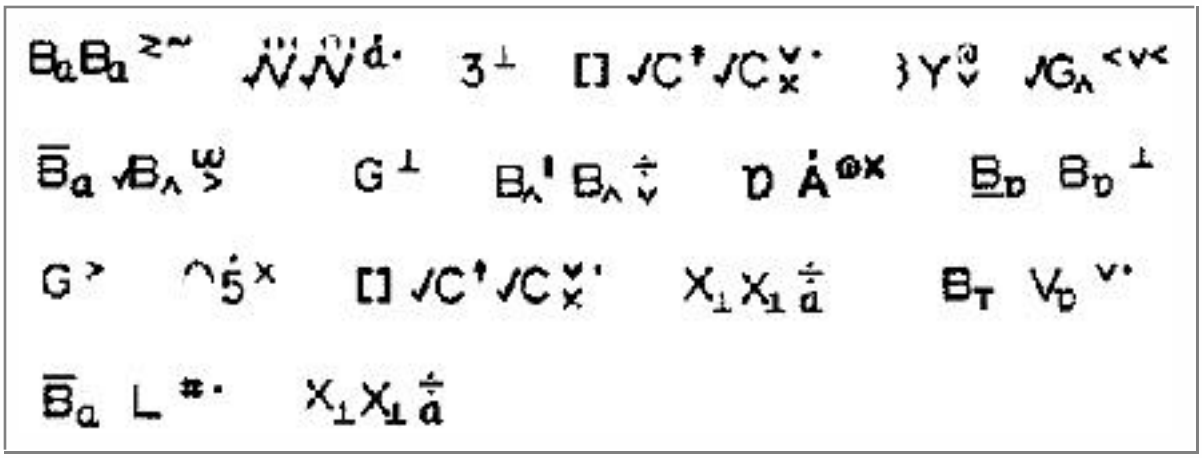
Then, just like any linguist analyzing a new language, he looked for "minimal pairs." A minimal pair is two words that differ only in one segment, for example Rode and Rude. These are two different words only because the second segment is different. This tells us that [u] and [o] are two different sound-segments in English, and we need to use different symbols for them. If changing a detail results in changing the meaning, then that detail is important. Changing our loudness or the color of our socks wouldn't change the meaning; that's why no writing system includes the color of our socks.

In fact, these two words Rude and Rode are different in only one phonetic feature - that of Tongue Location (Height). Setting the Location of the tongue "high" produces the [u] sound and setting it lower produces the [o] sound. Changing the setting of that one parameter, Location, changes the segment to the other; Rude becomes Rode. Specifically this depends on the position of the articulator- the tongue in this case. Stokoe showed that Location is a parameter in ASL even though the articulator is the hand rather than the tongue. Figure 5 shows three words that are exactly the same except for Location. Performing the illustrated movement on the chin location means "dry," performing the exact same movement on the lip means "ugly." Structurally, this is identical to changing tongue height to produce the English sounds [u], [o], and [a].

Figure 5

Using this accepted reasoning, Stokoe proved that each sign has the three parameters of Location, Movement and Hand Shape. His symbols for these are shown as the SN "characters" underneath each picture in Figure 5. Notice how each character includes three different kinds of symbols, corresponding to the three parameters. Location is shown by the first symbol, and since Location is the only difference between these three signs, that is also the only part of the characters that are different. At this point Stokoe's job was done. He had proven that ASL was structured like all other human languages, with parameters and features, and illustrated this with his newly invented script. See Figure 5a.

Figure 5a



Valerie Sutton

When SSW was invented in 1974 there was no longer a need to prove that signed languages were actually languages, the goal was simply to record them. With a background as a dancer rather than a linguist, Sutton was already a skilled movement notator before she began writing the movements of signed languages, having invented her own unique system of dance notation that was already used in the ballet profession.

When writing the movements of signed languages, Sutton had no need to adopt the theoretical assumptions of linguistics, to presuppose a finite set of smallest parts, to look for minimal pairs or even to analyze things for meaning. She was free to use the different goals and methods of dance notation, to "see and draw" using a schematic approach. Her goal was simply to record movement. When Sutton applied this to recording signed languages, she realized that to record the movement is also to record the language; "I also began writing Danish signs, and even though I did not know what they meant at the time, Deaf people whom I met in Denmark could read the signs and they knew what they meant" (Han 2), and even now, "I never ask what the sign means - I only try to capture how it is executed." (Sutton 21 Aug 99).

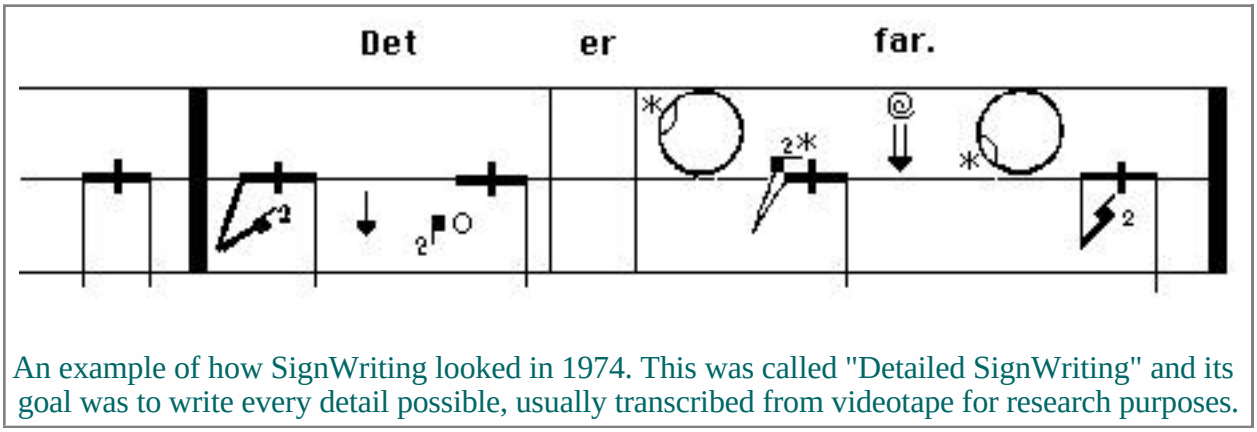
This approach is unique. SSW doesn't even require one to know that what they are writing is language. The notator serves only to transmit the visual image, the same as a recording would do. We might compare this with Crystal's "Joint Reading" (right) and ask, "Is writing down pictures of words the same as writing down words?" See Figure 5b.

Figure 5b: Joint Reading

> Smith has taught himself to read Russian letters, but he hasn't had time to learn the language. Bronski was brought up speaking Russian, but he never learned to read. One day Bronski gets a letter in Russian from a relative. He cannot read it. He shows it to Smith. Smith cannot understand it. But all is well: Smith reads the words aloud: Bronski recognizes them and interprets them. He is happy. But who is "reading"? (Crystal 209)

The earliest SSW was "DanceWriting from the waist up," using stick figures. Read: History of SignWriting, Chapter 2: Early Years in Denmark; 1974 - 78, or see Figure 5c.

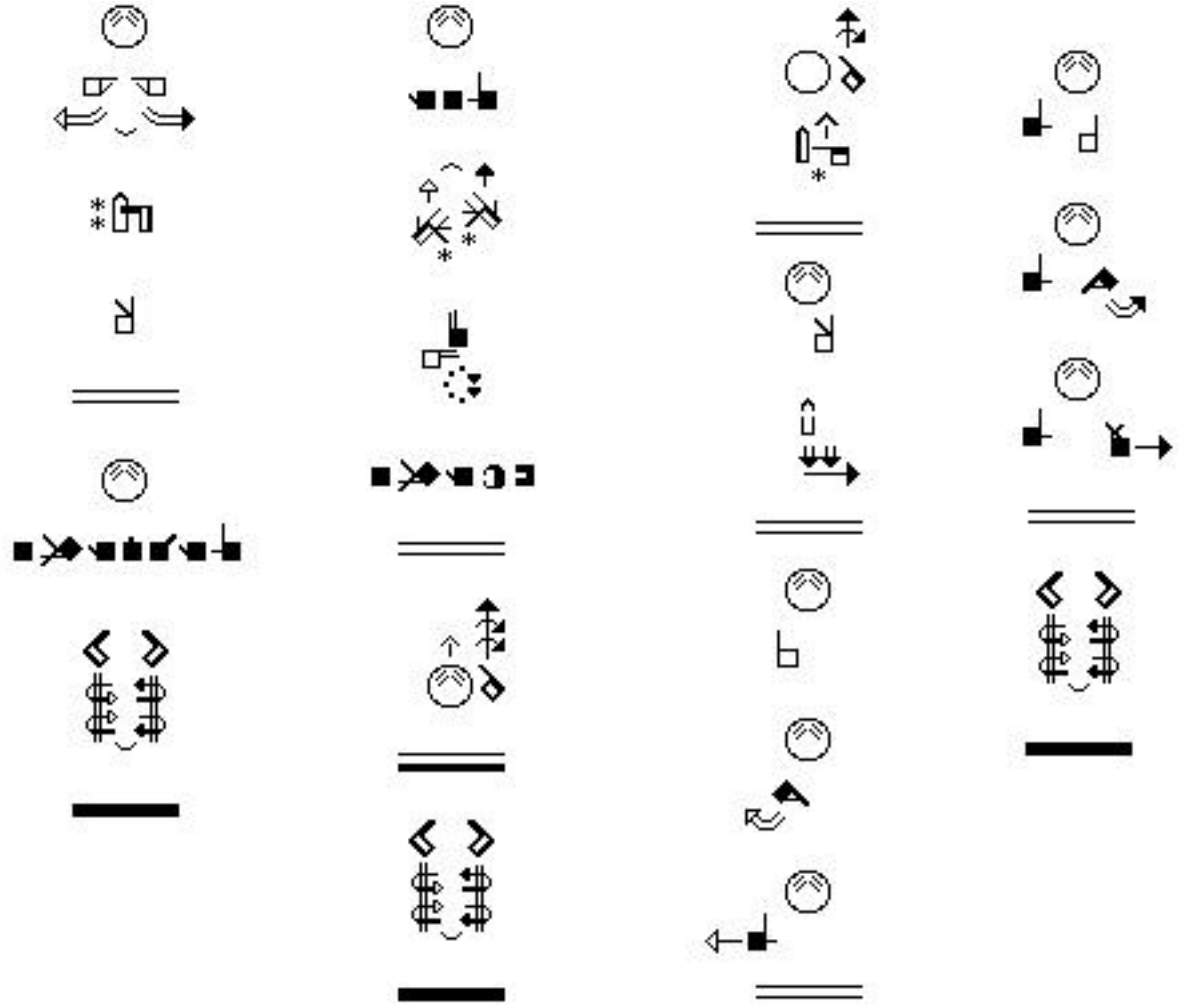
Figure 5c: Early SignWriting



An example of how SignWriting looked in 1974. This was called "Detailed SignWriting" and its goal was to write every detail possible, usually transcribed from videotape for research purposes.

A version of the stick figure, called Full Body SignWriting, is still used in Denmark today, but most users have chosen to simplify it after much consultation with native users and by general consensus. This constitutes a linguistic analysis in a sense, but is not based on theoretical assumptions, it simply follows the process of change that all languages, and all scripts naturally go through. Nor has it been used prescriptively. Irrelevant features (like brown socks) have been dropped from the regular notation but it is left up to the user to write them in if they so desire. In this sense SSW functions like the IPA; people can choose to write either a deep transcription (one showing every possible phonetic detail) or a shallow transcription, showing only as much as needed to get the message across. This is discussed in the article History of SignWriting, Chapter 7; The Evolution of Writing Styles. See Figure 5d.

Figure 5d: Today's Version of SignWriting Printing



Working with Deaf signers, to let the system evolve naturally at the hands of Deaf people, Valerie Sutton has continued to promote SSW to this day through the efforts of the non-profit Center For Sutton Movement Writing, which sponsors the Deaf Action Committee For SignWriting (the DAC). She and her small, mostly Deaf staff give support and act as a central clearinghouse to keep everyone informed of new developments.

COMPARING THE PARAMETERS

Having defined the scripts themselves and some terms used to discuss them, this section will give a descriptive comparison of how they handle the various parameters. Our current understanding of Signing requires five parameters to describe any Sign, and we will look at each one in turn. They are:

1.	2.	3.	4.	5.
Movement	Handshape	Location	Orientation	NMGSs

1. Movement

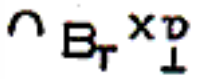
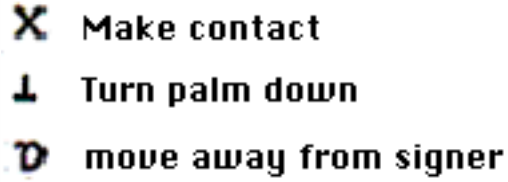
A basic theoretical choice must be made in order to show movement. One can represent the beginning position and the movement, show the beginning and end positions only, or show all three. SN has made the first choice while keeping the option of showing the end position if desired. Some signs show it and some don't, with the "spelling" being up to the writer.

SSW also allows all three choices, and as more and more people are reading and writing literature written in SSW, it is becoming evident that all three choices are needed at times. About 10% of SSW characters write both beginning and end position as well as movement. The majority of characters have only a beginning position and movement. However around 5% drop the beginning position and keep the movement symbol and ending position. Writing both positions is always an option in SSW, and is useful for beginning readers, or for unfamiliar signs.

At first glance these two scripts seem totally different, yet after allowing for the differing theoretical assumptions, they are surprisingly similar. Both use a set of arbitrary symbols for internal movement and both use arrows to show path movement, with different types of arrows for different directions. SN classifies all movement into 24 types, with a special symbol for each. Although SSW has fewer actual movement symbols, its freer spatial arrangement allows innumerable combinations, and thus considerably more detail.

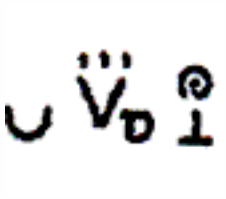
For example, axial and circular movement, which SN calls rotary, includes flexing the wrist or elbow or rotating the arm. (Figure 6) While SN requires the use of five more movement symbols, SSW shows these with combinations of the basic movement arrows.

Figure 6: Rotary Motion (Axial Motion)
The ASL sign for "don't know."

Stokoe Notation		
Sutton SignWriting		Arrows over head show a sideways head shake. A flat hand rotates as it moves out.

SN uses only one symbol, "circular," for any movement that is not straight. Anything more than a simple curve has to be treated rather digitally as moving up, then out, then down; whereas SSW arrows show curves and even loops (figure7).

Figure 7: Curved Motion (Looping Motion)
The ASL sign for "snake."

Stokoe Notation		Bent V moves away with Circular motion.
Sutton SignWriting		Notice the looping sideways movement arrow.

A SSW arrow consolidates a great deal of information in one symbol; the stem doubles for vertical movement, and the arrowhead is different for right, left, or both hands. Writing the nearer part of the arrow thicker makes use of perspective to show motion toward or away from the Signer (Figure 8).

Figure 8: Movement Away From Signer
The ASL sign for "enter."

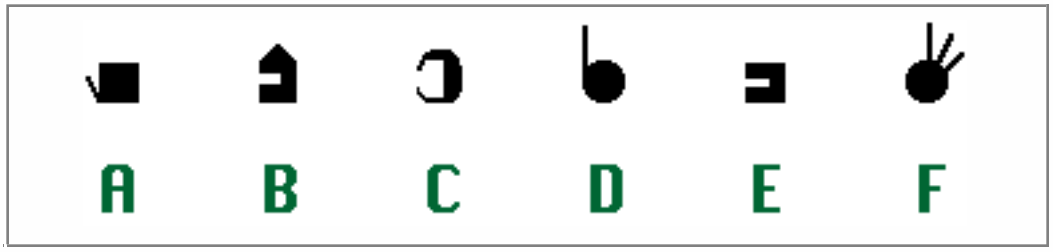
Stokoe Notation		Movement away from signer, stacked, palm down, open palms.
Sutton SignWriting		Tapered arrow curved movement down and away from signer.

2. Hand Shape

Hand Shape most clearly shows the difference between the schematics of SSW and the taxonomic approach of SN. The traditional taxonomic approach establishes a limited number of distinct shapes and gives each one a symbol. To write a Sign one looks at the whole hand shape, matches it with whichever one of the set it resembles most, and gives it that symbol. In contrast, the schematic approach used by SSW doesn't care how many shapes there are, as it represents each little part of the hand independently. For a new shape, SSW merely reproduces it, while SN is forced to put it with one of the existing symbols, even if it doesn't quite match.

For the Hand Shape parameter SN chose arbitrary shapes, the letters of the ASL manual alphabet and number system. This is natural enough and serves a mnemonic function but of course is a problem when applied to languages other than ASL. The hand shape used in ASL for <F> is used to represent <T> in Dutch Sign, in Sweden the hand shape for <B> is that of ASL's <A>, and in many cultures the ASL <F> is an obscene gesture (Miller 199). What's more, some signed languages have no manual alphabet at all (Chinese), or completely different ones (England, Australia). For them these letters are truly arbitrary, and of course, for children just learning to read, they are a burdensome task to memorize. The schematic alternative of SSW eliminates all these problems (Figure 9a).

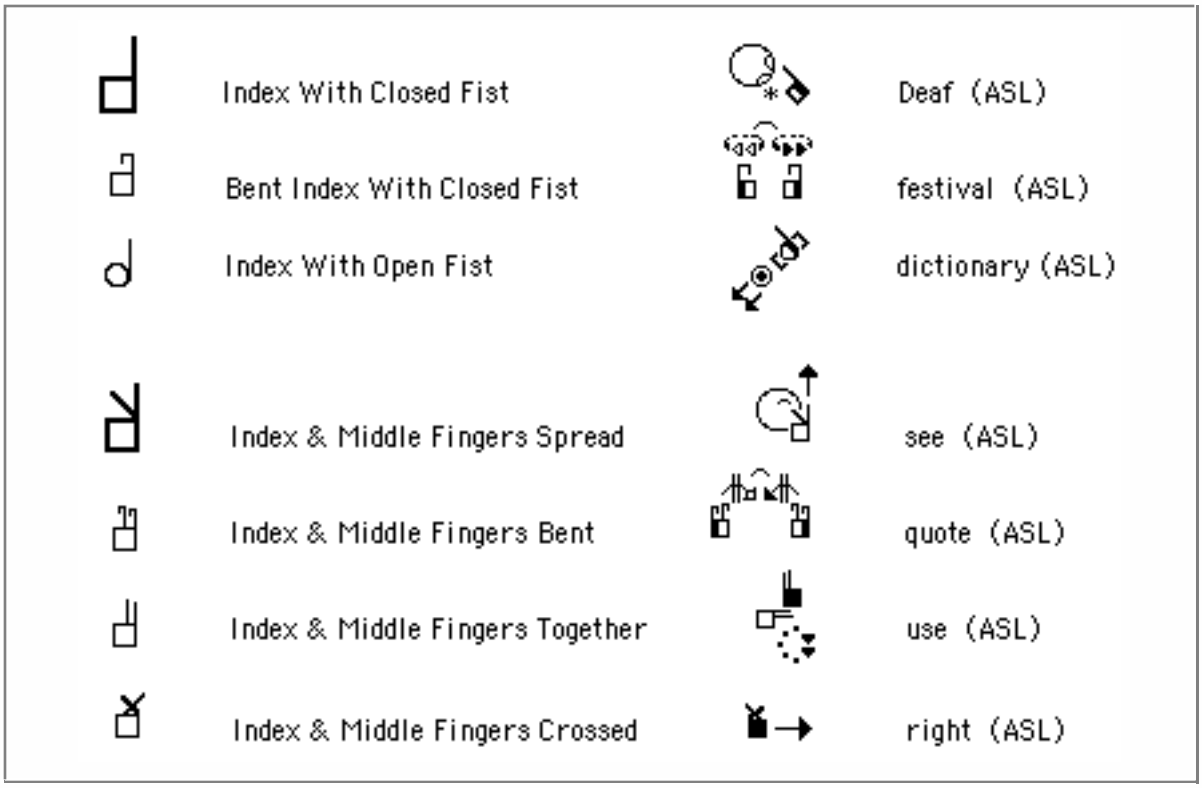
Figure 9a:
SSW Hand Shapes are schematic diagrams



SN kept the number of hand shapes down to 19 by such devices as treating the <A>, <S>, and <T> as one hand shape. Stokoe has been criticized for this as these three are clearly distinctive, and others have found many more distinctive hand shapes in ASL: Battison found 45, Klima about 40, Newkirk 54 (Valli & Lucas 185), and Johnson and Liddel 150 (Liddell & Johnson 223). I think Stokoe merely erred on the side of a popular script. "A hundred and fifty letters is more than we'd want," was his apparent assumption.

In SSW the number of hand shapes is effectively the number of positions the hand can take. The symbols are really 2-3 line segments per digit that join each other and the palm straight or at angles depending on the positions of the bones. The many thousands of possible combinations are organized into ten groups that correspond to the ASL numbers 1-10, and within each group the fingers can be crossed in four or five ways, the thumb bent out or straight in either of three planes and so on (Figure 9b).

Figure 9b:
SSW has a different symbol for each hand position



How much phonetic detail can these scripts show? As we have seen the original SN has proven inadequate in this respect, and I think Wilbur's criticism still holds for later versions. Although there is virtually no published discussion of SSW, it fares much better, at least as regards hand shape. Of the many feature analyses of ASL, perhaps the most ambitious is the work of Johnson and Liddell at Gallaudet University. Although their study deals in detail only with Hand Shape, SSW seems able to show every phonetic contrast they describe.

3. Location

For signs on the body, SN follows its usual taxonomic approach, giving mildly iconic symbols for 12 distinct locations. Again, later research has shown there to be many more; Corina lists 36 (Corina 30), while Liddell and Johnson found 56 (Liddell & Johnson 274). For two-handed signs, both systems treat the base hand as a location and describe it in terms of its hand shape. This shows its location within the signing space but not the relation between the two hands, for which SN includes a number of diacritics. The ASL sign meaning "coffee" is made with 2 fists, and a small horizontal line placed over one of them indicates the proper relationship, one hand under the other.

SSW has no symbols for Location. The parts of a SSW character are not written in left to right order, but in whatever relationship they actually take in a Sign. For "coffee," one hand is written underneath the other. The SSW "symbol for location" is the visual image itself, with its physical arrangement. This is a radical departure from any kind of linguistic thinking, but then so were languages that use space instead of sound (Figure 10).

Figure 10:
Location of Two Hands, One on Top of the Other

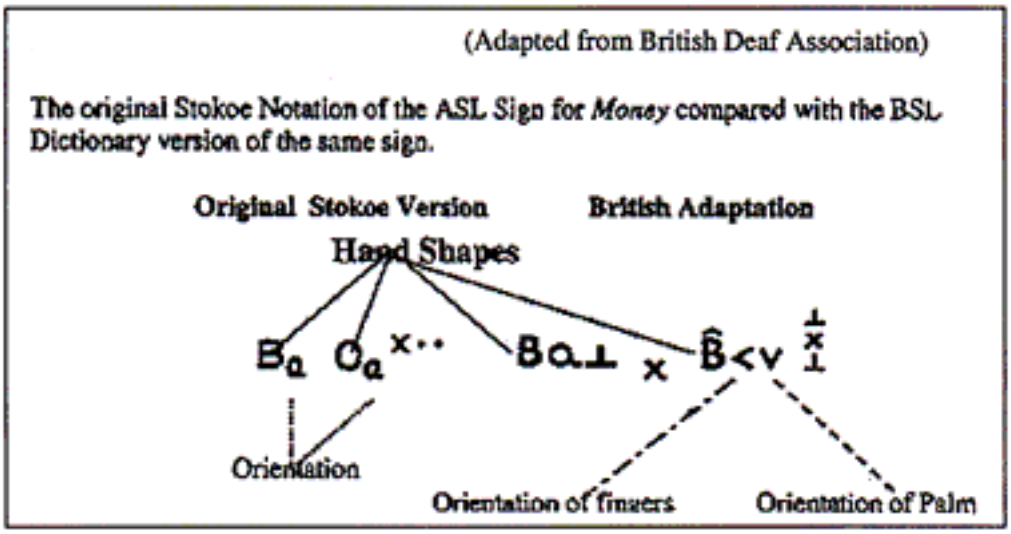
The ASL sign for "coffee."

Stokoe Notation		Circular motion, while remaining in contact. Line over first A-hand means it is lower of two stacked hands.
Sutton SignWriting		Two fists with light colored palms visible. Circular motion. Stacked position of hands is mapped.

4. Orientation

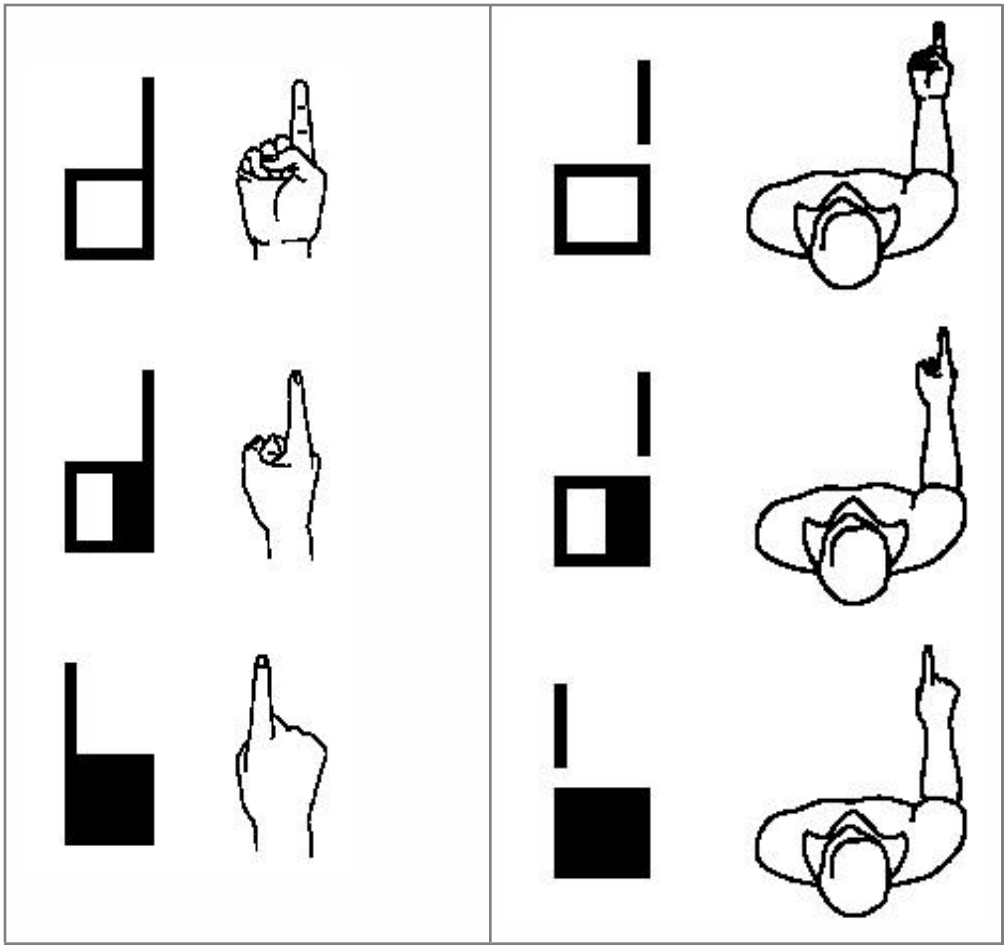
Stokoe argued that Orientation was a part of Hand Shape. Others later argued that the original SN treated this parameter as Movement in some cases, and part of Hand Shape in others, and it would be better to show Orientation as a separate parameter. This view is now standard, and researchers in Britain have incorporated it into SN. They modified the basic ordering formula so that every Hand Shape symbol is followed with a subscript for Orientation. In fact, they split the parameter in half and write it with two subscripts; the first one showing the way the fingers point and the second showing the way the arm is oriented (Figure 11).

Figure 11



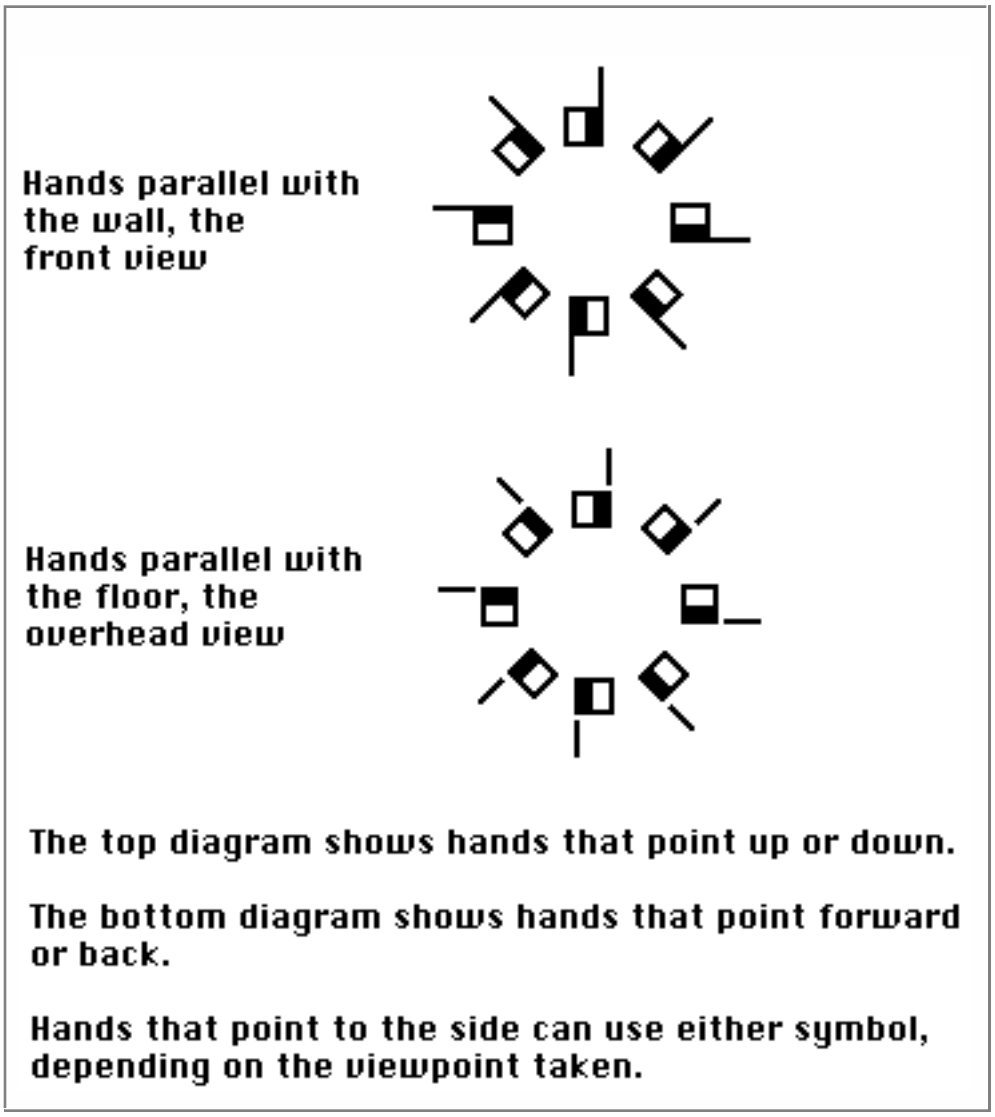
In SSW, Orientation has three parts. Taking advantage of the fact that the back of one's hand is darker than the palm, coloring in the back of the hand symbol indicates which way the palm faces. The other part of orientation, that of the arm's alignment, SSW handles in a completely different arbitrary way, by leaving a small gap in the symbol whenever the arm is aligned parallel to the floor (Figure 11b).

Figure 11b: SSW
Left column below: Hand parallel with your chest.
Right column below: Hand parallel with the floor.



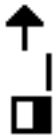
The third aspect of orientation in SSW is the unique fact that the symbols can be rotated to point in different directions (Figure 11c).

Figure 11c
In SSW, the fingers can point in different directions.



The Cree syllabary, another partly featural script, uses the orientation of its letters to represent vowels (Campbell 41), but SSW takes this idea even further. It points its Hand Shapes in the direction dictated by the grammar, just as the signed languages themselves do, and thereby solves the difficult problem of how to write signed pronouns (Figure 11d).

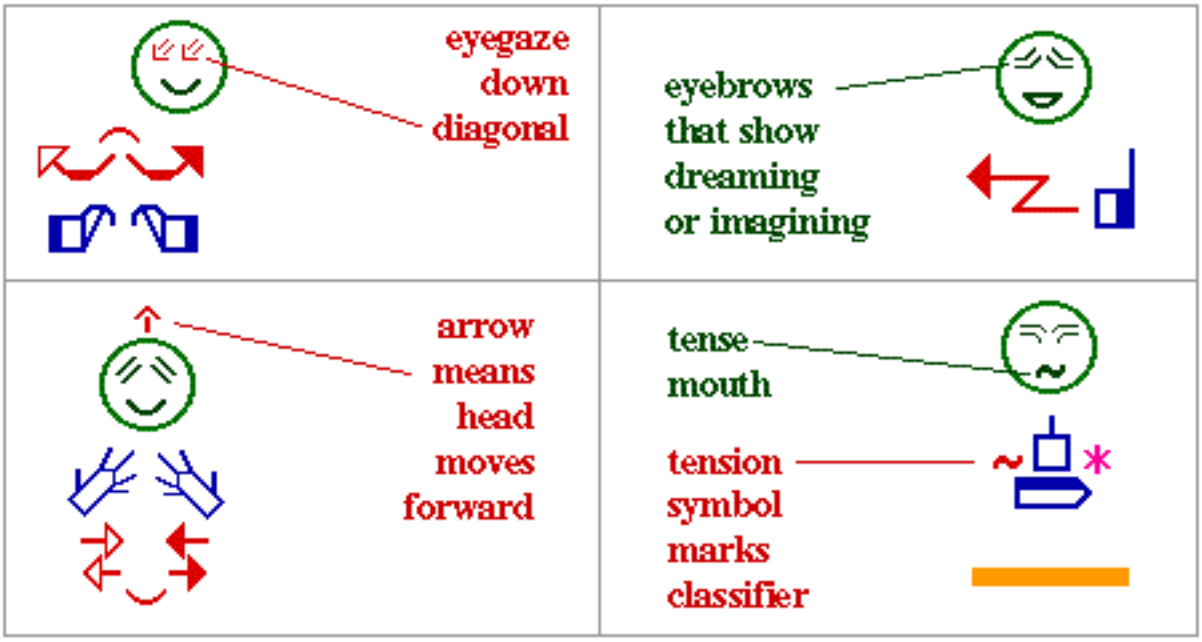
Figure 11d: ASL Pronouns written in SSW.

				
ME	YOU	HE or SHE located left	HE or SHE located right	THEY

5. NMGSs

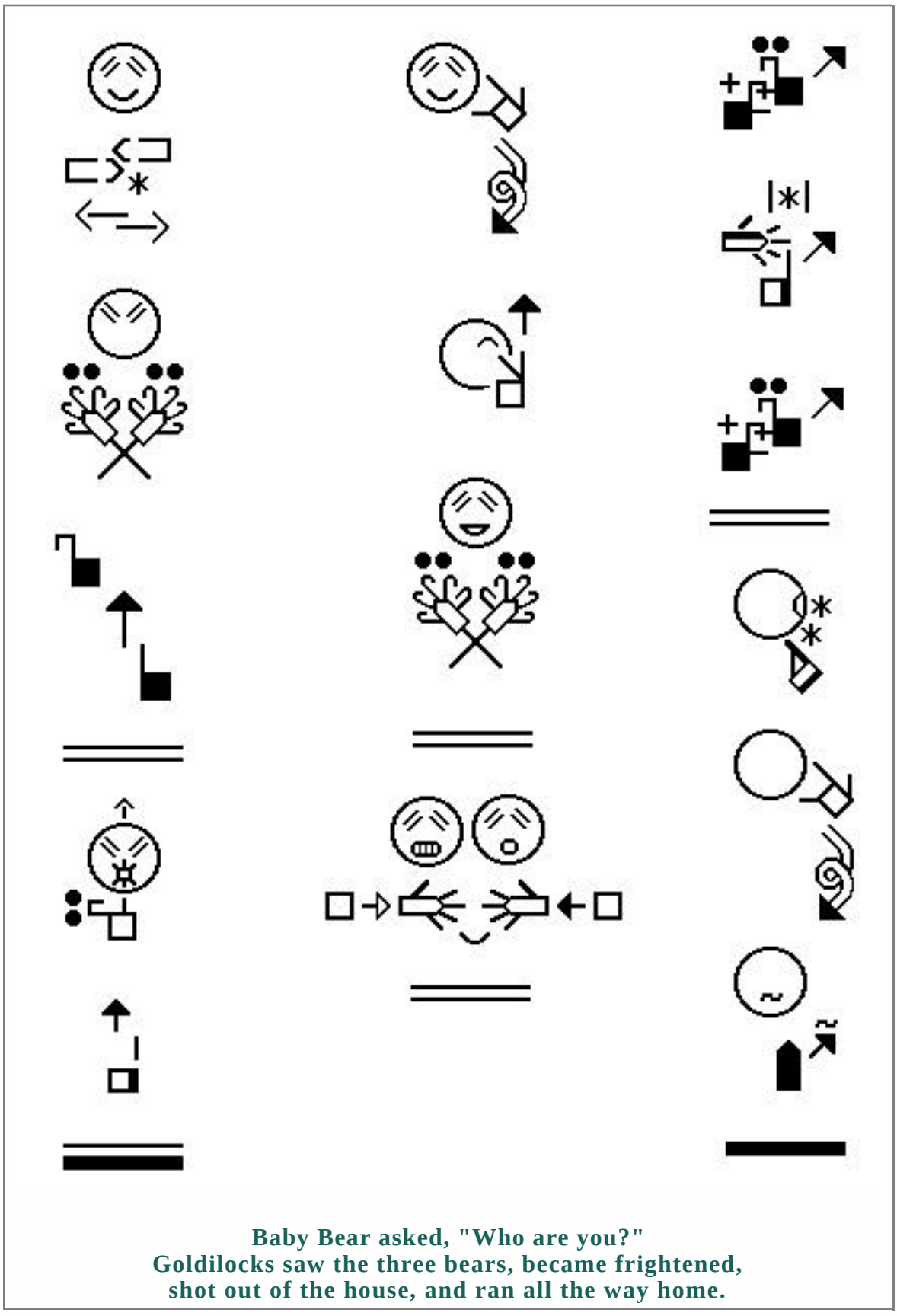
Non-Manual Grammatical Signals is the newer technical term for "facial expression," the most recent parameter to be described. This includes not only movements of the mouth and brows, but also movements of the shoulders, head and body. Without them no signed language is possible (Liddell 1977, 1). They not only signal questions, relative clauses and other grammatical information, but adverbs typically consist of only facial expressions (Figure 11e)

Figure 11e. Facial Expressions & Head Movement in SSW



SN ignores NMGS, and for an interesting reason. Stokoe realized that it was an "integral part of the formation of a sign" but analysis of them "presents many difficulties" and "will be much more feasible after the analysis of the basic aspects" had been carried out (Stokoe 1960, 38). He was wise to do this; today at least six channels by which information is transmitted in Signing have been identified beside the use of the hands: Facial Expression, Eye Gaze, Lip Movement, Body Posture, and Shoulder and Head Position (Kyle & Woll 29). All of these are shown in SSW. In fact chapters 10 and 11 of the SSW textbook are entitled "Facial Expressions" and "Head & Body" respectively, and show these in the usual schematic way (Sutton 1997a). English phrases like "she said happily," can be signed in ASL with a typical adverb, basically a smile, which in SSW looks like a little happy face. Children's stories in SSW are often full of these (Figure 11f)

Figure 11f. ASL children's story written in SSW
An excerpt from Goldilocks shows facial expressions.
It is written down the page in vertical columns, read from left to right.



**Baby Bear asked, "Who are you?"
Goldilocks saw the three bears, became frightened,
shot out of the house, and ran all the way home.**

As always, SSW shows these without reference to any linguistic structure, and so won't be bothered if they should eventually prove to be more than one new parameter. This is unlike traditional approaches, which depend on first isolating the parameters of the language, then assigning symbols for their different settings. In the case of non-spoken languages we simply do not yet know what those parameters are.

STRUCTURE

Discussing how these scripts came about and how they work raises some profound questions about signing, writing, and even the nature of language itself. This next section attempts, if not to answer these questions, then at least to define some of the issues involved.

Taxonomy

Taxonomic approaches like SN in general are unable to deal with spatial location (Stokoe 1987, 119). The number of possible relationships between the hand and the head, or any two articulators, is in theory infinite. A taxonomic approach must fail, as it can't provide an infinite number of symbols. This is not a problem just with writing systems, as our entire concept of language depends on a finite number of units. For instance, in all visual languages pronouns are pointing movements. Depending on where the subject is, there are theoretically an infinite number of places one can point to. Some hold that this removes them from the realm of language altogether (Liddel 2000, 23). Others argue that "a continuum of most linguistic to least linguistic is a useful concept" (Kyle & Woll 123). Either way, facing the complex questions of human perception that are involved may well result in a revised concept of language, and apparently a schematic approach can reflect this new concept while a more traditional approach can't. The pictorial nature of a method like SSW, as we have seen, effectively provides an infinite number of locations. One problem with SSW is that it focuses attention on aspects of language for which linguists are unable to provide answers.

Iconicity

Ferdinand de Saussure's 1916 Course in General Linguistics is "widely held to be the foundation of the modern subject" (Crystal 407). One of his key concepts involves the relationship between words and their meanings, and he "emphasized that the relationship between the two is arbitrary" (407) rather than "iconic" or picture-like. There is nothing about a cat, for example, that gives any indication as to the form of the word used to represent it.

Much of sign language is obviously not arbitrary, yet "Saussure insisted on this as one of the basic properties of language, and its incorporation into the dogma of scientific linguistics has posed a major problem for the linguistics of signed languages" (Armstrong 48). The conflict is more apparent than real: Saussure also stressed that arbitrariness is a matter of degree (Holdcraft 56). Still, Coulmas insists "the decisive step in the development of writing is phonetization; that is, the transition from pictorial icon to phonetic symbol" (1989, 33). Signed languages, however, present the possibility of being both iconic and phonetic at the same time, something that has not been considered previously.

Ordering

Signs, of course, just like spoken words, occur in a time sequence and so are arranged in linear order, and all scripts write them that way. This linearity of speech and writing is more of the "dogma of scientific linguistics" that Armstrong mentions; in this regard both SN and SSW follow convention. However, both SN and SSW use several different types of symbols, corresponding to different parameters, so that any complete character must contain one of each type. The way these two scripts arrange the component parts of their characters is fundamentally different.

> **Note B:** "For Ferdinand de Saussure, this property of linearity constitutes the most crucial characteristic (after its essential arbitrariness) of the (vocal) signifier" (Groves, 366). This should not be construed to mean linear only. Simultaneity is least obvious in the auditory reception of speech, yet even this minimally involves simultaneous perception of the multiple formants that define specific vowels. These of course are created by multiple articulators acting simultaneously. These articulatory movements in both speech and sign follow each other linearly. Overemphasizing either aspect obscures another Saussurean axiom, that language consists of syntagm and paradigm. Without the latter there could be only an endless repetition of identical segments. All language must have both even though speech and sign arguably differ in the relative importance given to each.

SN clings to the traditional idea of the "linear ordering of the speech signal." It arranges its symbols according to a strict formula: the Location symbol is first, followed by the Hand Shape, and lastly the Movement. Movement symbols stacked vertically signify simultaneous movement, while movement symbols following each other horizontally indicate sequential actions. (Even though Stokoe claimed that all the parts of an ASL sign happened at once, his notation clearly shows otherwise. The two dots in "Money" (Figure 12a) stand for repetitions of the same movement.)

This ordering scheme was chosen for economy; like the decimal numbering system, it allows the same symbol to do different tasks. A "B-hand" can stand for a Location (initial position) or for a Hand Shape (center position) depending on its position in the formula. On the other hand, this imposes an artificial relationship on the symbols, that of linear ordering. As Stokoe says, "This order corresponds to no sequence in sign phenomena; it is arbitrary" (Stokoe 1960, 40). However arbitrary, it arises from the traditional view of language as linear segments. Once freed from this artificial constraint, it seems curious to draw two items in the wrong place, and then invent a new symbol to tell how they were arranged to begin with.

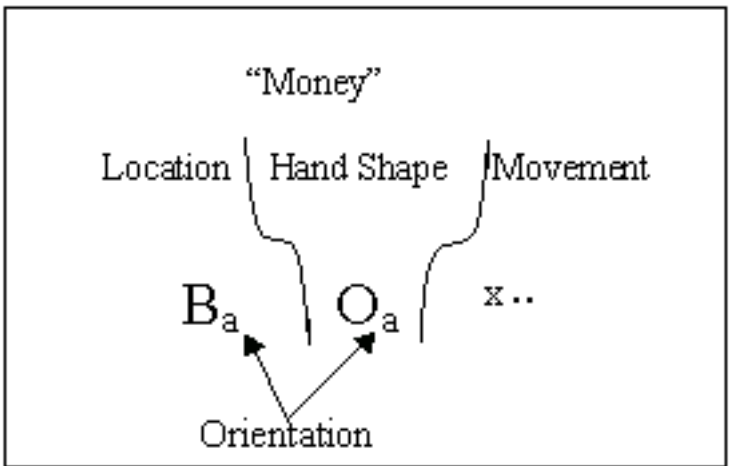


Figure 12a
SN Symbol Ordering

SSW organizes these elements spatially and simultaneously, as they actually occur. The SSW character is not a description of the sign, but an actual map showing the positions of the articulators. The center of the map, the reference point, is the center of the signing space. Unselected articulators, those not involved in making the sign, can be left out if desired, but all selected articulators are shown, together with the spatial relationships amongst them. This is why there is no need for a separate Location symbol. All the parameters, except Movement, can be treated as spatial relationships among the various articulators. The parameter called Location is the relationship of the Hand Shape to the body, the head and the other articulators. Hand Shape itself is no more than the location of (i.e. the relationship among) the fingers, thumb and palm. The parameter of Facial Expression consists of the relationships amongst the brows, lips and other parts of the face. Just like describing a hike through the mountains, there is no question that a map is the best way to represent relationships in space. If the articulators of speech weren't hidden away where we can't see them, it is likely we would use this method for speech too, instead of relying on the secondary information provided by sound waves.

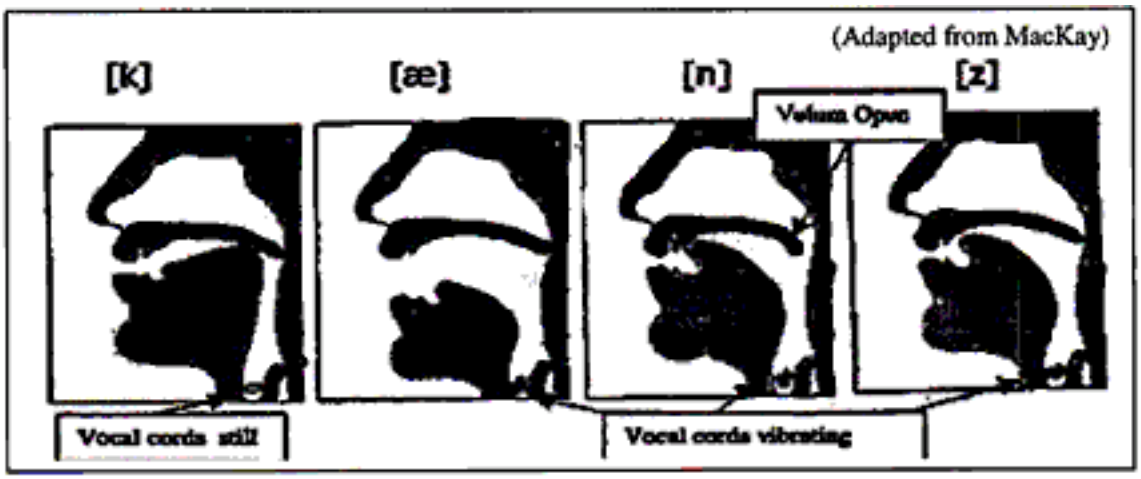
Figure 12b: SSW Symbol Ordering

	A map showing a "flat-O" Hand Shape centered above an open Left palm. The light colored palm is visible in both.

Four Dimensions

Discussions of writing signed languages often express puzzlement at how to represent a three dimensional language on a two dimensional surface. This doesn't seem such a problem in view of the fact that nearly every photograph does so successfully. A better question would be how to add the fourth dimension of time on a 2D surface. Remember that language segments are segments over time during which changes (movements) occur. If there is no movement there is no language. Referring back to Figure 2, we see four speech segments shown both schematically and alphabetically. The pictures show an instant in time, not an entire sequence of movement. The schematic of the first picture means nothing until compared with the second picture, understood to happen later in time, when we can see that the tongue has moved down, unblocking the air flow and thus producing a /k/ sound. The symbol <k> doesn't stand for just the blocked airflow shown in the picture, it stands for the entire sequence of movements involved in the block and release.

Figure 2



Each alphabetic letter then, stands for a certain sequence of movement in 3D space. Each schematic shows the beginning or end of that sequence, so that taken together they indicate the sequence of movement. A third alternative would be to draw arrows with the picture; as do both SN and SSW. All three of these methods successfully represent three-dimensional language on a two dimensional surface, and we have seen how linear ordering adds the fourth dimension.

Another issue is that non-spoken languages often use two sets of articulators at once, as in signing different things with each hand. How to represent this in the linear manner we are accustomed to has been called an insurmountable problem, necessitating awkward multiple lines of script (Miller 199). For SN this may be true, but SSW solves the problem by using a "line" that sees not just one hand but the entire body, thus viewing all the articulators simultaneously.

Reading, Writing & Typing

One problem with both SN and SSW is that neither can be typed on a standard keyboard. No one has ever developed software for typing SN as a popular script. However SN fonts can be found at http://www.panix.com/~grvsmth/stokoe/, and a way to transcribe SN into ASCII is online at: http://world.std.com/~mam/ASCII-Stokoe.html.

The situation with SSW is entirely different. Software has been developed, and this script is used daily throughout the world to type over a dozen different signed languages. It is typed with the SignWriter Computer Program, an MS-DOS program developed in 1986 and constantly upgraded since. The English-ASL edition, which includes a 3000 word ASL dictionary can be downloaded as free shareware at http://signwriting.org/sw128.html.
For a full description of the existing software, see http://signwriting.org/sw124.html.
Much-improved SignWriter 5.0, http://signwriting.org/prog000.html, which runs on both Windows and MAC, is under development. You can read the story of all these developments at http://signwriting.org/prog004.html.

All this technological progress has resulted in SSW becoming much better known, but there is a downside as well. Today, most people become acquainted with the system through the computer generated, printed, version. Assuming that this computer generated printing is all there is to the system, they may attempt to reproduce this by hand, find it too slow and tedious, and conclude that SSW is impractical. This is a misconception. Most scripts, including our own Roman alphabet, provide both a printed version for clarity in reading, and later on a cursive version for ease in writing. Printed SSW, with its filled in shapes and multiple arrows, is designed to be easily learned and read.

There is also not only a handwritten but a shorthand version. This is a very fast way of writing, designed for stenography, with extremely simplified symbols that may take only one or two strokes. In a letter to the SignWriting List, Researcher Dr. Karen van Hoek, formerly of the Salk Institute, describes using this method; "someone in a lab meeting at Salk would say something interesting in ASL, and I would jot it down, maybe with a note, `Can you also say...' and a possible sentence in ASL that I wanted to check out. It was faster than writing signs with English glosses" (2/1/00). This version of SSW can be written at the speed of actual signing, as with other shorthands. Unlike them, there is no need to rewrite it later in full, as it is fully legible on its own. It can be read by people other than the writer, and even many years later (Charles Butler, personal communication, 2/2/00). This handwritten SSW is not instantly readable like the printed version, and this makes it a closer equivalent to the type of scripts we are used to, having to be learned in the usual way by those knowing the language. Seeing the printed version first is intended to make this easier.

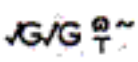
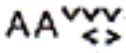
There is no shorthand or cursive SN. It was designed to show the parameters of individual signs, and this it did very well. It was not designed as a popular script, however, and it is difficult or impossible to read. The problem is that the parameters that it presents in linear order don't really occur in that order. There is some question whether it is even possible for our eyes to read this way. Karen van Hoek, now at the University of Michigan, encountered this while working with the similar notation SignFont. She compares it to writing all the letters in alphabetic order, with little numbered subscripts to tell the order to pronounce them. "Obviously this is unreadable," she says," and I think SignFont and Stokoe Notation are unreadable for the same reason" (personal communication 3/12/99).

SSW seems to require the eyes to move in all directions, even backwards at times; yet this may not matter, since skilled readers see not words but whole phrases at once. It seems likely that familiar SSW characters would be read like Chinese logographs yet new ones could be easily "sounded out" by their features. Studies have shown that individual logographs of Chinese can be read by the right brain only, without using the language centers in the left brain (Zaidel & Peters), and this raises questions as to which part of the brain is used in reading SSW pictographs. When little Suzie reads the word "CAT," does she say the sound to herself (phonological recoding) or does she just memorize the series of symbols (pattern recognition)? There is no way to tell, since every script, even Chinese, links the symbols with sound. SSW and SN, for the first time ever, give researchers a way to separate these two methods and discover how we really read. All this cries out to be investigated.

Grammar

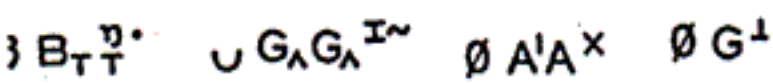
At its most basic, language consists of a grammar as well as a vocabulary. Writing entire sentences raises a whole forest of new problems that don't appear with just single signs, and one of the biggest of these is how to write inflections, or word endings. Instead of adding segments to the end of words as spoken languages usually do, signed languages tend to change the words themselves, along the order of "swim-swam-swum." Alphabetic writing is possible because there are only a limited number of syllables to go in that middle position, from about eighty down to as few as thirteen in Hawaiian (Armstrong 78). However, "there is no limit on the number of elementary gestures that can be performed, as there is a limit on the number of ways that the vocal tract can be configured--one can point anywhere--so, signed languages--have potentially infinite resources"(108). This is why scripts for signed languages have to be featural. All those thousands of syllables combine only a limited number of features, so a featural script needn't have thousands of "letters." Figure 13 shows three entries from the DAC dictionary listing different inflections on an ASL verb. The parameter that varies is movement, so below them I have written what seem to be similar motions from the DASL. Both scripts seem capable of showing this level of detail. SSW uses combinations of the basic movement arrows, with other symbols held in reserve for such details as rate, tension and so on, while SN manages--barely--with its set of movement symbols.

Figure 13: Verb Inflections

Sutton SignWriting	 **Continuative**	 **Distributional**	 **Iterative**
Stokoe Notation	 **signing**	 **cheer**	 **pull repeatedly**

While SN seems capable of handling at least some aspects of grammar, I have found no published attempts to do so. Figure 14 shows a "sentence"--a string of words--taken from DASL, along with its SSW counterpart. One is immediately struck by the analytical nature of SN in contrast with the holistic visual nature of SSW. It is barely noticeable that the location symbols of SN are mildly iconic, showing the side of the face, lower face, and neutral signing space respectively (the last of which SSW shows by an absence of symbols). The vertical bar at the end of the lower SSW sentence marks a pause, and functions the same as an English period. SSW, unlike SN, has a complete system of punctuation.

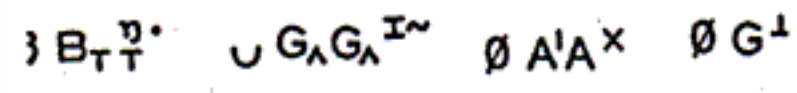
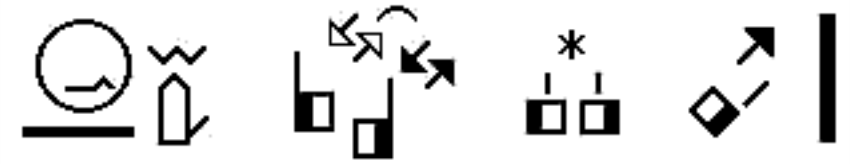
Figure 14:

Stokoe Notation	
Sutton SignWriting	

The second and fourth SSW characters of Figure 14 demonstrate grammatical agreement, perhaps the biggest problem for writing signed language. Speech uses matching segments "**she** ate **her** food" but signed languages use imaginary points in space! It's difficult to see how this could be written in SN, but the second and fourth SSW characters of Figure 14 demonstrate agreement. The movement arrows in both these signs are oriented towards an imaginary point in space that is occupied by the "him" that is being talked about. For the sentence to make any sense they all have to point to the same place. These two signs are pronouns, and if the arrows pointed straight forward it would mean they were pointing at "you" instead of "him". By rotating the symbols SSW can indicate any number of persons. Note that it is SSW's handling of the location parameter that makes this possible. The human eye sees these arrows as pointing to the same spot, with the same limitations on perception applying to SSW as apply to actual signing.

There are also limitations on short term memory that seem to require all languages to express ideas at about the same rate. Although it takes longer to move the articulators in Signing, expressing a given amount of information takes the same amount of time as it takes in speech (Klima & Bellugi 194). Moving the larger articulators in Signing takes longer, but the near-infinite number of possible phonemes allows use of all its various channels at once. Speech has a limited number of phonemes, but the movements of the articulators are very small and fast, making for long strings of contrasting segments. We can write English using strings of ones and zeros with no simultaneous contrasts at all, and for a computer this is practical, but a popular script should reflect whatever simultaneity is present, and this differs between signing and speech.

Figure 14a:

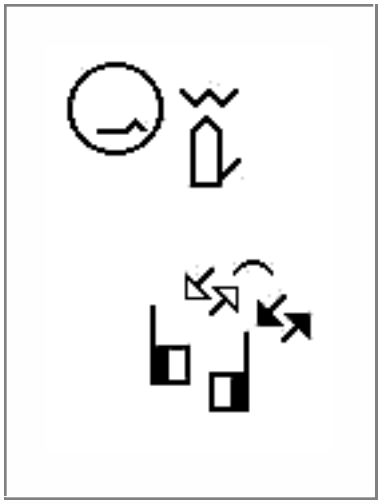
Roman Alphabet	**BEFORE TALK WITH HIM**
Stokoe Notation	
Sutton SignWriting	

The example shown in Figure 14, repeated here in Figure 14a, is neither English nor ASL. It is Pidgin Sign, which is only arguably a language at all. To be language there has to be more than words, there must also be a particular grammar. A grammar, in this special linguistic sense, is a specific set of rules that tell how to put words together in one particular language. In English, the grammar requires putting in function words that tell the grammatical relationships, and word endings. It requires that every sentence has both a subject, and a verb that shows tense. On the other hand, the grammars of both ASL and Japanese allow one to omit both subject and tense. Every language has its own unique set of rules.

Figure 14 doesn't indicate the grammar of any language, it is just a string of words. Two strings, in fact; one taken from English and written in the Roman Alphabet, and the other taken from ASL and written in both SN and SSW. Without knowing the grammar though, there is no way to tell exactly what these words mean. There are any number of ways to make the English word-string into a proper sentence, and the DASL gives us two of them: "I have just been talking with him," or "I had already talked with him." Each of these two ways draws from the grammar of English and adds a tense ending (-ed, -ing), a subject (I), and several function words. The result is a correct, understandable English sentence.

English tends to show its grammar by adding words like this, but ASL has other methods, and tends to use fewer words. For example, it is not necessary to sign "with him" after this ASL verb "talk." This is an "incorporating verb," one which includes both the subject (I) and the object (him). The hands move between the two people talking, clearly showing that the talking is "with" someone, and even telling exactly where that someone is. Rather than meaning "talk" as the gloss suggests, it actually means something more like "(I) conversed with (the specific person in that location)." So this one sign conveys the same meaning as a whole sentence in English. Figure 15 shows the correct sentence in ASL, written in SSW.

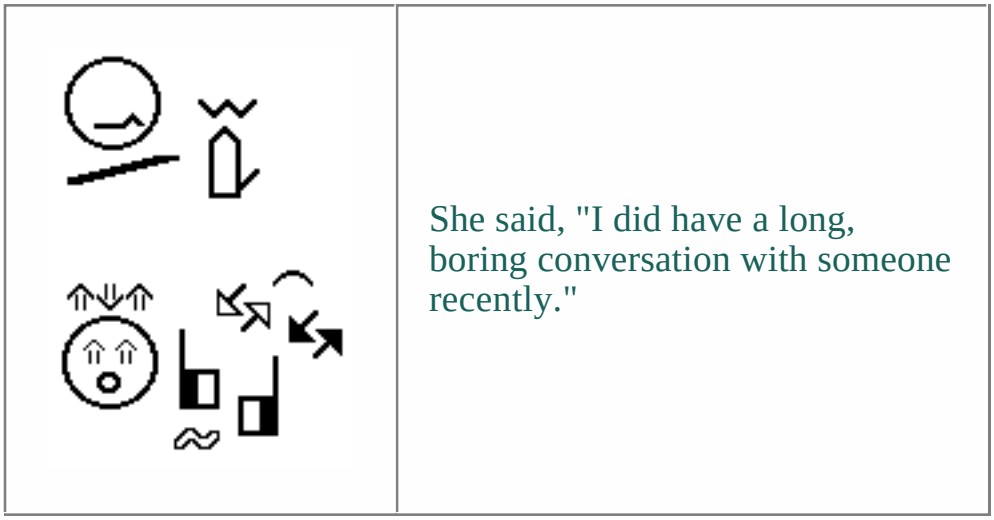
Figure 15



It can't be written in SN for a couple of reasons. First, we have seen how SN is unable to handle the pronoun system of ASL, and for the same reasons we can't use it to write this type of verb. In the example in Figure 14, the movement arrow in the SN character shows movement towards the person talked to. This would not mean "talk with him" at all, it would mean "talk with you." Secondly, the first sign means "at some time in the past." The DASL seems to interpret it as meaning only a short time ago, since it gives the translations "just," and "already." However, these are adverbs, and ASL usually expresses adverbs through the NMGS that were left out of SN. This idea of "just a short time ago" is usually shown by a certain mouth expression involving the lip corners. Combined with a time adverb like this it can mean the same as the English "just _____ed" (Liddell 76). This scrunched up mouth is indicated by the crooked line within the face circle of the first SSW character in Figure 15.

The point is that nearly all the word endings, grammatical function words, and other things that change mere word-lists into meaningful statements, signed languages convey through NMGSs (and a knowledge of the language's specific grammar). Scripts that don't take this into account from the very beginning are not capable of writing signed languages. This includes SN, but not SSW.

Figure 16



The NMGSs include facial expressions involving the brows, and the mouth, and also head nods, eyegaze, and body shifts. Some of them are:

1. Reported speech: By a slight shift of the shoulders, the signer takes on the role of a second party, equivalent to the English "she said" (Liddell 8). This slight shift, since it means someone else is talking, can change all the pronominal and other referents in all the rest of the statement. In our example, the subject of the verb--the person who is talking--changes from "I" to some other person, even though the sign doesn't change (Bahan 150). In Figure 16, the tilted bar in the first character is a "shoulder line," tilted to show this shift in reference.

2. Affirmation: Nodding the head up and down adds the meaning of affirming what is said. Mandatory in many constructions, it can also add affirmation like the English "do" (Liddell 47). Here, it is shown by the arrows above the head circle.

3. Careless manner of performance: The mouth opens in a specific formation to indicate an action is performed carelessly, with little attention (Liddell 77). Since it is used here with the verb "talk," I translate this as "boring." The little circle in the face shows this adverb. Signing the verb with a relaxed type of movement can convey the same idea, and that is the meaning of the hollow wiggly symbol under the character.

4. Unspecified object: A wandering upward eyegaze indicates an unspecified "someone" or "something" (Bahan 174). The arrows inside the head circle indicate this.

Figure 16 puts all these into one ASL sentence, a little contrived perhaps, but grammatically correct. Most of its meaning depends on an understanding of the grammar of the language and the non-manual signals. Even though it takes an extremely large number of English words to translate it correctly, it still uses only the SAME TWO SIGNS as the earlier simple sentence, and would still be given the SAME GLOSS. It is widely admitted that the use of English glosses is inadequate to express sign language, and simply changing the glosses to ASL is little improvement. It seems desirable also that a sentence of two signs should be written as two signs, but without losing any of the meaning of those two signs. The processes discussed here are an integral and necessary part of ASL, and other signed languages are similar. To be unable to show them is to be unable to write the language. To date, SSW is the only script that even approaches being able to do this.

Learnability

From the beginning it has seemed that deaf children can read SSW without even being taught, and in the absence of research, anecdotal evidence is accumulating that this is indeed the case (Kegl, 18 Aug 1999). It seems astounding that this has not attracted researchers, especially in view of the immense effort and misery connected with teaching deaf children to read. Yet this is what we should predict given that SSW is essentially a picture of the sign.

We know that there are several prerequisites to reading alphabetic script. First one must memorize the arbitrary symbols of the alphabet. Then one must learn to break words up into segments, a skill called phonologic awareness, something no one seems able to do without being taught (Rayner & Pollatsek 336). Both these requirements apply in the case of SN.

In a visual language however, phonologic awareness is automatic in a sense--no one needs to be taught to see an extended finger. SSW takes advantage of this as much as possible by using symbols that needn't be memorized. All that is required of the learner is to match a mental image of the sign they already know with the mental image of the picture they are looking at. Of course

some parts of SSW are arbitrary, and must be learned. The hand shapes and locations can be treated as maps, but we can't draw a picture of movement. Just as we predict, the movement symbols are the parts that deaf learners "must learn", whereas the hands and face are read automatically, without their having to be taught (Lourdes Toulette, personal communication Oct 21 1999) (Figure 17).

Figure 17. Ease of Learning Various Scripts.

☺ = Obvious without Instruction **X** = Must be Taught

	English Roman Alphabet	Stokoe Notation	Chinese Characters	Sutton SignWriting
Ordering of symbols	☺	**X**	☺	☺
Linguistic level of script	**X**	**X**	☺	☺
Separate words into Phonetic parts	**X**	**X**	☺	☺
Memorize the symbols	**X**	**X**	**X**	☺

If a child knows how to sign, to a large extent they can read SSW without having to be taught. No other script in the world can make this claim.

Evolution

SN is still in use. One of its major advantages is that it is computer friendly, due partly to its use of standard keyboard symbols, but also partly to its basic organization. Its treatment of each parameter separately lends itself well to manipulation in databases, something very important to research. The Edinburgh Non-Manual Coding System is an adaptation of SN to show NMGS (Miller 198), a translator project is at http://s-leodm.unm.edu/signsynth/, and I am sure there are many other innovations. SN has gone in many different directions, yet no one has ever promoted it as a popular script. Stokoe himself states that "theory suggests" sign language cannot be written (Stokoe 1987, 118), and even in DASL he wrote that "only carefully made motion picture studies or observation of actual signing can give an adequate idea of the nature of [Movement]" (xiv). This attitude persists. "Despite almost forty years of the best efforts of linguists and others, those who write about American Sign Language still generally use pictographs to represent the signs they discuss. Because of the extreme complexity of the sublexical structuring of ASL (in four dimensions), reducing it to the two dimensions of phonetic writing may prove more trouble than it is worth" (Armstrong 99). It's almost embarrassing to point out that their favored pictographs are in two dimensions. As long as their theory won't allow them to view such writing as phonetic, these writers are at a dead end.

By contrast, SSW is actively supported by a dedicated community of users. By now there are many such communities throughout the world, using SSW for many different languages, and each area is developing their own orthographies. The Danes have dropped the symbol for Contact, in keeping with the normal trend toward a more phonemic, less phonetic script (Sutton, 25 Jun 99). Nicaraguan Sign Language now underlines all proper names (Kegl, 2 Nov 98). There are other examples, and new ones arise constantly as SSW adapts to the needs of varied signing communities. A growing body of literature is being produced, including an ongoing Bible translation available on-line at:

The SignBible Site
http://cyberjer.com/signbibl/

A recent change, unique in the history of writing, has been the switch to writing in vertical columns instead of horizontally. This aids in showing some grammatical constructions in ASL, such as comparisons:

The Importance of Writing
SignWriting Down In Columns
http://www.signwriting.org/vert000.html

CONCLUSIONS

William Stokoe's proof that ASL was a true human language ranks among the great intellectual achievements of all time. The resulting separation of language from speech has solved one of history's great philosophical problems, and forced us to revise our most fundamental ideas. No longer can language be defined in terms of sounds, and time-honored concepts like arbitrariness and linearity have taken on new roles. We are well past the time when it is acceptable to state that "talking =thinking = being human" (Leiberman 4), or that "the primary defining feature of writing is the representation of speech" (DeFrancis 248). We are approaching the point where no one can afford to remain ignorant of these advances and still call themselves linguists. The future calls upon us to look far outside the traditional domain of linguistic study and to examine methods previously seen as having no bearing on the science.

These two scripts well illustrate this. Stokoe developed his notation at a time when a signed language was literally unimaginable, and of necessity he built on existing linguistic theory. He published his work in 1960 knowing it was incomplete and leaving for others the task of developing his new script into a viable writing system. That others have not done so seems due precisely to its being based on traditional concepts. Attempts to force the new data to conform with traditional assumptions have led to failure, while on the other hand SSW has pursued a course independent of these assumptions, and this has allowed it to work.

SSW is working. Today schools are using it, as in Nicaragua (Brooks D-2), research establishments are adopting it, as has California's Salk Institute after finding other systems inadequate (Clark 6), and it is being used in regular correspondence and publications (Sutton 1997b, 3).

Just as new discoveries in physics forced physicists to expand their theoretical concepts to encompass Relativity, linguists are now being forced to expand their models to encompass senses other than speech. These new notations for human language serve both to illustrate the necessity of this and as tools for its accomplishment.

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