Complexity in two-handed signs in Kenyan Sign Language

Evidence for sublexical structure in a young sign language

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This paper investigates whether two-handed signs in Kenyan Sign Language, a relatively young school-based sign language, conform to the same constraints on combinations of movement and handshape that hold in other sign languages. An analysis of 467 two-handed signs, separated into four types based on complexity, found that KSL is highly constrained, with only a few signs that violate proposed conditions. Three hypotheses to account for handshape restrictions on the non-dominant hand in highly complex signs are tested. Findings show that a universal unmarked set accounts for most of these handshapes; a language-specific unmarked set does no better; and a constraint on markedness at the featural level essentially accounts for all the signs. Further analyses discover that a preference for unmarked handshapes in the most complex signs extends to all two-handed signs to some degree. Finally, a phonotactic preference for the *G/1* handshape on the *dominant* hand in complex signs is uncovered. Some evidence suggests that this tendency may surface in other languages as well.

Keywords: Kenyan Sign Language, complexity, dominance, symmetry, handshape, markedness

1. Introduction

A unique property of language in the visual-manual modality is that it has two identical articulators, the hands, rather than a single vocal tract. However, not all possible permutations of the hands are attested, and not all attested combinations occur to the same degree within a lexicon (Battison 1978; Rozelle 2003; Eccarius & Brentari 2007; Crasborn 2011). These differences appear to be motivated by differing levels of formational complexity. The current study tests whether the same

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pattern found in other languages is observed in an under-described language, Kenyan Sign Language (KSL).

KSL is a relatively young language less than 50 years old. Thus it might be predicted to contain more holistic, iconic forms than older sign languages, resulting in more complex permutations in two-handed signs than has been found in older sign languages. Evidence for this prediction comes from studies of historical language change. Two-handed signs in older sign languages become formationally less complex over time (Frishberg 1975; Radutzky 1990). Also, research on a relatively young language, Al Sayyid Bedouin Sign Language (ABSL), finds that iconic signs prevail to such an extent that phonological components have not yet precipitated out (Sandler et al. 2011). However, factors other than language age, such as the size of the signing community and characteristics of interactions (context-dependency, portability), may also influence the level of iconicity in a language (Nonaka 2004; Nyst 2007; de Vos 2011), such that smaller communities will maintain more iconicity. This may be the case for sign languages like ABSL and Adamorobe Sign Language (Nyst 2007).

In the present study, we ask how KSL compares to older sign languages in its phonotactic patterning in two-handed signs. Here we analyze a corpus of 991 signs and find that KSL, despite its youth, limits the two hands in lexical production in highly constrained ways, more so even than older languages in some respects.

The paper is structured as follows. First, a description of the constraints on two-handed signs is provided (Section 2), followed by a history of KSL (Section 3), and the predictions for how KSL will conform to the constraints, or not (Section 4). Section 5 details the materials and methods in the paper, Section 6 offers the results, and further analysis and discussion is provided in Sections 7 and 8.

2. The Symmetry and Dominance Conditions

The two hands are important formational components in the structure of signs. Battison (1978) analyzed the combinatorial possibilities for these two articulators and found that not all combinations are possible in American Sign Language (ASL). To explain this, he proposed a hierarchy of complexity in different types of two-handed signs, based on the degree of redundancy and informational content in the two articulators (1978: 31–32). A two-handed sign that shares all phonological aspects is the most redundant and therefore least complex. An ASL example is given in (1) showing a sign with the same handshape, movement, and location.

In this view, increasing mismatches (departures from symmetry) between the two hands in each of these aspects create more complexity, and Battison posited that ASL prohibits the most complex forms. He formulated two conditions

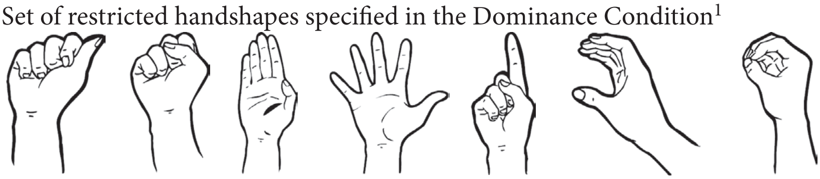
(1) ASL sign ADDRESS (courtesy of Signing Savvy, LLC):
Both hands with *Å* handshape touching the torso move upward, once

that captured the constraints governing possible combinations, the Symmetry Condition (2) and Dominance Condition (3) (Battison 1978: 33–34).

(2) **The Symmetry Condition**
a. if both hands of a sign move independently during its articulation, then
b. both hands must be specified for the same location, the same handshape, and the same movement (whether performed simultaneously or alternatingly).

(3) **The Dominance Condition**
a. if the hands of a two-handed sign do not share the same specification for handshape (i.e. they are different), then
b. one hand must be passive while the active hand articulates the movement, *and*
c. the specification of the passive handshape is restricted to be one of a small set: *A*, *S*, *B*, *5*, *G*, *C*, *O*.

(4) Set of restricted handshapes specified in the Dominance Condition[1]



Importantly, these restrictions exclude "a large number of logically possible gestures in which two hands perform different motor activities" (Battison 1978: 34; see also Crasborn 2011). Further research has shown that these two conditions constrain lexical items to a greater degree than handshapes and movement in

1. Images courtesy of Gladys Tang.

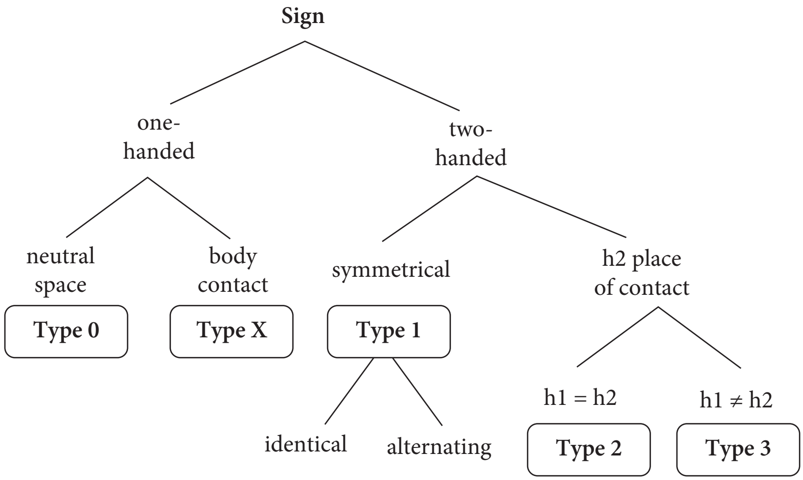


Figure 1. Schematic representation of Battison's sign typology. *h1* is the dominant hand; *h2* is the non-dominant hand.

morphological or syntactic constructions (Engberg-Pederson 1993: 295; Eccarius & Brentari 2007).

For Battison, the limitation on handshapes in the Dominance Condition was significant evidence that complexity is the source of restricted combinations. This is because handshape is only restricted in the narrow environment of the non-dominant hand in a sign unmatched for both handshape and movement — the most complex combination allowed. The set of handshapes in this environment (4) stands out in other ways, too. Battison noted that the seven handshapes allowed on the passive hand share traits that designate them as *unmarked* elements. First, they are maximally distinct geometric shapes; second, they are the most common handshapes across many different contexts in ASL; third, they are found in other sign languages; fourth, they are among the first handshapes acquired by children learning ASL; fifth, several were found to be resistant to distortion in a perceptual experiment (Lane et al. 1976); sixth, production errors involving handshape substitution tend to be members of this set; and seventh, they are less restricted overall in certain environments and are specifically less restricted in how many points of contact on the handshape they can make (Battison 1978: 36–38).

In conjunction with the two conditions, Battison offered a corresponding typology of signs (Figure 1). In two-handed signs governed by the Symmetry and Dominance Conditions, *Type 1* signs are those, as in ADDRESS (1) above, in which both hands are active and matched for handshape, location, and movement; the movement can be either simultaneous or alternating and the location will be either identical or symmetrical. The next most complex is a *Type 2* sign that is also matched for handshape, but not for movement — one hand is active (the dominant hand) while the other (non-dominant hand) is passive. Finally, a *Type 3* sign is similar to Type 2, except that the hands have different shapes, and is therefore even more complex.[2]

Battison discusses a fourth type of two-handed sign that rarely occurs in sign language. This is a two-handed sign balanced for movement (i.e. both hands have the same movement, either simultaneous or alternating), but with two different shapes on each hand; e.g. TOTAL-COMMUNICATION in ASL. According to van der Hulst (1996: 125), Frishberg has referred to these as *Type 4* signs based on a matrix that is the logical extension of Battison's typology (5).

(5) Full matrix of possible two-handed sign types

	Balanced (for movement)	**Unbalanced (for movement)**
One handshape (on both hands)	Type 1	Type 2
Two handshapes (one on each hand)	Type 4	Type 3

One reason Battison views these as unnatural in the signing modality is that they are more common in sign systems such as Signed English that artificially create new lexical items based on English letters; e.g., using -T- and -C- for TOTAL-COMMUNICATION. Another reason is that children using Type 4 signs from these systems show a tendency to change the handshape on one hand to match the shape on the other hand, in the direction of symmetry (1978: 68–75). Also, Frishberg found that Type 4 signs were more common in an older ASL lexicon from the late 1800s, but tended to change over time in the direction of the Symmetry and Dominance Conditions; that is, toward Types 1, 2, or 3 (1975). The same process of historical change has been observed in Italian Sign Language (LIS) as well (Radutzky 1990). Therefore, Type 4 signs may occur in a sign language lexicon, but are thought to be relatively unstable compared with other two-handed signs. Considering that older forms of ASL and LIS had more Type 4 signs, we might expect a young sign language like KSL to have several in its lexicon.

2.1 Revisions to Symmetry and Dominance Conditions

In the decades following the publication of Battison's work, several researchers have tested and further clarified the ways that two-handed signs are constrained,

2. See Crasborn (2011) for a recent review of different approaches to and terminology for two-handed signs.

but proposed changes have been refinements rather than refutations of the original conditions. Three revisions are described here.

First, one unresolved issue with the two conditions, as Battison himself observed (1978: 36), was that they do not explicitly address Type 2 signs with identical handshapes but one stationary hand (e.g., FAR, CHEESE, ADVERTISE in ASL). It is therefore left unclear whether the Dominance Condition should also apply to Type 2 signs by restricting handshapes to an unmarked set. Because this was not the original intention, Sandler and Lillo-Martin (2006: 184) clarified this in the following revision.

(6) **Revised Dominance Condition**
In signs in which the h2 (the nondominant hand) is passive (i.e. does not move), h2 must either be unspecified underlyingly, or it must be characterized by an unmarked handshape.

A second refinement of the two conditions is based on an additional limitation in two-handed signs, which Battison again only mentions. Rozelle (2003) elevated this observation to a separate constraint, making it convenient to use here. This constraint (7) captures the fact that the dominant hand has a proximity relationship to the non-dominant hand in signs where the non-dominant hand is passive/unmoving (Rozelle 2003: 50). Despite the fact that it is extremely easy to articulate a sign that violates this condition, Rozelle's analysis of four unrelated sign languages found that it is consistently followed in each of them (ASL, Korean SL, New Zealand SL, and Finnish SL).

(7) **Contact Condition**
If one hand moves and the other remains still (Type 2 or Type 3), there must be contact (or proximity) between the two hands at some time during the articulation of the sign.

In a third approach, Eccarius and Brentari (2007) re-analyzed Type 3 signs using a measure of featural complexity that accounts for more two-handed signs than either Battison's Dominance Condition or the revised condition in (6) because sign languages tend to have a few relatively marked handshapes in this position. At the whole handshape level, ASL violates the handshape restriction of the Dominance Condition in 4.1% of cases (14 signs; e.g., SKIP-CLASS, CHOOSE, THEN) and Hong Kong Sign Language (HKSL) violates it 13.0% of the time (54 signs). But when the restriction is re-considered as a constraint on the amount of total marked features across both articulators, all but 1.7% (ASL) and 1.2% (HKSL) of Type 3 signs conform.

In their methodology, Eccarius and Brentari rate both dominant and non-dominant hands in Type 3 sign as [+/−marked] for *finger selection* and [+/−marked] for *joint configuration*. Joint configuration is [–marked] only if the fingers are completely extended (e.g. *B, 5*) or completely flexed (e.g. *S, A*). Finger selection is [–marked] under three conditions: if the hand configuration includes all four fingers (*B*), only the index finger (*1*), or only the thumb (*Å*). All other conditions are [+marked]. Therefore, each handshape could have up to two [+marked] features (one for joints and one for finger selection), and therefore each two-handed sign could potentially have up to four total [+marked] features. Their results show that over 98% of signs have a limit of two total marked features across both articulators and their updated Dominance Condition in (8) reflects this (Eccarius & Brentari 2007: 1187; changes from Battison in italics).

(8) **Dominance Condition based on Handshape Features**
   a. If the two hands do not share the same specification for *both selected fingers and joints* (i.e. *the handshapes* are different), then
   b. one hand must be passive while the active hand articulates the movement, *and*
   c. *the form as a whole (i.e. selected fingers and joints for both hands) is limited to two marked phonological structures, only one of which can be on the passive hand.*

The present analysis of two-handed signs in Kenyan Sign Language evaluates Type 3 signs using both whole handshapes and ratings of featural complexity.[3]

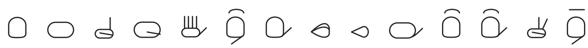
2.2 Revisions to the unmarked set of handshapes in the Dominance Condition

When Battison formulated the two conditions, data on the sub-lexical structure of sign languages other than ASL were not widely available. Also, the evidence he used to argue for restricted handshapes being *unmarked* was grounded in phonetic factors, such as ease of production and perceptibility, and thus theoretically applicable to all sign languages. So it was reasonable to assume that the same set of unmarked handshapes from ASL would appear on the non-dominant hand in Type 3

3. Another type of two-handed sign not yet discussed are those with different handshapes that move together; e.g., SHOW, LEAD, and HELP in ASL. These fail to conform to either condition: *Symmetry* is violated because the hands do not move independently, and *Dominance* is violated because both hands are in motion. Morphophonological analyses have demonstrated that the hands in these signs act as a single articulator (Sandler 1989; Brentari 1998), and therefore do not fit into typologies that treat the hands as separate articulators (i.e., both Battison [Figure 1] and the matrix in [5]). They also exemplify how two-handed signs remain a challenge for theories of sign phonology. In the present analysis, the only sign found in the dataset of this sort (SHOW, an ASL cognate) has been classified as a Type 3 sign. Despite being an imperfect fit, the designation is maintained for the purpose of analyzing handshape complexity across the two hands.

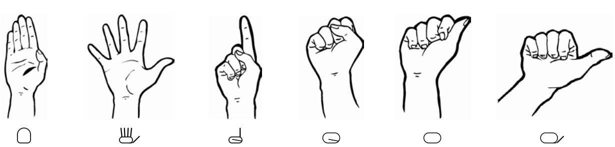
signs in other sign languages. However, as more languages are described, it has become clear they do not have the exact same set of handshapes in this environment; the set of handshapes in four historically unrelated sign languages is shown in (9).

(9) Handshapes found on the non-dominant hand in Type 3 signs in four sign languages (Rozelle 2003: 111)[4]

Language	Handshapes allowed on h2 in type 3 signs
ASL	
Korean SL	
New Zealand SL	
Finnish SL	

Three ways of approaching these varying sets of "unmarked" handshapes are considered in the present analysis. The first approach arises from cross-linguistic analyses and investigations of handshape markedness (Sandler 1996) that propose a smaller set of shapes better fit the criteria of being *unmarked* than the set of seven identified by Battison. Based on observations of allophones in ASL and other languages, Sandler suggested this set may be only three underlying shapes with allophonic variants in different environments: *B~5*, *1*, and *S~A~Å~O* (Sandler & Lillo-Martin 2006: 161). These are the "underlying shapes" referred to in their Revised Dominance Condition (6). Sutton-Spence & Woll (1999: 162) suggest that four shapes (*B*, *5*, *G*, *A*) comprise the unmarked set in BSL, accounting for 50% of handshapes in the lexicon. And Rozelle reports that across four unrelated sign languages (in [9]), just six handshapes account for 50% of all handshapes (2003: 111), and calls these the *universal unmarked set* (10). Remaining agnostic about the underlying phonemic handshapes in KSL, the current study uses these six shapes to test handshape markedness in Type 3 signs.

(10) Universal Unmarked Set



B *5* *1* *S* *A* *Å*

4. Shown in the Hamburg Notation System or HamNoSys (Prillwitz et al. 1989). Drawings to match symbols can be found here: http://www.sign-lang.uni-hamburg.de/dgs-korpus/tl_files/inhalt_pdf/HamNoSys%20Handshapes.pdf

It is important to point out that while this is an improvement to the Dominance Condition because it better fits the cross-linguistic evidence, replacing a fixed set of seven shapes with merely a tendency for three underlying universal shapes (or six surface forms) is a weaker claim because it allows other shapes without predicting where they can come from or how likely an unmarked shape is to appear.

A second approach that does make predictions about the full set of handshapes that can occur in Type 3 signs says that the handshapes appearing here will be unmarked in the language in which they appear (Rozelle 2003: 110; Eccarius & Brentari 2007: 1178). Following the view put forth by Greenberg that unmarked structures are more frequent than marked structures (2005: 63–65), this can be measured by comparing the frequency of each handshape in the Type 3 h2 environment with its frequency throughout the lexicon. The prediction is that these Type 3 handshapes will be the most frequent ones in the lexicon. However, while some studies have measured handshape frequencies (Sandler 1996; Rozelle 2003; Nyst 2007), none have explicitly tested whether the handshapes that occur in the Type 3 environment are the most frequent in the entire lexicon. This paper takes up the question with regard to Kenyan Sign Language and evaluates language-specific markedness using this metric.

The prediction that handshape will be restricted in the most complex environment is testable in the other two-handed sign types as well. Napoli & Wu (2003) used another metric — the ratio of handshapes appearing in a sign type compared with the total handshapes in the language — and replicated Battison's findings in ASL that handshape is restricted in signs with different handshapes on each hand (Type 3) but not in two-handed signs with the same handshape (Types 1 and 2). Among 319 Type 3 and 4 signs, Napoli & Wu found that only 16 out of 39 possible handshapes are used. In contrast, among 165 Type 2 signs, 21 handshapes are used, and in 381 Type 1 signs, at least 34 handshapes are used. This supports the hypothesis that signs unbalanced for handshape are the most restrictive, and we expect to find the same pattern in KSL.

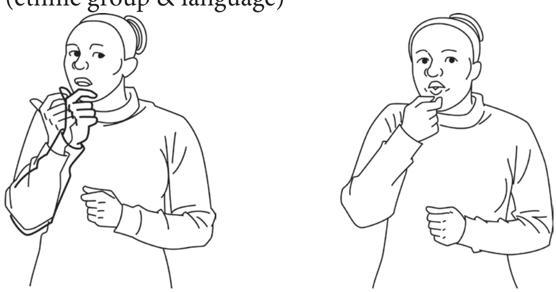
The third approach is Eccarius & Brentari's (2007) reanalysis of complexity across both articulators in Type 3 signs, as described above. In this proposal, complexity is distributed and constrained across both hands, not just h2; however, h2 is limited to only one marked feature. Next, we provide a brief overview of the origins of KSL and its relationship to other languages.

3. Kenyan Sign Language

Like many national sign languages, KSL is believed to have originated with the establishment of residential deaf schools as enrollment resulted in a critical mass of deaf people creating the conditions necessary for the emergence of a sign language. The first two deaf schools in Kenya were established around 1962 in western Kenya, about 50 miles from each other; and the language began to truly emerge in the 1970s, according to Kenyan linguists Okombo and Akach (1997). Based on their interviews with the first generations of students in these two schools, they concluded that signs created there spread as new schools opened and students transferred to schools closer to their parents' homes, bringing the new language with them. A lexical comparison shows that ASL has influenced about a third of the lexicon used in the current analysis (Roberts 2009), which is below the level thought to indicate a familial relationship between sign languages (Parkhurst & Parkhurst 2003). Less than a dozen BSL cognates have so far been found: e.g., PROBLEM, TRAVEL, NOT-YET, and TRUE. Space limits do not permit a more detailed history (see Okombo & Akach 1997; U.S. Peace Corps Kenya 2007; Roberts 2009; Hochgesang 2007; Morgan et al. in prep.).

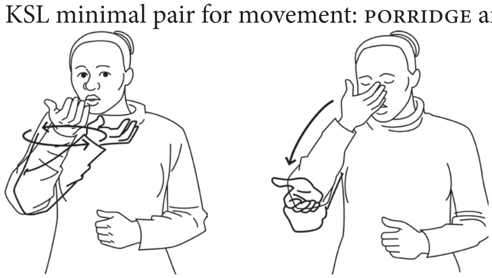
Here we establish that KSL makes use of the same basic phonological parameters found in other sign languages. One minimal pair each for handshape, movement, location, and orientation is presented to demonstrate that they are phonemically contrastive in KSL (11–14).

(11) KSL minimal pair for handshape: GITHERI (beans & maize dish) and LUO (ethnic group & language)[5]



a. GITHERI; h1= b. LUO; h1=

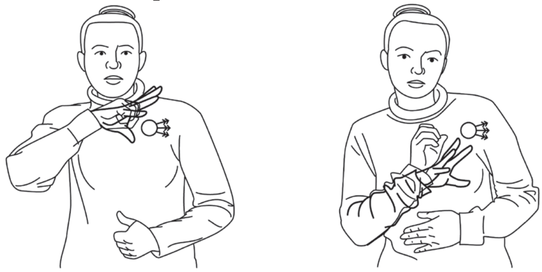
(12) KSL minimal pair for movement: PORRIDGE and IGNORE



a. PORRIDGE: b. IGNORE:

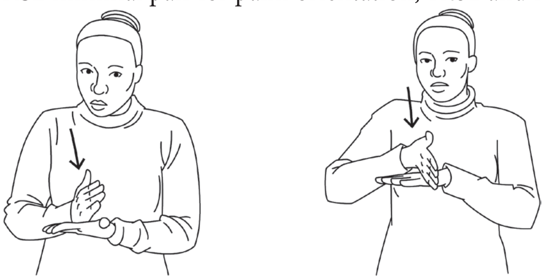
5. Illustrations of KSL (12, 13, 14, 16, 17) by Allen Gladfelter.

(13) KSL minimal pairs for location: COMPLAIN and FEAR



a. COMPLAIN: > at neck   b. FEAR: > over heart

(14) KSL minimal pair for palm orientation, TRUE and FALSE



a. TRUE: h2 palm up   b. FALSE: h2 palm down

4. Testing restrictions on two-handed signs in KSL

In Section 6, we report first on whether two-handed signs in KSL conform to the allowable configurations of handshape and movement on the two hands (Symmetry Condition, Revised Dominance Condition, Contact Condition). This is accomplished, in part, by providing the distribution of signs in the KSL lexicon that correspond to Battison's existing sign typology. Based on the prohibitions against Type 4 signs spelled out in the two conditions, we predict that there will be none or very few of this type. However, since KSL is relatively young and possibly at an early stage of lexicalization, we might see many Type 4 signs in the lexicon.

Finally, we report on handshape restrictions in all two-handed sign types, with the assumption that handshape will be restricted on h2 in Type 3 signs, but not in other environments. The handshape restriction on Type 3 signs is evaluated in three ways. First, we determine whether the majority of handshapes come from the set of universal unmarked shapes in (10). Second, we evaluate whether those handshapes not in the universal set are among the most frequent shapes in KSL (a language-specific set). And third, we measure the featural complexity across both hands in Type 3 signs.

5. Data set and methodology

The source of data for this study is a KSL video dictionary on CD-ROM produced in 2004 by the Kenyan Sign Language Research Project (KSLRP)[6] in conjunction with U.S. Peace Corps volunteers (Mjitoleaji Productions 2004). The CD contains 991 videos of KSL words in citation form. Each video file is in the form of a QuickTime movie, 170 x 116 pixels. This dictionary was developed as a tool for learning basic conversational KSL. It therefore includes the most common signs essential for communication in Kenya, including different parts of speech (e.g., nouns, verbs, prepositions, conjunctions, modifiers), relevant place names, and several sample sentences. The signer is a right-handed Deaf woman from Central Province in Kenya who lives and works in Nairobi. She has used KSL since primary school and has also previously participated in the production of a printed KSL dictionary (Akach 1991).

A FileMaker Pro 9.0 database was created to capture parameters of each sign in separate fields, including detailed information about *h1* and *h2* in two-handed signs. Before the data were analyzed, 33 records were excluded because they were either fingerspelled place names or duplicates. Four other types of signs were included in the analysis but require further explanation: homophones, borrowings, dynamic handshapes, and compound signs. *Homophones* mostly originate from places given the name of an associated word (e.g. SENEGAL/SUGARCANE; NIGERIA/POWER), but also include a few signs with identical form but different unrelated meanings (e.g. GRASS/PAPER). *Homophones* were retained to give an accurate assessment of handshape frequency in the lexicon. *Borrowings* in sign languages originate from three types of language systems, as shown below (Battison 1978; Sandler 1996: 125; Rozelle 2003: 46).

(15) Sources of Handshape Borrowing
   a. Other sign languages (e.g. indigenous country names)
   b. Fingerspelled letters/symbols from orthographies (using ‘F’ in F̲REE)
   c. Manual codes for morphological forms in spoken language (‘AM’, ‘-ING’)

The present data set does not include any manually coded signs (15c), but does contain borrowings from other sign languages (15a) and initialized signs (15b). Borrowings include some signs from ASL and the names of foreign countries. Initialized signs are those with handshapes that correspond to the fingerspelling of the first letter of the word that serves as a gloss for that sign. Seventeen initialized signs (some also ASL borrowings) were found in the KSL data set. These include

6. A joint enterprise of the University of Nairobi and the Kenya National Association of the Deaf (KNAD).

FREE, FRUIT, WEST, EAST, GHANA, LESOTHO, etc. For the purpose of testing the Symmetry and Dominance Conditions, these signs are included.

Dynamic handshapes are also found in the data set. These are hand configurations that change from one shape to another during articulation (e.g., the signs in (14)), and comprise 10.5% of signs in the data set (101 of 958). Signs with dynamic handshapes were included in the overall sign typology distribution, but are not included in the handshape frequency counts in Section 6.2, because it is not clear which shape should be considered as the underlying one.[7]

Compound signs are constructed from two or more individual signs and often undergo systematic phonological changes based on the process of compounding, such as assimilation of hand configuration and/or location (Sandler 1989). While compound signs in KSL follow such phonological processes in fluent signing,[8] the citation forms in this dictionary corpus have the full articulation of each phonological parameter. Compound signs are used in this analysis in two ways: (i) the dominant hand in the first sign of the compound is included in the baseline handshape frequency calculations; (ii) in Section 6.2, signs in compounds with Type 3 signs are included in order to have more data for determining handshape restrictions. Otherwise, compounds are not part of the complexity analysis.

For the purpose of testing the handshape restrictions in the Dominance Condition, handshapes were coded in the database initially with a shorthand name by the coder (first author), and later with a symbol in the Hamburg Notation System, an orthographic method of coding handshapes at the phonetic level (Prillwitz et al. 1989). This transcription method was chosen because it is componential at a sufficiently narrow level to permit both flexibility in creating new handshape symbols and description within a reasonable amount of detail. Also, it has been used by many other researchers and therefore supports cross-linguistic comparisons.

7. Although dynamic handshapes are not included in the analysis, it appears that they may be less complex overall than the static handshape inventory. Half of all handshape changes (52/101) have all fingers selected and change by only joint articulation (31 *closed*>*open*; 14 *spray*>*flat-O*; 7 *open*>*closed*). And only 2 of 101 signs feature a handshape in either starting or ending position with two marked features (see Section 2.1). Interestingly, both of these are borrowings from ASL and have a *bent-V* handshape: SEARCH (from ASL ANALYZE) and STEAL.

8. Based on the first author's observations in Kenya. For example, in the database, the sign NEWSPAPER is signed as two fully articulated components, but in fluent signing, this sign undergoes assimilation of handshape and orientation and elision of a location in the second sign.

6. Results: Typology of signs & adherence to articulatory combinations

The first hypothesis is that two-handed sign types in KSL will allow many Type 4 signs due to its relative youth. Table 1 shows the full classification of sign types found in the data set, following the Battison typology. There were 369 one-handed signs and 457 two-handed signs. Of the two-handed signs, the majority were Type 1 (310 signs), followed by 80 Type 3 signs, and 65 Type 2 signs. Only two Type 4 signs and one sign, MOVIE, did not fit into the expected sign types.

Table 1. Distribution of sign types in the KSL dictionary database

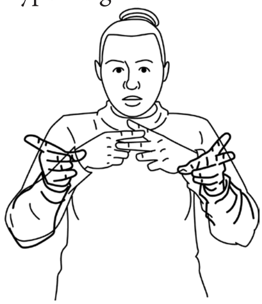
Type	Description	Number	Percentage
0	One-handed signs; articulated in space, without body contact	148	15.45%
X	One-handed signs; articulated with body contact	221	23.07%
1	Two-handed signs; matched for handshape and movement (synchronous or alternating)	310	32.36%
2	Two-handed signs; matched for handshape; dominant hand active & non-dominant hand passive	65	6.78%
3	Two-handed signs; unmatched for handshape; dominant hand active & non-dominant hand passive	80	8.35%
4	Two-handed signs; unmatched for handshape, but matched for movement	2	0.21%
C	Compound sign	131	13.67%
other	Two-handed disyllabic monomorphemic sign	1	0.10%
	Total	958	100%

The Contact Condition was found to hold without exception for all Type 2, 3, and 4 signs and the disyllabic sign (it does not pertain to Type 1 signs, because the articulators can articulate a symmetrical movement without coming into contact or proximity with each other). Therefore, KSL adheres to the proposed conditions for two-handed signs at least as much as other sign languages, notably much older ones, previously studied.

6.1 Results: Non-conforming signs

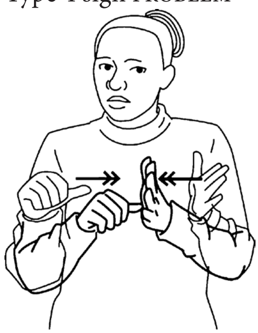
The two Type 4 signs are START (16) and PROBLEM (17). Both signs have different handshapes on each hand, but identical movement. This violates the Symmetry Condition. Although each hand does "move independently during… articulation" and both hands have the same movement, they are crucially unmatched for handshape. They also violate the Dominance Condition because the handshapes are unmatched, but the non-dominant hand moves during the sign.

(16) Type 4 sign START



Dominant hand is *1*; non-dominant hand is *V*. Both hands start with selected fingers interlaced and palms facing in, then pivot outward at the wrists, once.

(17) Type 4 sign PROBLEM



Dominant hand is *Å*; non-dominant hand is *5*. Both hands start in neutral space shoulder-width apart, touching at the center of the body, repeated twice.

Despite the clear violation of the two conditions in these signs, there are qualifications to be made. Comparing the current data with a print dictionary published thirteen years earlier (Akach 1991), START is the same, but PROBLEM is articulated as a Type 3 sign in which h2 is unmoving. This older citation form is consistent with the first author's observations in Kenya. In fact, the form in the present data set is more precisely interpreted as an emphatic form: "a big problem."

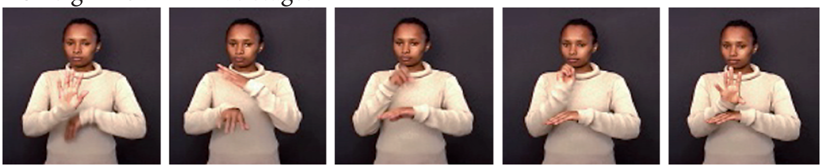
For the sign START, the author has observed some signers articulating this with two *V* ([illegible]) handshapes, thus conforming to the Symmetry Condition. So although this sign has been used for over twenty years, it appears to be somewhat unstable.

The third non-conforming sign, MOVIE (18), does not fit neatly into the existing sign types, including Type 4. It is monomorphemic[9] (i.e., not a compound), but contains two distinct and complex movements: one simultaneous path movement

9. It is unlikely to have been reduced from a compound in the past; KSL users who were asked did not believe it had separable parts. Also, other compounds in this dictionary are not reduced.

& handshape change (*Open*>*O*) of the dominant hand circling behind the non-dominant hand and one dynamic handshape movement, *O*>*Open,* as h1 lands on h2. Note that both are complex syllables (two simultaneous movements; see Brentari 1998: 237). Thus this sign is unusual in two ways. It is a disyllabic sign that does not result from reduplication of the first syllable or from compounding, which is rather uncommon (Brentari 1998). Also, it consists of two complex syllables and involves the two hands, which makes it particularly complex overall. Despite this, MOVIE is a commonly used and understood sign in KSL (first author observation).

(18) KSL sign MOVIE in five stages[10]



Although it does not fit easily into the typology, this sign can be evaluated on the two conditions. It conforms to the Dominance Condition but not the Symmetry Condition because the hands are asymmetric for movement. That is, although h2 moves in the first syllable in this example, it is probably a sympathetic phonetic movement and not specified phonemically, similar to the movement of h2 in ASL's YEAR. Although dynamic handshapes are not explicitly examined in this analysis, we can see that the shapes here are unmarked and therefore conform to handshape restrictions. This sign also conforms to the Contact Condition because the two hands are in a proximity relation in the first syllable and a contact relation in the second.

To summarize, we see that KSL contains a small number of forms considered to be dispreferred and/or highly complex in sign language, but one of these is probably in fact a Type 3 sign and the other shows signs of evolving in the current generation. Altogether, two-handed signs in KSL adhere very closely to the allowable permutations of handshape and movement.

6.2 Results: Restrictions on handshape complexity

In order to evaluate whether handshape is restricted on the non-dominant hand in Type 3 signs, it is first necessary to establish the number of handshapes in the lexicon and their frequencies. Frequency here is determined by the number of times the handshape appears on the dominant hand across all sign types in the database

10. Photos of Kenyan Sign Language provided courtesy of Mjitoleaji Productions.

(following others such as Nyst [2007: 59]), shown in Table 2.[11] These tokens include only the first sign in a compound sign and exclude duplicates, fingerspellings, and handshapes that change shape during articulation, but include homophones and borrowings. After these exclusions, there are a total of 875 handshape tokens.

Table 2. Frequency of phonetic handshapes in KSL on h1 in 875 signs

#	HS	Freq	#	HS	Freq	#	HS	Freq
1	[handshape symbol]	0.224	**19**	[handshape symbol]	0.014	**37**	[handshape symbol] 2 3 4 5	0.002
2	[handshape symbol]	0.167	**20**	[handshape symbol]	0.013	**38**	[handshape symbol] 3	0.002
3	[handshape symbol]	0.061	**21**	[handshape symbol]	0.011	**39**	[handshape symbol] 2 \ 5	0.002
4	[handshape symbol]	0.054	**22**	[handshape symbol] 2	0.010	**40**	[handshape symbol]	0.002
5	[handshape symbol]	0.040	**23**	[handshape symbol] 5	0.010	**41**	[handshape symbol]	0.001
6	[handshape symbol]	0.034	**24**	[handshape symbol]	0.008	**42**	[handshape symbol]	0.001
7	[handshape symbol]	0.033	**25**	[handshape symbol]	0.007	**43**	[handshape symbol] 5	0.001
8	[handshape symbol]	0.031	**26**	[handshape symbol]	0.006	**44**	[handshape symbol]	0.001
9	[handshape symbol]	0.027	**27**	[handshape symbol]	0.006	**45**	[handshape symbol] 2 5	0.001
10	[handshape symbol]	0.027	**28**	[handshape symbol]	0.006	**46**	[handshape symbol]	0.001
11	[handshape symbol]	0.024	**29**	[handshape symbol]	0.005	**47**	[handshape symbol] 2 [handshape symbol] 3	0.001
12	[handshape symbol]	0.022	**30**	[handshape symbol]tense	0.005	**48**	[handshape symbol] 1 [handshape symbol] 2 3 [handshape symbol] 4	0.001
13	[handshape symbol]	0.019	**31**	[handshape symbol] 5	0.003	**49**	[handshape symbol]	0.001
14	[handshape symbol]	0.019	**32**	[handshape symbol]	0.003	**50**	[handshape symbol] 2	0.001
15	[handshape symbol]	0.017	**33**	[handshape symbol] 5	0.003	**51**	[handshape symbol] 2 \ 3	0.000
16	[handshape symbol]	0.017	**34**	[handshape symbol]	0.003	**52**	[handshape symbol] 3	0.000
17	[handshape symbol]	0.016	**35**	[handshape symbol]	0.003			
18	[handshape symbol] 1	0.015	**36**	[handshape symbol]	0.002			

These 52 handshapes have been coded at a relatively fine-grained phonetic level. It is therefore likely that some of these handshapes are allophones; e.g., *A* ([handshape symbol]) and *S* ([handshape symbol]). However, without a full phonemic analysis of handshape in KSL, the present study is conducted at this level.

Handshapes in the **Type 1** signs appear to be unrestricted (but see Section 7.1 for further analysis): 32 out of the 52 possible handshapes occur in the 275 Type 1 signs that did not have a handshape change, including many infrequent handshapes, such as [handshape symbol], [handshape symbol] 2 [handshape symbol] 3, and [handshape symbol] 3. These results conform to Battison's assumptions that the least complex two-handed signs impose no restrictions on handshape.

Handshapes in the 65 **Type 2** signs were unexpectedly found to be restricted in three ways. First, only 15 out of the 52 possible handshapes occur in these signs. Second, 50 out of 65 signs feature one of the universal unmarked shapes,

11. See http://www.sign-lang.uni-hamburg.de/dgs-korpus/tl_files/inhalt_pdf/HamNoSys%20Handshapes.pdf and the least marked handshape in KSL, *Flat/B* (), occurs in half (56.9%) of Type 2 signs — far more frequently than in Type 1 signs (28.2%) or the baseline frequency (22.4%). Finally, the only Type 2 signs with dynamic handshape changes were those with *O* > *Spray* (>), which is the most common type of handshape change. A few infrequent handshapes also occur, such as one handshape (freq. 0.001; MARRY) and one handshape (freq. 0.001; ORANGE).

For **Type 3** signs, three approaches to handshape restrictions are addressed in turn: universal unmarked set, language-specific unmarked set, and featural complexity across both hands. In order to have as much data as possible about handshapes in this environment, ten signs from compounds that contained a unique Type 3 sign were included,[12] bringing the total number to 90.

Among the 90 Type 3 signs, the non-dominant hand in two signs, CONDUCTOR and HOW-MANY, were difficult to code for handshape. In the first case, the finger position was obscured in the video (and unfamiliar to the first author), but later feedback from Evans Burichani, a deaf teacher in Kenya, reveals that the handshape in CONDUCTOR is not a handshape found in any other sign in the database.[13] In the second case, HOW-MANY, the fingers in the non-dominant hand curl in one-by-one as the dominant index finger taps each one. As with handshape-internal movement, it is difficult to say what the underlying handshape is in this case. Therefore, they have both been labeled as "complex 1" and "complex 2", respectively.

It should be mentioned that these results are roughly comparable to the ratio of handshapes per sign type in ASL, as analyzed by Napoli & Wu (2003); see Section 2.2. In both languages, the proportion of possible handshapes that occur in Type 1 signs is the greatest (34/39 in ASL; 32/52 in KSL), followed by the proportion of handshapes that occur in Type 2 signs (21/39 in ASL; 15/52 in KSL), and lastly the proportion in Type 3 signs (16/39 in ASL; 11/52 in KSL). Importantly, the proportions hold despite the fact that there are fewer overall Type 2 signs in each language, providing another way to demonstrate handshape restriction in Type 3 signs.

For the approach based on the notion of an universal unmarked set, Table 3 shows all the handshapes that appear on the non-dominant hand in Type 3 signs with the number of occurrences, frequency in the h2 Type 3 environment, and baseline frequency.

12. From the signs: CLOCK, COMPUTER-DISK, CONDUCTOR, EXERCISE-BOOK, GERMANY, NEWSPAPER, PASSPORT, SECONDARY-SCHOOL, STOCKINGS, WEEKEND.

13. The handshape mimics a hand holding a book of tickets and paper money, with both interlaced through the fingers.

Table 3. Handshapes on the non-dominant hand in Type 3 KSL signs. The jagged line separates the "universal unmarked" handshapes from other handshapes.

	Handshape Name	Picture	HamNoSys	Occurrences (90 total)	Frequency on h2 in Type 3	Baseline Freq. (all h1)
1.	*Flat/B*		▢	57	0.633	0.224
2.	*S*		⊖	9	0.100	0.033
3.	*Open*		⩐	8	0.089	0.061
4.	*1/G*		⫝̸	5	0.056	0.167
5.	*A*		⬭	4	0.044	0.054
6.	*Thumb-T*		⬭ 2\3	2	0.022	0.000
7.	[complex 1]	-	-	1	0.011	0.000
8.	[complex 2]	-	-	1	0.011	0.000
9.	*C*		⍜	1	0.011	0.024
10.	*Claw*		⩐	1	0.011	0.031
11.	*Flat-O*	 [a]	⊲	1	0.011	0.027

[a] Image from Tennant & Gluszak Brown (1998).

We see that the non-dominant handshapes in Type 3 signs are overwhelmingly derived from the "universal unmarked" set (above the jagged line): 83 out of 90 signs have one of these unmarked shapes. The *Flat/B* (▢) handshape accounts for the majority of this trend, appearing on h2 in 63.3% Type 3 signs. Therefore, the hypothesis that the universal set will predominate in this environment is strongly upheld.

In contrast, the frequency data show that the second approach — a language-specific unmarked set in KSL — does not account for the remaining shapes. For three of the handshapes — *Thumb-T* and the two complex handshapes — the baseline frequency is 0.000 because they never appear on the dominant hand in any sign in the corpus, meaning that they are rare in KSL. The remaining three handshapes, *C* (⍜), *Claw* (⩐), and *Flat-O* (⊲) are relatively common (ranking as

8th, 10th, and 11th), but other shapes are even more common (e.g., *bO/* and *X/*) and do not occur on h2 in Type 3 signs.

The third approach to handshape markedness in Type 3 signs is the Dominance Condition based on handshape features. Under this approach, Type 3 signs should be limited to 2 total marked features and the non-dominant hand should be limited to 1 marked feature. Considering that the "universal unmarked" handshapes on h2 all have zero marked features, we can see that 83 of 90 Type 3 signs already conform to the first part of the condition (1–5 in Table 3). Here we look more closely at the remaining signs to see if they can be accounted for by this approach.

Table 4 lists the seven signs that did not have a handshape of the universal unmarked set on the passive hand. We also include here the Type 4 sign START because it has an h2 with a marked feature, violating Symmetry & Dominance, but perhaps conforming to the Revised Dominance Condition. PROBLEM is not included because the h2 is an unmarked *Open* ( ) handshape.

Table 4. Type 3 signs without a universal unmarked handshape on h2

	KSL Sign	Non-dominant handshape	Dominant handshape
1.	CONDUCTOR	[complex]	*1*
2.	HOW-MANY	[complex]	*1*
3.	CLITORIS	*Thumb-T*	*1/G*
4.	FEMALE-CIRCUMCISION	*Thumb-T*	*1*
5.	RUSSIA	*C*	*1*
6.	POTATO	*Claw*	*1*
7.	START	*V*	*1*
8.	CREATE	*Flat-O*	*Spray* → *Flat-O*

We find that the *1/G* handshape appears on the dominant hand in nearly every sign in this specific environment. The one exception is the sign CREATE, which has a dynamic handshape on the dominant hand. As mentioned previously, we are not making claims about the underlying specifications of dynamic handshapes, so we will consider CREATE no further.[14] With this sign removed, the remaining handshapes on the dominant hand are all the same: *1/G*. This unexpected pattern will be discussed more in the next section.

Calculating featural complexity across both hands in the remaining signs reveals that all of them can be accounted for because they all have 2 or fewer total marked features. However, 2–4 of the signs violate the constraint of only one marked feature on h2 (Table 5, 1–4).

14. Also, this is arguably a Type 2 sign underlyingly.

Table 5. Marked structures on each handshape in Type 3 & 4 signs that violate the Dominance Condition (following Eccarius & Brentari 2007)

	KSL Sign	[+marked] features on h2 Joints	Fingers	[+marked] features on h1 (1 handshape)	Total [+marked] features in sign
1.	CONDUCTOR	1	1	0	**2**
2.	HOW-MANY	1	1	0	**2**
3.	CLITORIS	1	0 or 1	0	**1 or 2**
4.	FEMALE-CIRCUMCISION	1	0 or 1	0	**1 or 2**
5.	RUSSIA	1	0	0	**1**
6.	POTATO	1	0	0	**1**
7.	START	0	1	0	**1**

One handshape, *Thumb-T* ($\subset^{2}\backslash^{3}$), is [+marked] for *finger selection*, since both the thumb and index are selected (unmarked would be the thumb only, index only, or all digits), while the markedness status for *joint specification* is somewhat less clear. Following Eccarius and Brentari (2008), the joints are fully flexed, which should be unmarked, but they are also *crossing*, which is a marked feature (Eccarius p.c.).

Altogether, these minor violations on h2 markedness are consistent with Eccarius and Brentari's findings in other sign languages (2007). Recall that 1.7% of Type 3 signs in ASL and 1.2% of Type 3 signs in HKSL had more than two marked features. Here we find KSL has *no* signs with more than 2 marked features and only 0.02–0.04% signs that exceed the limit for marked features on h2. Thus, measuring complexity at the featural level accounts for more of the data compared to the other approaches. Importantly, we see that KSL has less complexity overall across the hands in Type 3 signs relative to ASL and HKSL.

To summarize, the handshapes that appear on the non-dominant hand in the most complex two-handed signs overwhelmingly come from the universal unmarked set. The remaining handshapes cannot be explained by a language-specific unmarked set, but nearly all can be accounted for under a featural complexity account across both hands. It should be noted that these results contradict a strict interpretation of the Revised Dominance Condition in (6), which states that when

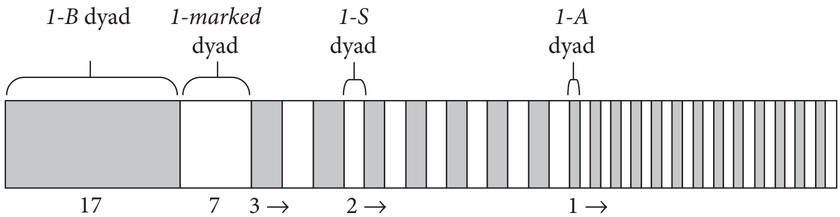


Figure 2. Distribution of handshape dyads in Type 3 & Type 4 signs (Number of occurrences at bottom; only dyads with 1 handshape on h1 are labeled.)

h2 is passive (Types 2 and 3), it must either be unspecified or unmarked. In Type 3 signs in KSL, h2 can be marked. Next, we return to the *1* (☝) handshape on h1 in Type 3 signs.

7. Analysis: the *1* (☝) handshape in Type 3 signs in KSL

Our finding that Type 3 signs with relatively marked handshapes on the non-dominant hand all have a *1/G* handshape on the dominant hand is not due to any morphological generalization. In POTATO and FEMALE-CIRCUMCISION, the *1* handshape appears to be derived from a knife classifier, but the handshape in CONDUCTOR and HOW-MANY is highly pantomimic, resembling physical movements that may be transparent to a hearing Kenyan. The *1* handshape in RUSSIA is derived from a graphic symbol (also a borrowing), while the handshape in START is fully abstract and opaque; and in CLITORIS, *1/G* it appears primarily to create a full syllable by interacting with the body part classifier on the non-dominant hand (both index and thumb contact h2).

When we look more closely, a phonological pattern emerges showing that this handshape is generally preferred on h1 in all Type 3 signs, while the other unmarked handshapes occur infrequently. Table 6 shows that 25.2% of dominant hands in Type 3 signs have this shape, in contrast to 16.7% on dominant hands across the full data set.

Table 6. Frequency of unmarked handshapes in baseline condition and on the dominant hand in Type 3 signs.

Unmarked Shape	Baseline Frequency (h1)	Type 3 Frequency (h1)	Type 3 Count
Flat/B	0.224	0.032	3/90
1/G	0.167	**0.252**	23/90
Open	0.061	0.032	3/90
A/S	0.087	0.021	2/90

In fact, the *1* (☝) handshape is most often paired with a *flat/B* (▢) handshape on h2 (*1-B dyad*) in Type 3 signs, as shown in Figure 2. The next most frequent cluster is the group of seven signs in Table 5 (*1-marked dyad*). The other handshapes that appear on h1 in Type 3 signs consist of 22 unique handshapes — some relatively uncommon — and eight unique dynamic handshapes. Recall that all of these are paired with one of the universal unmarked shapes, in keeping with the Dominance Condition.

Therefore, we have another explanation for the handshapes that occur in this marked Type 3 environment: a phonotactic regularity pairs the *1/G* shape on h1 with a relatively marked shape on h2. Battison himself hinted at a similar phenomenon when he introduced the handshape restriction in Type 3 signs:

> (T)he reduction from approximately 45 handshapes to a mere 7 greatly reduces the complexity of the sign and increases the redundancy, since a specification of one hand from among seven possibilities requires less information than a specification among 45 possibilities. This constraint on complexity should tend to facilitate both the production and perception of such a complex sign. (Battison 1978: 36)

In this way, *predictability* is a factor that reduces complexity in Type 3 signs in KSL; the smallness of the set is potentially as important as the markedness of the individual handshapes within the set. From this perspective, KSL may have developed this phonotactic regularity in order to create more predictability in the language system as a whole. Why specifically *1* (☝)? One possible explanation is that it is simply the second-ranking unmarked handshape in KSL. Another explanation, at the phonetic level, is inspired by Channon's view that the *flat/B* hand is common on h2 in Type 3 signs because it allows for maximum access to all parts of the hand (Channon 2004). Similarly, it could be argued that an indexical shape, *1* (☝), can more easily interact with a complex handshape on h2 by reducing the point of contact to facilitate articulation when the dominant hand must contact a location on a complex h2 handshape, such as the thumb in *Thumb-T*. Articulatory control over the index finger is greater than with any other finger or combination of fingers. Finally, the visual distinctiveness of this shape also reduces perceptual confusion.

If properties of markedness and other phonetic factors favor this handshape on h1 in Type 3 signs, we might expect to find it in other sign languages as well. A cursory search of the literature shows that this may be the case. Hara (2003: 47) reports that *1* (☝) is the most frequent handshape in this environment in ASL (14.7% of Type 3 signs). In Adamorobe Sign Language, Nyst (2007: 80) also finds this handshape is most frequent: 20 out of 88 Type 3 signs have *1* (☝) on the dominant hand (22.7%). Further investigation is required to know whether this is a cross-linguistic phonotactic tendency.

7.1 Analysis: Unmarked handshapes in all two-handed signs in KSL

The discovery of the *1* (☝) handshape on h1 in Type 3 signs prompted a more thorough investigation of the frequency of universal unmarked handshapes across all sign types, shown in Table 7. The high baseline frequency of the flat/B (▢) handshape (0.224, Table 7, a) is unexpectedly due in part to its preference on h1 in two-handed signs in general: *Type 1* = 0.282 (Table 7, c), *Type 2* = 0.569 (d). This is in comparison to its much lower frequency in one-handed signs: 0.173 (b). Thus, in KSL, the restriction on handshape complexity is exerted across all two-handed signs and the *flat/B* (▢) handshape has special status as being the least marked shape, followed by *1* (☝). Although beyond the scope of this paper, we note that the ▢ shape is preeminent cross-linguistically as well (Rozelle 2003).

Interestingly, as the hypothesized complexity of the handshape environment increases, à la Battison (Section 2), the likelihood of the least marked *flat/B* (▢) shape also increases: Type 0/X (h1) < Type 1 (h1/h2) < Type 2 (h1/h2) < Type 3 (h2). When the handshapes are unmatched in Type 3 signs, the next most frequent/unmarked shape predominates on h1, ☝, as discussed above.

Table 7. Frequency of universal unmarked handshapes in all sign types

	All signs	**1-handed signs**	**2-handed signs**				
	a.	b.	c.	d.	e.	f.	g.
Unmarked Shape	**Baseline Freq. (h1)**	**Type 0/X (h1)**	**Type 1 Freq. (h1)**	**Type 2 Freq. (h1)**	**Type 3 Freq. (h1)**	**Type 3 Freq. (h2)**	**Type 2+3 Freq. (h1)**
Flat/B (▢)	0.224	0.173	**0.282**	**0.569**	0.032	**0.626**	**0.258**
1 (☝)	0.167	0.159	0.088	0.107	**0.252**	0.055	0.193
Open (🖐)	0.061	0.029	0.106	0.030	0.033	0.088	0.032
A(⬭)/*S*(⊖)	0.087	0.039	0.098	0.076	0.021	0.144	0.045

Therefore, not only does KSL adhere to the Symmetry and Dominance Conditions as envisioned by Battison (see also Eccarius & Brentari 2007), but it goes further by preferring the least marked handshape, ▢, in all two-handed signs. As mentioned, this causes a problem for the Revised Dominance Condition (6), which infers that handshape is only restricted in Type 3 signs, and only on the non-dominant hand.

Another way to state these restrictions is that KSL has a system of word formation that is highly conservative in its recruitment of handshapes. That is, new two-handed signs are preferentially formed by changing how the two articulators move in relation to each other rather than by introducing a new, distinctive handshape. Two other factors affecting word formation may also play a role. First, borrowings from orthographic systems is lower in KSL compared with languages like ASL and HKSL (which violate constraints on Type 3 signs more often), meaning that marked handshapes from orthographies may be used less often than in other languages. Second, the KSL lexicon itself may be smaller than other sign languages', and therefore it may not have "used up the prime real estate" in the phonological space. However, these are hypotheses that must be further tested.

Note that the distribution of ▢ and ☝ handshapes in Type 2 and 3 signs may provide quantitative evidence for the view that the hands in two-handed signs are part of a larger Articulator, as suggested by Sandler (1989), Brentari (1998), and others. That is, when Type 2 and 3 signs are combined and treated as one type, *h2-Place* (Sandler 1993), as shown in column *g* in Table 7, the frequency (on *h1*) more closely matches the proportion in the baseline frequency in column *a*: the ▢ handshape has a frequency of 0.258 in *h2-Place* signs and a baseline frequency of 0.224; the ᑯ handshape has an *h2-Place* frequency of 0.193 and a baseline of 0.167. This is true even though *h2-Place* signs account for only 17% of signs included in the baseline frequency. However, the strikingly uneven distribution of these two handshapes in Type 2 and Type 3 signs also demonstrates the usefulness of considering them as separate sub-types for some analyses.

7.2 Summary

To summarize, Kenyan Sign Language conforms to the Symmetry and Dominance Conditions in all but a small number of cases. Two or three signs fall outside the standard sign typology (Type 4 and a complex disyllabic sign), and seven Type 3 & 4 signs have handshapes on the non-dominant hand that are neither from the universal unmarked set nor from a language-specific unmarked set. However, these signs almost completely fall within proposed restrictions on featural complexity. In addition, two unexpected findings emerge from this study. First, KSL has a phonotactic preference for the *1* handshape on h1 Type 3 signs. This limits restrictions on featural complexity and may also increase overall predictability in the language system. Second, KSL restricts handshape beyond Type 3 signs; specifically, Type 2 signs also have fewer handshapes and have more universal unmarked shapes than expected. Type 1 signs show a similar trend, but to a lesser extent; the number of handshapes is not restricted, but there is a stronger preference for unmarked shapes relative to one-handed signs.

8. Discussion and conclusions

Our analyses of KSL phonotactic constraints on two-handed signs has provided multiple insights into in a young and under-described language, Kenyan Sign Language. KSL conforms extremely well to the Symmetry and Dominance Conditions (in all but 2 or 3 out of 457 two-handed signs). No sign was found that violates the Contact Condition. We tested three different approaches to handshape restrictions in Type 3 signs and found a strong tendency from handshapes in the universal unmarked set in this environment. The remaining signs could not be accounted for under a language-specific unmarked set, but all conformed to a constraint against more than two marked finger and/or joint features across both hands.

We discovered a phonotactic preference in KSL for *1-dyads* in Type 3 signs, which may reflect a cross-linguistic tendency found in other languages as well. Finally, we showed that KSL provides new evidence for Battison's original view of increasing levels of complexity in the combinatorial permutations of the two articulators.

One remaining question is why KSL should have developed such strong phonotactic constraints relative to other sign languages. School-based languages may evolve more quickly than village sign languages because, in effect, a new generation is formed in each school year. As the case of Nicaraguan Sign Language demonstrates, the structure of the language can change remarkably with each new generation (Senghas et al. 2004). The quick emergence of sublexical structure in KSL, as we have found here, shows that the size of the language community, interactions with people outside of the family or village, and cumulative changes over multiple generations may be driving factors as important to language evolution as simple age.

Much work has yet to be done both in KSL and other sign languages to uncover which properties are general to sign languages and which properties are developing uniquely in individual languages (or in sign language families). Our study has made some small steps forward in this direction.

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