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UNIVERSAL CONSTRAINTS ON TWO-FINGER EXTENSION ACROSS SIGN LANGUAGES

James Woodward

Introduction. Linguists investigating American Sign Language (ASL) have expressed interest in a theory of marking for sign language phonology; i.e. the level of sublexical structure in sign languages analogous to but not dependent on the phonological components of spoken languages.[1] Battison (2) and Siple (19) are notable pioneers in research on physiological constraints on [the making of] signs. Others have sought perceptual bases for discrimination of formational aspects in order to develop a feature analysis of handshapes and locations by using a visually degraded signal (13,17). Frishberg and others have shown that signs in ASL and French SL undergo natural language change comparable to "unmarking" in spoken languages (7,27,28). Boyes proposed a four-stage model of handshape acquisition in ASL (4). McIntire retained the four-stage model but posited somewhat different handshapes in each stage (14,15).

Much of this data, however, as De Santis pointed out, is based on the production of signs by White, middle-class linguistic consultants (6). In addition, most studies have used data from the performance of only one or two consultants. De Santis (6) and Woodward (24) attempted to expand studies of marking by looking at

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certain locations and handshapes across nine different sign languages from five different sign language groups.

Language	Source	Number of lexical entries (personal names excl.)
1. American	21	1,962
2. Australian	10	919
3. British	5	325
4. Finnish	18	2,974
5. French	16	872
6. Japanese	9	1,078
7. Providence Is.	Field data (1977)	1,035
8. Rennell Is.	12	217
9. Swedish	3	2,541
10. Indian	22	896

Table 1. Sources of data, source & sample size.

In this paper I will examine two-finger extension in data from ten different sign languages. A summary of sources of data and of language relationships follows. Table 1 shows the languages, the data sources, and the size of the sample. Not all data was collected by trained linguists. The most trustworthy data (with regard to form and not necessarily meaning of signs) is from Providence Island, India, Rennell Island, ASL, and FSL -- all languages investigated by linguists. Regardless of the disciplinary background of investigators, however, all the languages show the same patterns and similar frequencies for handshape formation. Table 2 shows hypothesized relationships among these sign language varieties; it divides them into six groups: French, British, Asian, Indigenous 1, Indigenous 2, and Unknown affiliation.

Group	*Sign language(s)*
French SL:	*American, Finnish, French, Swedish*
British SL:	*Australian, British*
Asian SL:	*Japanese*
Indigenous 1:	*Providence Island*
Indigenous 2:	*Rennell Island*
Unknown affil.:	*Indian*

Table 2. Hypothesized relationships among SLs.

The French Sign Language group is the best researched of these sign languages. Old French Sign Language (FSL) was used until about 1880, at which time it was forced underground by mandatory oral education and the banning of deaf persons from instructional positions in France. Modern FSL is a highly restructured version of Old FSL. ASL is historically related to Old FSL, but there is evidence to support the hypothesis of a language mixture and the possible creolization of Old FSL with indigenous varieties of ASL in the United States ca. 1817 (25). Swedish and Finnish sign languages may be related to Old FSL, but modern FSL, ASL, Swedish SL and Finnish SL are not mutually intelligible (2,11).

The British Sign Language group may have a tenuous connection with FSL, but it is viewed primarily as a separate group of historically related languages distinct from the FSL group. Stokoe reports much greater difficulty in establishing communication in sign with British than with French signers (21). It is important to distinguish communication between signers from mutual intelligibility of sign languages: communication between

signers of unrelated languages may occur beyond any mutual intelligibility of languages because of a general flexibility on the part of deaf people to modify their own signs, to create spontaneous hybrids or pidgins, or to resort to pantomime (2).

Japanese Sign Language is not related historically to the French or British groups, but it appears to have some connection with Hong Kong and Taiwanese deaf signing.

Indigenous sign languages are found in isolated groups who have no direct contact with users of other sign languages. Providence Island in the Caribbean is very isolated and has three to six times the expected deaf population -- at least seventeen deaf people in approximately three thousand (23). In addition, it has a different sign language from Colombia, to which it belongs.

The other indigenous sign language, reported by Kuschel (12), in contrast to that of Providence, is used by only one deaf man (with his hearing companions) among the approximately twelve hundred inhabitants of Rennell Island in the Pacific.

Indian Sign Language (i.e. the sign language used by deaf people in India), while influenced slightly by British and American SLs (through missionary contact), definitely belongs to a different group from any of the others in the list (22).

With this body of data, I will examine the relative frequencies of occurrence of handshapes with two-finger extension; but note that not all sign languages make use of all six two-finger extended handshapes; i.e. index + mid (V-hand and H-hand[2]), index + ring, index + pinky (Ψ-hand), mid + ring, mid + pinky, and ring + pinky.

Sign Language	No. entries	1-Finger ext. %	2-Finger ext. %
American	1,692	16.1	9.5
Australian	919	16.8	7.9
British	325	20.6	3.4
Finnish	2,975	18.7	7.9
French	872	13.5	6.9
Indian	896	20.5	4.7
Japanese	1,078	23.9	5.8
Providence Is.	1,035	21.6	1.3
Rennell Is	217	17.1	3.2
Swedish	2,541	17.4	6.3

Table 3a. Frequencies of 1-finger extension and 2-finger extension handshapes in whole lexicon.

Sign Language	No. entries	1-Finger ext. %	2-Finger ext. %
American	1,692	14.8	7.0
Australian	919	16.3	6.8
British	325	20.6	3.4
Finnish	2,975	18.6	6.9
French	872	12.9	5.0
Indian	896	19.6	4.7
Japanese	1,078	23.9	4.2
Providence Is.	1,035	21.6	1.0
Rennell Is	217	17.1	2.7
Swedish	2,541	17.4	5.8

Table 3b. Frequencies, with numeral signs and signs borrowed from spoken languages excluded.

Before looking at the relative marking of two-finger handshapes to each other, it is useful to note that two-finger handshapes, like one-finger handshapes, are basically closed handshapes; i.e. the non-extended fingers and very often the thumb are balled into a fist. Two-finger handshapes are more marked than one-finger handshapes. Evidence for this comes from two

sources, psycholinguistic data and cross-linguistic frequency data. Single finger handshapes are acquired before or at the same time as two-finger handshapes (4,14,15). Cross-linguistic data (Tables 3a, 3b) show that single finger handshapes occur with much greater frequency than do two-finger handshapes.

We can now examine comparative data on two-finger handshapes to determine if there are frequency differences within two-finger handshapes for the ten sign languages under study.

SL	No. entries	Index + Mid	Index + Pinky	Pinky + Ring	Pinky + Mid	Mid + Ring	Index + Ring
Finnish	2,974	7.8	.1	.03	0	0	0
American	1,692	8.9	.6	0	0	0	0
French	872	6.8	.1	0	0	0	0
Swedish	2,541	6.2	.1	0	0	0	0
Indian	896	5.6	.3	0	0	0	0
Australian	919	7.9	0	0	0	0	0
Japanese	1,078	5.8	0	0	0	0	0
British	325	3.4	0	0	0	0	0
Rennell Is.	217	2.7	0	.5	0	0	0
Prov. Is.	1,035	1.3	0*	0**	0	0	0

** Providence Is. SL has two signs with index + pinky at the phonetic level; however, this form can be derived from an underlying index + mid, and so these two signs ae not listed under index + pinky.*

*** PISL also has a variant of the number 'two' (pinky + ring); this variant is not common and can be considered to be subsumed under the main morpheme for 'two', which is made with index + mid. Thus this variant is not listed under pinky + ring.*

Table 4a. Frequencies of handshapes with 2-finger extension (all signs included).

Analysis. Table 4a shows an analysis of frequencies of two-finger handshapes in the ten sign languages. Three 2-finger handshapes do not occur in

these sign languages (mid + ring, pinky + mid, index + ring); moreover, it is doubtful that they will occur in any sign language. Pinky + ring occurs only in Finnish SL and Rennell Island SL with one sign in each. Rennell Island SL shows the only exception to the pattern. Index + pinky occurs in the majority of sign languages but much less frequently than index + mid, which occurs in all the sign languages. Thus, handshapes on the left side of Table 4a are less marked (more natural) than those on the right-hand side.

Table 4a, however, does not present the complete picture. Some of the two-finger handshapes occurring are borrowings from spoken languages by using an initial manual alphabet handshape in their production, or they are used only in hand counting systems (not part of the sign language and reflecting hearing, not deaf, culture). Table 4a shows the relative markedness in sign languages if these borrowings from spoken languages are included. To determine the relative markedness of these handshapes purely within sign languages, without influence from spoken languages, these borrowed signs should be excluded from the analysis. Table 4b shows frequency of handshapes with these excluded.

There are now no exceptions to the pattern. Only three of the six possible handshapes occur in the data. A language's having pinky + ring always implies it has index + pinky, which always implies it has index + mid. Index + mid is always more frequent than index + pinky, which is always more frequent than pinky + ring.

The relative markedness of these handshapes also holds in correlations of the number of locations where the handshape can occur. Table 5 shows this relationship of handshape and location permitted by each language.

SL	No. entries	Index + Mid	Index + Pinky	Pinky + Ring	Pinky + Mid	Mid + Ring	Index + Ring
Finnish	2,974	6.8	.1	.03	0	0	0
American	1,692	6.4	.6	0	0	0	0
French	872	4.9	.1	0	0	0	0
Swedish	2,541	5.7	.1	0	0	0	0
Indian	896	4.4	.3	0	0	0	0
Australian	919	6.8	0	0	0	0	0
Japanese	1,078	4.2	0	0	0	0	0
British	325	3.4	0	0	0	0	0
Rennell Is.	217	2.7	0	0	0	0	0
Prov. Is.	1,035	1.0	0*	0	0	0	0

* See note above, Table 4a.

Table 4b. Frequencies of handshapes with 2-finger extension, with number signs & signs borrowed from spoken languages excluded.

Group	Hands or O-tab	Face	Trunk	Arm
0	-	-	-	-
1	+	-	-	-
2	+	+	-	-
3	+	+	+	-
4	+	+	+	+

Table 5. Possible locations for handshapes.

The import of Table 5 is that if a handshape can occur on the trunk, it can also occur on the face, and if on the face, then also on the hands or in zero-tab. Thus, if a handshape can occur in a more marked location, it tends to occur also in a less marked location (see also ref. 6).

The data fit this pattern nicely. Table 6 shows the actual correlation of handshape with location (without borrowings from spoken languages). There are 64 slots in the implication table and only one exception to the implication, yielding a 98.4 % rate of scalability.

Group	Hand or O	Face	Trunk	Arm	Handshape	Language
4	+	+	+	+	index+mid	Finnish
2	+	+	–	+	"	" American
4	+	+	+	+	"	" French
4	+	+	+	+	"	" Swedish
4	+	+	+	+	"	" Indian
3	+	+	+	–	"	" Austral.
2	+	+	–	–	"	" Japanese
3	+	+	+	–	"	" British
2	+	+	–	–	"	" Rennell I
2	+	+	–	–	"	" Prov. Is
1	+	–	–	–	index+pnky	Finnish
2	+	+	–	–	"	" American
1	+	–	–	–	"	" French
1	+	–	–	–	"	" Swedish
1	+	–	–	–	"	" Indian
1	+	–	–	–	pinky+ring	Finnish

Table 6. Actual correlation of 2-finger handshapes with location.

In addition to the regularity shown in Table 6, it is also possible to find another implication based on the group number. Table 7 shows this relationship. In all cases unmarked handshapes can occur in more locations than do marked handshapes. Index + mid occurs in more locations than index + pinky (or as many), and index + pinky occurs in more locations than does pinky + ring.

We can still offer some further tests of markedness by comparing these normal two-finger handshapes to some other related handshapes; i.e. bent and crossed handshapes involving two fingers. Table 8a shows frequencies for bent two-finger handshapes. Both bent and crossed counterparts follow the same implicational pattern as do straight two-finger handshapes. Notice that bent and crossed handshapes are even more constrained (marked) than straight ones, since only index + mid can be bent or crossed. Note too that not all sign languages make use of these very marked features.

Sign Language	Number of Lexical Entries	Bent Index + Mid	Bent Index + Pinky	Bent Pinky + Ring	Bent Pinky + Mid	Bent Mid + Ring	Bent Index + Ring
American	1,692	1.2%	0	0	0	0	0
Australian	919	1.0%	0	0	0	0	0
Finnish	2,974	1.2%	0	0	0	0	0
French	872	.6%	0	0	0	0	0
Indian	896	.3%	0	0	0	0	0
Japanese	1,078	1.0%	0	0	0	0	0
British	325	.3%	0	0	0	0	0
Swedish	2,541	0	0	0	0	0	0
Rennell Is.	217	0	0	0	0	0	0
Providence Is.	1,035	0	0	0	0	0	0

Table 8a. Actual Frequencies of Handshapes With Bent Two Finger Extension (No signs with bent two finger handshapes are numnbers or are borrowed from oral languages.)

SL	*Ind+mid*	*Ind+pky*	*pky+rng*	*pky+mid*	*mid+rng*	*Ind+rng*
Finnish	4	1	1	0	0	0
American	2	2	0	0	0	0
French	4	1	0	0	0	0
Swedish	4	1	0	0	0	0
Indian	4	1	0	0	0	0
Australian	3	0	0	0	0	0
Japanese	2	0	0	0	0	0
British	3	0	0	0	0	0
Rennell Is	2	0	0	0	0	0
Providence	2	0	0	0	0	0

Table 7. Implicational grouping of location with 2-finger handshapes (w/o numeral & borrowed).

Sign Language	Number of Lexical Entries	Crossed Index + Mid	Crossed Index + Pinky	Crossed** Pinky + Ring	Crossed Pinky + Mid	Crossed Mid + Ring	Crossed Index + Ring
American	1,692	.2%	0	0	0	0	0
Australian	919	.1%	0	0	0	0	0
Finnish	2,974	.1%	0	0	0	0	0
French	872	0	0	0	0	0	0
Indian	896	0	0	0	0	0	0
Japanese	1,078	0	0	0	0	0	0
British	325	0	0	0	0	0	0
Swedish	2,541	0*	0	0	0	0	0
Rennell Is.	217	0	0	0	0	0	0
Providence Is.	1,035	0	0	0	0	0	0

*One sign in the Swedish Sign Language data appears to have an R handshape. However, this means a crossed handshape occurs less than .04%. For all practical purposes this is a zero occurrence.

**In some sign languages, e.g. Taiwanese Sign Language, there is a crossed handshape involving four fingers. In this handshape, the index is crossed with the mid and the pinky is crossed with the ring simultaneously. However, there are no reported occurrences of a two finger handshape with only the pinky and ring extended and crossed.

Table 8b. Actual Frequencies of Handshapes With Crossed Two Finger Extension (numbers and signs borrowed from oral languages excluded)

The relationship among straight, bent, and crossed is shown graphically in Table 9. For all sign languages, straight handshapes are more frequent than bent, and bent are more frequent than crossed.

SL	*Lexical entries*	*Str. index + mid*	*Bent index + mid*	*Crossed ind. + mid*
American	*1,692*	*6.4 %*	*1.2 %*	*.2 %*
Australian	*919*	*6.8*	*1.0*	*.1*
Finnish	*2,974*	*6.8*	*1.2*	*.1*
French	*872*	*4.9*	*.6*	*0*
Indian	*896*	*4.4*	*.3*	*0*
Japanese	*1,078*	*4.2*	*1.0*	*0*
British	*325*	*3.4*	*.3*	*0*
Swedish	*2,541*	*5.7*	*0*	*0**
Rennell Is.	*217*	*2.7*	*0*	*0*
Providence	*1,035*	*1.0*	*0*	*0*

** One sign in Swedish SL data appears to have an R-handshape (index crossed by mid), but this means a crossed handshape occurs less than .04 %, here treated as zero.*

Table 9. Comparison of actual frequencies of relevant straight, bent, and crossed handshapes involving 2-finger extension (w/o number & borrowed signs).

Explaining marking. In an earlier paper (26), I proposed that handshapes that are non-central and ulnar are least marked. These features are shown below for single-finger handshapes:

	Unmarked - - - - - - - Marked			
	index	pinky	mid	ring
central	-(u)	-(u)	+(M)	+(M)
ulnar	+(u)	-(m)	+(u)	-(m)

It seemed reasonable to look for a similar solution for two-finger handshapes. However, the above explanation does not work for two-finger extension. In fact, no

solution with known features on the extended fingers proved successful to explain two-finger extension.

After some time I began to look at the closed fingers and found that while handshapes with finger extension are probably best described by extension, relative markedness is best explained through features on both extended and closed fingers; e.g. a V-hand is best described as "index + mid, extended, and spread." However, the relative markedness of V is determined not only by these features but also by the relationship of the closed fingers to each other.

The most important characteristic that determines markedness for handshapes with two-finger extension is the adjacency of the closed fingers. Adjacent closed fingers make the handshape least marked, as is shown graphically below:

	Marked - - - - - - - - - - - - - - Unmarked					
	index + mid	index + pinky	pinky + ring	pinky + mid	mid + ring	index + ring
closed fingers adjacent	+(u)	+(u)	+(u)	+(M)	-(M)	-(M)

The three most marked handshapes do not have their closed fingers adjacent. These handshapes, while possible of formation, do not occur in the data on the ten sign languages here examined.

Several other features may be interacting to explain markedness in the three handshapes that do occur. More ulnar is unmarked, adjacency of extended

fingers is unmarked, ring finger extension is very marked. Below we can see how these features apply to the handshapes that do occur in the data:

	Unmarked		Marked
	index + mid	index + pinky	pinky + ring
ulnar	+(u)	x(M)	-(M)
ring f. ext.	-(u)	-(u)	+(M)
adjacency	+(u)	-(m)	-(u)

While all of these features may be important, the ulnar feature in itself is sufficient to explain what occurs.

What is interesting about the above explanation is that it explains not only two-finger extension but also single-finger extension. Below, the features of closed finger adjacency and ulnar are applied to handshapes with single-finger extension:

	Unmarked			Marked
	index	pinky	mid	ring
cl. finger adjacency	+(u)	+(u)	-(M)	-(M)
ulnar	+(u)	-(m)	+(u)	-(m)

Both single-finger and two-finger extension are unmarked if the closed fingers are adjacent. Single-finger extension rarely allows non-adjacent closed

fingers. Two-finger extension, because it is more marked than single-finger extension, does not allow non-adjacent closed fingers. Ulnar is unmarked for both single- and two-finger extension.

Conclusion. The analysis of these data shows that a theory of marking can be developed for sign languages along the same lines as those used for spoken languages -- only the particular physiology is different. The data here show the same trends as those found by Greenberg (8); i.e. the occurrence of more marked (more complex) units will imply the occurrence of less marked (more natural) units, and more complex units will be less frequent of occurrence than less marked units. In addition, more complex units will tend to be learned later than the more natural ones.

We have seen, for example, that sign languages with two-finger extension also have single-finger extension, and that there are a much larger number of single-finger handshapes than two-finger handshapes. The data from the all too few studies of child language of ASL also indicate that handshapes with single-finger extension are learned before (or at the same time as) handshapes with two-finger extension.

Also found: the non-adjacency of closed fingers in handshapes implies adjacency, non-ulnar characteristics imply ulnar, bent implies non-bent or straight, crossed implies non-crossed, and crossed implies bent. Adjacent is more frequent than non-adjacent, ulnar more frequent than non-ulnar, straight more frequent than bent, which itself is more frequent than crossed. The data from child acquisition of ASL show that adjacent, ulnar, and straight extended finger handshapes are learned earlier

than (or at the same time as) non-adjacent, non-ulnar, bent, or crossed handshapes. Thus, as expected in marking theory, forms that are most complex imply simpler forms and tend to be statistically less frequent as well as later-learned than simpler forms.

More research is obviously needed, especially -- comparative data from widely diverse sign languages, before a true theory of marking can be developed for sign language phonology. However, such pieces as we are able to fit together at this time suggest a strongly ordered hierarchy of marking for sign language handshapes and point to a natural theory of phonology for all sign languages.

NOTES

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[2] For the purpose of this paper, V (spread) and H (non-spread) handshapes with index and middle finger are counted together. For readers interested in separate counts for V and H, the frequencies are shown below. Note that Japanese and Providence Island SLs do not distinguish between V and H, and that V is more frequent than V, as H is more frequent than H. Number and initialized signs from fingerspelled words are excluded from the analysis below:

Sign language	V %	H %	Bent V %	Bent H %
American	4.3	2.1	1.0	.2
Australian	2.8	4.0	.9	.1
Finnish	4.7	2.1	1.0	.2
French	3.4	1.5	.2	.1
Indian	2.3	2.1	.1	.1
Japanese	4.2	1.9	.1	0
British	1.9	1.5	.3	0
Providence Island	1.0	1.5	0	0
Rennell Island	1.8	.9	0	0
Swedish	3.2	2.5	0	0

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Patricia Siple and Susan Fischer are planning a conference on the theme: Theoretical Issues in Sign Language Research, and would like to invite papers (to be refereed) on the topics listed below.

The conference is to be held in Rochester, New York at the University of Rochester, from June 13th through June 16th in 1986. Abstracts are to be submitted -- by September 1, 1985 -- to

Patricia Siple, Ph.D.
Department of Psychology
Wayne State University
Detroit, MI 48202

Topics:

1. ASL structure
2. Psycholinguistics of SL
3. Neurolinguistics of SL
4. Acquisition of SL
5. Signing in English/bilingualism
6. Signing in exceptional populations

The organizers wish to invite as wide participation as possible. Further information will appear in the Summer issue of Sign Language Studies.

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c o n t e n t s

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