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Comparing Iconicity Trade-Offs in Cena and Libras during a Sign Language Production Task

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Abstract: Although classifier constructions generally aim for highly iconic depictions, like any other part of language they may be constrained by phonology. We compare utterances containing motion events between signers of Cena, an emerging rural sign language in Brazil, and Libras, the national sign language of Brazil, to investigate whether a difference in time-depth—a relevant factor in phonological reorganisation—influences trade-offs involving iconicity. First, we find that contrary to what may be expected, given that emerging sign languages exhibit great variation and favour highly iconic prototypes, Cena signers exhibit neither greater variation nor the use of more complex handshapes in classifier constructions. We also report a divergence from findings on Nicaraguan Sign Language (NSL) in how signers encode movement in a young language, showing that Cena signers tend to encode manner and path simultaneously, unlike NSL signers of comparable cohorts. Cena signers therefore pattern more like non-signing gesturers and signers of urban sign languages, including the Libras signers in our study. The study contributes an addition to the as-yet limited investigations into classifiers in emerging sign languages, demonstrating how different aspects of linguistic organisation, including phonology, can interact with classifier form.

Keywords: sign language; phonology; iconicity; classifiers; language change



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1. Introduction

Classifiers present a ubiquitous, rich, and productive morphological category of structures within sign languages. Despite the myriad ways in which they exploit iconic properties of the referent they depict, similar to sublexical units of a language, their features may also be constrained by phonology. As phonological reorganisation takes place over time (Frishberg 1975; Brentari et al. 2012; Senghas et al. 2004), our study compares results from the same production task between signers of Cena, an emerging sign language of north-eastern Brazil in its third generation, and Libras, the national sign language of Brazil, to determine how handshape complexity and variation fare in two languages of different ages and sociolinguistic profiles. We aim to investigate the question of whether in a language of relative youth, we find more complex and varied classifier handshapes given that classifiers are likely unconventionalised, thus putting a greater burden on recoverability through strategies such as iconic depiction. We also explore how signers choose to encode manner and path in motion events. Considering existing findings from signers of Nicaraguan Sign Language (NSL) illustrating that later-cohort signers show a

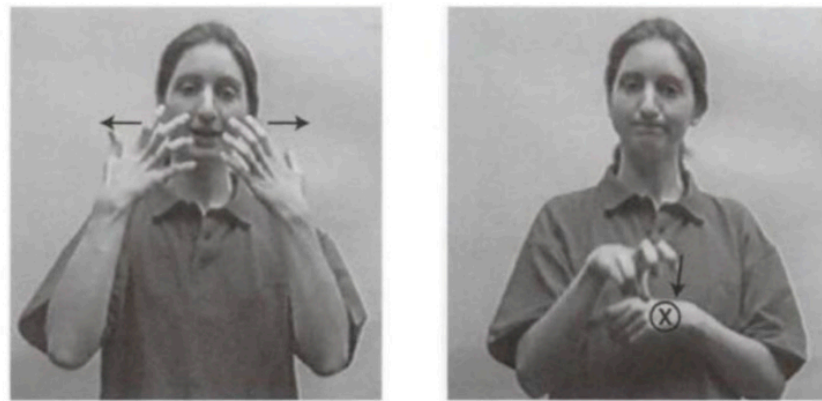
greater preference for encoding manner and path sequentially relative to earlier-cohort signers, we are interested in whether this departure from iconic depiction represents a developmental stage of emerging sign languages generally, or whether it may be specific to the conditions under which NSL emerged.

In Section 1, we provide background on classifiers in sign languages, providing a brief summary of common categorisations of classifier types. The section also details how the phonological features of classifier complexity may be reorganised in predictable ways over time and provides a model of quantifying complexity based on the prosodic model (Brentari 1998). Finally, Section 1 contextualises both languages in the study and the cultural contexts in which they are used. Section 2 details the Haifa Clips communicative production task, developed for Sandler et al. (2005), in which signers describe basic motion events to another native signer who must correctly identify the events, and our subsequent analysis methods. Section 3 provides results, finding that, overall, Cena signers do not appear to make as much use of more complex handshapes as we may have expected given young sign languages' propensity for iconic depiction (Sandler et al. 2011; Hou 2016), and although we do find more handshape variants in one type of classifier in Cena, these may be accounted for by assimilation. Our results also show how in their encoding of movement, both Libras and Cena signers pattern more like gesturers, early-cohort NSL signers, and signers of urban sign languages. Section 4 presents discussion of the findings. We consider and further break down results in terms of complexity and variation in this section, before discussing our conclusions in Section 5.

1.1. Classifiers in Sign Languages

1.1.1. An Overview

Classifiers are handshapes that denote a broad class of referents such as vehicles, people, or round objects within a given sign language. In this way, they function similarly to those of spoken languages, although in the interests of space we will not include a detailed comparison here¹. Handshape is usually described as one of the sub-lexical building blocks of signs that combines with location and movement to form meaningful signs, much in the same way meaningless sounds combine to form words in spoken language. However, handshapes as they exist in classifiers are morphemic; simply put, they are meaningful. Classifiers may be combined with particular movement or location specifications to depict verb events, forming what we will call *classifier constructions*, although labels in the literature vary (c.f. Engberg-Pedersen 2010 for *classifier signs*; Cormier et al. 2012 for *depicting constructions*) depending on which model of proposed classifier representation and structure one may subscribe to. Examples of classifier constructions from British Sign Language (BSL) (Sutton-Spence and Woll 1999) and Hong Kong Sign Language (HKSL) (Tang and Yang 2007) are shown in Figures 1 and 2. In Figure 1, the signer first produces the lexical sign CAT in the image on the left, and on the right depicts an action performed by the referent with a BSL animal classifier and a motion verb. The construction in Figure 2 combines a vehicle classifier with a verb of motion producing *a vehicle arrives*. Both classifiers pick out some visual characteristic of the referent—the vehicle classifier depicts the overall shape, whereas the animal classifier highlights the salient property of its legs. This exemplifies what is known as *iconicity*, which features heavily in classifiers—some motivated relationship between form and meaning.



(L) CAT (R) CL:ANIMAL-SITS

a cat sits

Figure 1. An animal classifier used in a classifier construction ‘a cat sits’ in BSL. Reprinted with permission from Sutton-Spence and Woll. Cambridge University Press 1999.

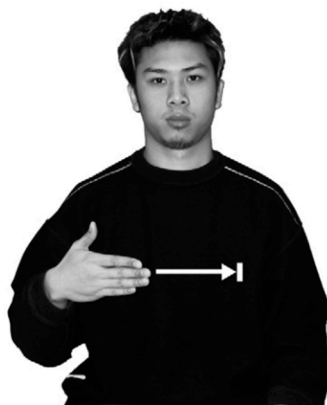


Figure 2. A vehicle classifier used in a classifier construction in HKSL. Reprinted with permission from Tang and Yang. 2007 Elsevier.

Classifiers vary in the properties of their referents they pick out and how they do so. In his early analysis of American Sign Language (ASL) classifiers, Supalla (1982, 1986) proposed five types: (i) size and shape specifiers (hereby SaSSes), which denote a referent by depicting its size or physical form; the hands may statically show the outer edges of the object to show its height or width (such as the thickness of a book), or they may trace its shape (such as the outline of a Christmas tree); (ii) semantic classifiers, depicting a general semantic class of objects such as an animal in Figure 1 or vehicle in Figure 2, but may be manipulated to show additional or specific details; Supalla (1986) gives the example of a tree classifier—a signer is free to modify this broad semantic category classifier to show the type of tree, be it a palm or weeping willow; (iii) body classifiers, which use the body of the signer to denote the whole body of an animate referent; (iv) body part classifiers in which parts of the body represent themselves; and (v) instrument classifiers, indirectly denoting a referent through depicting its handling or manipulation. In the manipulation of the referent object, the hands can represent themselves, or a tool being manipulated (one may think of a flat hand moved in a sawing motion to represent a knife).

Since Supalla’s work, many other categories have been proposed for ASL and other languages, and terminology varies (see Tang et al. 2021 for a recent overview). Studies also vary in the number of proposed sub-types of classifiers, but the same two main types of

classifiers persist throughout much of the literature even when additional categories are also proposed:

1. Whole entity classifiers, in which the hand or hands directly represent a whole object. They denote a general class of objects (e.g., people, vehicles, four-legged animals) using some aspect of their form, though their iconicity can vary in its transparency. Some consider this category to include SaSSes (e.g., Zwitserlood 2012), while others do not (Morgan and Woll 2007).
2. Handling classifiers, which denote an object through depicting the handling or manipulation of the object in question, e.g., holding a mobile phone, or turning a key. These often still provide some information about the size and/or form of the object, although indirectly.

Classifiers are often discussed as a freer class of items in a sign language relative to lexical signs, in that some (not all) featural specifications of the same classifier may vary across usages based on the semantic properties of the specific referent. The movement features for an entity classifier within a classifier construction depicting a person walking may depend on their style or speed of walking, just as the type of tree depicted may determine specifics of the chosen handshape. However, whilst a signer has relatively more articulatory choices at their behest when using classifiers, it is not completely unconstrained. They must become conventionalised within a given language. Classifiers for the same group of referents vary crosslinguistically and are not always transparent despite their tendency to take advantage of iconic relations—compare the BSL vehicle classifier handshape² to that of ASL .

This crosslinguistic variation might in part be due to the iconic capacity of handshape being more varied than that of movement and location. There are often many aspects of an entity available for iconic depiction, and choices are influenced by various factors including conceptual salience (Tkachman et al. 2020), i.e., which visual aspect of the referent may be most salient such as the beak of a chicken as opposed to its feet. The choices for movement and location are not so broad, if one wants to depict iconically. In reality, referents are only ‘specified’ (to use a phonological metaphor) for one location at any given time, relative to other potential referents. The same may be said about orientation, and to a lesser extent, movement³. It cannot be said that an entity is specified only for one shape, however. A human being or a car could be deconstructed into many shapes, including but not limited to their overall shape. The overall shape of a referent is merely one representational choice available out of many in constructing an entity classifier. This variety of choice can be observed in experimental contexts. Schembri et al. (2005) found that when depicting the same referents, the handshapes of classifiers used by signers of unrelated sign languages varied much more than their movement or location specifications. In short, handshapes for the same referent vary widely between languages. We turn next to what may influence system-wide choices in handshape in languages, particularly those of different ages and stages of conventionalisation.

1.1.2. The Phonology of Classifiers

Such variety of possibility in classifier handshape may serve as one motivation to stray further away from iconicity. As users of any communicative system mediated through anatomy, signers and speakers are subject to biological principles of energy conservation and a temptation towards the path of least resistance. It is known that signs become less iconic over time (Frishberg 1975), and that such phonological reorganisation can be motivated by ease of articulation. Eccarius (2008) notes the older form of the airplane classifier handshape in HKSL is the highly marked . Over time, young signers are replacing this handshape with , wherein the index finger is extended rather than the middle. What this newer variant may lose in iconicity, it gains in ease. Only the thumb, index, and pinky fingers are controlled by muscles that allow them to extend independently with no adjacent digit to support them (Ann 2006, p. 94). This pull towards articulatory ease appears

strong enough to transcend the lone domain of handshape. The movement features of VIDEOTAPE-RECORDER in ASL have shifted from being asymmetrical—depicting the way in which the reels really move—to being symmetrical (Figure 3). The motivation from articulatory ease is clear. Human physiology is marked by bilateral symmetry, and as such movements that are symmetrical from the midline of the body can be specified for only one path of movement, rather than the two that asymmetrical movements require. Empirically, studies on symmetry in gesture (in hearing non-sign language-learning infants) and sign (in deaf sign language-learning infants) in young children support the idea that two-handed symmetrical movement is articulatorily easier than two-handed asymmetrical movement (Fagard 1994; Cheek et al. 2001; Pettenati et al. 2010). We take this as strong evidence of their relative ease, analogously to how factors such as infant substitutions and error shape conclusions about the relative difficulty of sounds in spoken language.

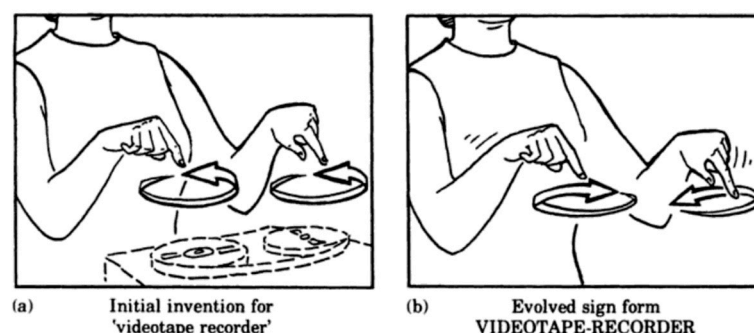


Figure 3. The evolution of ASL VIDEOTAPE-RECORDER. Adapted from Klima and Bellugi (1979). Reprinted with permission from Klima and Bellugi. 1979 Harvard University Press.

In short, the balance of the trade-off between faithfulness to iconicity and pressures of phonology may shift over time. Such an idea is also supported by more recent work. Brentari et al. (2012) present evidence that the phonological features of classifiers show a predictable distribution in terms of complexity. Naturally, a quantifiable measure of complexity is needed for such a claim. The authors compare two types of complexity—finger complexity and joint complexity—and define them as follows. Finger complexity is concerned with which fingers are selected for a given handshape, as articulatory difficulty varies in part because of how different muscle groups support the extension of the digits of the hand. For example, it is less strenuous for the middle, ring, and pinky fingers to all share the specification of flexion or extension in a handshape (see Ann 2006 for an anatomical explanation of why). Brentari and colleagues describe the different criteria one can use to arrive at a notion of low finger complexity in handshapes: early acquisition, crosslinguistic frequency, and representational simplicity—in this case under the prosodic model (Brentari 1998)⁴. These criteria all overlap to capture three selected finger groups of low complexity (all, index, and thumb) shown in Table 1. Handshapes with medium complexity are those that have a single non-radial finger extended, i.e., the middle, ring, or pinky finger. Additionally, the medium complexity category captures handshapes with two selected fingers. Representational complexity determines this criterion; medium finger complexity handshapes differ from low complexity handshape by one additional feature specification. The prosodic model utilises one of the central ideas of dependency phonology⁵: features dominate over other features to yield possible contrasts. This is analogous to representations of vowel systems wherein the place feature [high] alone might be realised as [i], but if [high] dominates over [low] this results in [ɪ]. For a handshape where the index and middle fingers are extended, for selected fingers [one] dominates [all]. Similarly, different place features combine in dominance relations to yield handshapes such as the ring finger alone being extended. As such feature interactions require two features, this additional feature forms the criteria for medium complexity. High complexity captures

all other possible selected finger groups that differ in the type and number of additional feature configurations they need.

Table 1. Handshapes demonstrating finger complexity scores according to Brentari et al. (2012).

Finger Complexity	Handshape Examples
Low	
Medium	
High	

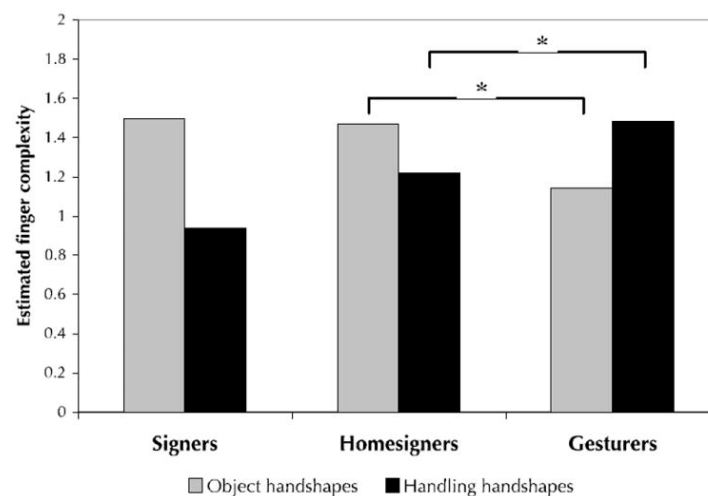
Whilst joint complexity was not the authors' focus, they define it as follows. Fully open and fully closed handshapes are given the lowest score of 1, in which the selected fingers are fully extended, or all fingers are fully closed respectively. Flat and spread handshapes receive a higher score of 2. Flat handshapes are formed by bending the finger(s) at the base joint while the other finger joints remain extended, and spread handshapes are any in which the extended fingers are spread apart from one another. Curved and bent handshapes receive a higher score still (3), wherein all the selected finger joints are flexed to a greater (bent) or lesser (curved) degree. The category of highest joint complexity, 4, is reserved for stacked (in which each selected finger is increasingly flexed) and crossed (when selected fingers are crossed) handshapes. Accompanying examples of all groups can be found in Table 2. These complexity scores are again based on a notion of representational complexity under the Prosodic Model (Brentari 1998), but the resulting stratification accurately predicts patterns we would expect given such categorisation (Brentari et al. 2016). In acquisition, the handshapes that are the earliest acquired by ASL- (Boyes Braem 1990) and BSL-learning children (Morgan et al. 2007) are of low joint complexity. Those that are of high joint complexity, conversely, are among the latest acquired and among the most infrequent crosslinguistically (Rozelle 2003). However, whilst all handshapes of low complexity may be those that are crosslinguistically frequent and earliest acquired, the reverse does not necessarily hold. That is, handshapes that may be frequent or easily acquired may not always receive scores of low complexity. One such exception is the curved  handshape⁶, which is considered unmarked (Battison 1978) and is frequent crosslinguistically in classifiers (Zwitserslood 2012). Its relative frequency in classifiers across languages is likely at least partially grounded in its ubiquity as a manual configuration for handling objects. As the model of Brentari et al. is motivated primarily by representational complexity, such a model will overlook influences of this type.

Moving away from notions of complexity defined by linguistic criteria, Brentari et al.'s model generally overlaps with a model of articulatory ease based on the anatomy and physiology of the hand proposed by Ann (2006), with some minor differences⁷. Whilst keeping in mind that representational complexity is not automatically the same as articulatory difficulty, it is pertinent to determine to what extent a phonological measure of complexity overlaps with purely motoric articulatory difficulty. In this case, this model of representational complexity does largely overlap with conceptions of articulatory difficulty based on acquisition, crosslinguistic distribution, and anatomy.

Table 2. Handshapes demonstrating joint complexity scores according to Brentari et al. (2012).

Joint Complexity	Handshape Examples
1	
2	
3	
4	

Considering the findings of Eccarius (2008) and Brentari and Eccarius (2010), that handshapes in entity classifiers (or *object classifiers* as they call them) have greater finger complexity and handshapes in handling classifiers have greater joint complexity across unrelated sign languages, Brentari et al. (2012) compare hearing gesturers, homesigners, and ASL and Italian Sign Language signers to shed light on whether this pattern is one imposed by some aspect of the linguistic system, or a general tendency in codification shared by signers and non-signers alike, based on iconic properties available to all. The authors found the former: gesturers demonstrated the inverse of the results from the crosslinguistic studies (i.e., greater joint complexity in object handshapes and greater finger complexity in handling handshapes). The homesigners' results mirrored those of signers but with less polarised differences, and the signers in the study replicated findings from previous research. In other words, there is a unidirectional pattern of change in phonological complexity through gesturers, homesigners, and signers respectively. Finger complexity in entity classifier handshapes increases, as does joint complexity in handling classifier handshapes. Differences in finger complexity distribution across signers, homesigners, and gesturers found by Brentari et al. (2012) can be seen in Figure 4, in which the asterisk denotes a statistically significant difference. Taken together with examples from Frishberg (1975) and Eccarius (2008), this seems to suggest that even in a realm as iconic as classifiers, we still observe that something like handshape complexity is not distributed equally across classifier types and is subject to, at least in part, predictable phonological organisation. We take this as our starting point for the current study.

**Figure 4.** Finger complexity in object⁸ and handling classifier handshapes across groups. Adapted from Brentari et al. (2012). Reprinted with permission from Brentari et al. 2012 Springer Nature.

1.1.3. Manner and Path in Motion Events

Entity classifiers allow signers to set up a referent in space and have it undergo or perform actions. As such, they are often used by signers to depict motion events. If motion occurred, there is always a start and end point between which a referent moved; this is what is referred to as *path* movement. There is also a *manner* of movement—how a referent got from A to B (such as rolling or walking). Perceptually, both these aspects of movement are perceived simultaneously and thus one might imagine that any linguistic expression of motion events would reflect this simultaneity. However, comparisons made among spoken languages demonstrate that they tend to segment a motion event into two linguistic structures, one encoding the path and another the manner (Talmy 1985). More recent research on signers and gesturers has aimed to answer the question on whether this tendency to segment and linearise is a general property of language, or an effect of modality. Visual information such as path and manner of movement can be easily ‘stacked’ in sign languages—encoded simultaneously mirroring the way it is visually experienced. Sequential encoding is of course equally possible (see Figure 5 for both methods). Nicaraguan Sign Language (NSL) offers a unique vantage point into the dynamic early stages of a developing sign language and how motion information is encoded (Senghas et al. 2004); much like hearing Spanish-speaking, non-signing gesturers, first-cohort child NSL signers tended to encode events holistically, representing the simultaneous exhibition of path and movement features as they occur in the real observed event. In second- and third-cohort child signers, significantly less simultaneous encoding was observed, and was replaced by sequential encoding at a comparable rate of frequency (Figure 6).

However, one should not rush to conclude that there is simply a unidirectional change in a language from simultaneous encoding towards sequential encoding as a language develops over time. When tested with the same materials as the NSL signers, signers of Spanish Sign Language encoded manner and path primarily simultaneously (Senghas and Littman 2004), demonstrating the tendency of urban sign languages to depict manner and path simultaneously rather than sequentially. There are mentions, however brief, in existing literature on other conditions in which linear segmentation of movement may occur. Supalla (1990) describes two types of constraints on simultaneity of manner and path in ASL classifiers: motoric constraints, where manner and path physically cannot be depicted simultaneously, and grammatical constraints, wherein existing constraints on movement prohibit a particular combination of a verb of motion with a selected classifier⁹. Newport and Meier (1985), De Beuzeville (2004), and Tang et al. (2007) all report instances of sign language-learning children breaking down motion events into linear constructions, the individual parts of which sequentially encode aspects of its path or manner. Newport and Meier (1985) argue that this is motivated by articulatory ease, that children may struggle to articulate classifier handshapes (which are often marked) and the path or manner of the motion verb simultaneously. Concerning the choice between linear segmentation and simultaneous encoding of manner and path, the latter is the more iconic choice in terms of temporality. That is, manner and path are simultaneous in a motion event itself, so to encode them as such is faithful to reality. Among children acquiring sign languages, in the trade-off between iconicity and articulatory ease, ease may prevail when certain aspects of manner or path are difficult to produce simultaneously for the young signer.

What the cases of later-cohort NSL signers and children in the acquisition stage seem to suggest is that segmentation is the exception rather than the rule. The language model available to later-cohort NSL signers (who exhibit linear segmentation of motion events) was one that was undergoing rapid and multifaceted restructuring as various homesigners came together. Children in the acquisition stage are also in an atypical linguistic situation relative to other language users; they are in a transitory and temporary period when they do not yet have a full grasp of their native language. What both these cases have in common is some unique environment in terms of language input and/or acquisition stage, and both cases involve child signers. None of this applies to signers in our study. On the other hand, further investigation may suggest that these are not conditioning factors in accounting for

sequential encoding of manner and path, and the preference may be also found in second and third cohorts of adult signers of emerging sign languages. The current study takes one step towards answering this question.

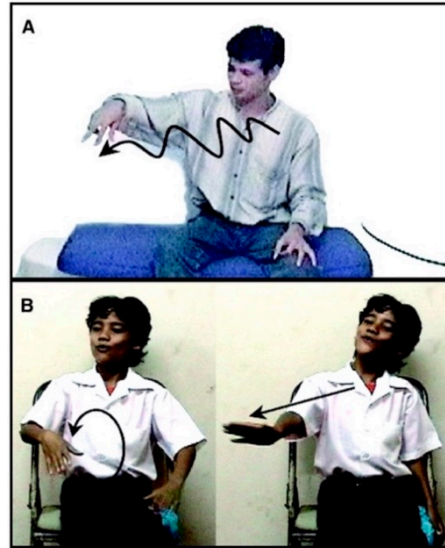


Figure 5. (A) A gesturer encoding manner and path simultaneously; (B) a NSL signer encoding manner and path sequentially. Adapted from [Senghas et al. \(2004\)](#). Reprinted with permission from ([Senghas et al. 2004](#)) The American Association for the Advancement of Science.

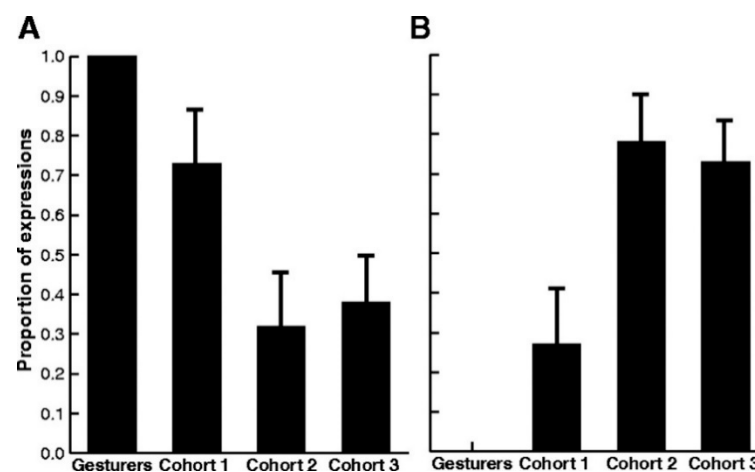


Figure 6. Proportion of simultaneous (A) and sequential (B) movement encoding across groups in [Senghas et al. \(2004\)](#). Reprinted with permission from ([Senghas et al. 2004](#)) The American Association for the Advancement of Science.

1.2. The Current Study

So far, we have presented evidence that classifiers are indeed an area in which the phonological domains of handshape and movement are subject to (re)organisation over time. Subsequently, we present an exploratory analysis of classifier handshape and movement in two sign languages differing in age and sociolinguistic profile. Existing work by [Sandler et al. \(2011\)](#) on Al-Sayyid Bedouin Sign Language (a village sign language of Israel, henceforth ABSL) in accounting for phonetic variation details how signers of an emergent sign language aim for highly iconic holistic depictions of referents, in lieu of contrastive primitives or phoneme-like units in a phonological system. This appears to be true of other typologically similar sign languages (e.g., [Hou 2016](#)). If it is the case that classifiers are subject to pressures from articulatory ease over time, and that signers of emerging sign

languages tend to aim for holistic iconic depictions, we may expect greater complexity and variation in Cena considering its youth relative to Libras, as Cena signers aim for specific and unconventionalised iconic depictions.

To test this, we compare responses to a video depicting a bottle falling from Cena and Libras signers. In the stimulus, the bottle falls without intervention from a visible human agent so it elicited mostly entity classifiers and SaSSes (our criteria for assigning a classifier each of these labels is explained in Section 2.3). We present the analysis of these types separately, to tease apart the distribution of handshapes across different types of classifiers considering there may be aspects of each type of depiction (whole entity vs. size and shape) that may influence the selection of handshapes, as we have seen happens between entity and handling handshapes. The variants will be coded for complexity following Brentari et al. (2012) and Brentari (1998) and compared across languages. We will also assess variation by way of the number of handshape variants per language and their distribution. Last, we present an analysis of how movement manner and path are encoded in descriptions of motion events considering the relevant variable of language time-depth (cf. Senghas et al. 2004). The domain of classifiers is well-suited to our aims. The high degree of iconicity often found in classifiers provides an opportunity to observe other factors that may pull sign form away from faithfulness to semantics or an iconic representation, such as articulatory ease, or the emergence of sequential encoding.

Predictions

The conventionalisation of classifier form in languages over time is a process that allows signers to rely on convention to depict referents rather than only iconic resemblance, inviting the possibility for forms to become phonologically reorganised under the pressure of articulatory ease in cases where the two are indeed opposing forces. Of course, there are other forces influencing classifier form such as semantics, but pressures of ease function within such influences (there are articulatorily more and less difficult ways of picking out the same semantic property). Given the tendency for signs—including classifiers—to submit to pressures of articulatory ease as a system increases in time-depth and becomes more conventionalised, and given the holistic depictions found in village sign languages in lieu of robust systematic phonological structure (Sandler et al. 2011; Hou 2016), we predict that iconic depiction will triumph in any trade-off against articulatory ease. Our first hypothesis is as follows:

Hypothesis 1 (H1). *Cena classifiers will exploit handshapes of greater complexity than Libras.*

Since it is unlikely that a systematic level of phonological structure has emerged in a language of such an age and sociocultural profile, and that close-knit communities can tolerate great variation (Wray and Grace 2007) at higher rates than their national counterparts (Meir and Sandler 2019) over long periods of time (Meir et al. 2012), our second hypothesis is:

Hypothesis 2 (H2). *Cena classifier handshapes will exhibit greater intersigner variation than Libras.*

Last, we turn to the encoding of motion events. Whilst Cena signers have not yet been grouped into distinct cohorts by researchers, they are not homesigners; most of them grew up with an existing language model. However, this linguistic input is different to that of later-cohort NSL signers, who showed a greater preference for the linear sequencing of motion events relative to first-cohort signers. The vertical linguistic input of later-cohort signers was that of various unconnected homesigners whom the establishment of a school had brought together. Although we believe the majority of Cena signers in our study to be roughly second cohort, their language is not undergoing the intense restructuring of second-cohort NSL, or others in creolisation language contexts (though this may have been partly in play with the establishment of Libras over 150 years ago in its early development

with the foundation of INES). Recall also that linear sequencing of motion events has been observed in children acquiring a sign language. As all signers in our study are well past the acquisition period, and given that Cena does not share its context of emergence with NSL and the subsequent type of restructuring that follows, we predict Cena signers will prefer simultaneous encoding of manner and path. We also predict Libras signers will prefer this strategy, in line with data from signers of Spanish Sign Language. Our final hypothesis is as follows:

Hypothesis 3 (H3). *Both Cena and Libras signers will exhibit a preference for simultaneous encoding of motion events.*

1.3. Language Profiles

1.3.1. Libras

Libras—an abbreviation of its Portuguese name, *Língua Brasileira de Sinais*—is the official national sign language of Brazil, used in (but not limited to) institutions and urban centres across Brazil. Its establishment was associated with the foundation of the National Institute of Deaf Education (INES) in Rio de Janeiro in 1857. Since one of the original teachers at the institute was French, modern Libras has evolved from a mixture of French Sign Language and existing signs in use in the region (Xavier and Agrella 2015). In 2002, Libras was legally recognised as the language of many Brazilian deaf communities, reaffirming its cultural and linguistic importance as a natural language¹⁰. The legal recognition of Libras under the ‘Libras Law’ (as Federal Law 10.436 is known) and a resulting decree (5.626) has manifested basic deaf rights in Brazil, including rights to interpreters in official settings and the translation of official documents. In the wake of such legal recognition, Silva (2021) suggests we need to look anew at the sign languages of Brazil used outside of urban centres. Outside of legal protections and benefits, we have seen that their documentation paves the way for a richer and broader understanding of (sign) language typology (de Vos and Pfau 2015), phonology (see Sandler et al. 2011 for the emergence of), and syntax (Sandler et al. 2005 for word order; Meir 2010; Padden et al. 2010; Ergin et al. 2018 for argument structure). We compare Cena to Libras in the current study to control as many orthogonal variables as possible. Primarily, the comparison ensures that the repertoires of ambient gestures of the surrounding culture are closely matched. This is a known and significant influence on sign languages, as they absorb and reorganise gestures that are culturally specific even within the realms of classifiers (Nyst 2019). We know of at least one such borrowing in Cena, where the sign PAST/A-LONG-TIME is identical in form to a common Brazilian finger-snapping gesture relating to time passing. Therefore, although the desired comparison is primarily between a young emergent language and an urban sign language with greater time depth, we aim to minimise confounds from distinct gestural influences by comparing Cena to the most culturally similar language that otherwise meets our criteria.

1.3.2. Cena

Silva (2021, p. 107) details studies that deal with at least 21 sign languages used by deaf communities in Brazil (see Fusellier-Souza 2004; Stoianov and Nevins 2017; and Godoy 2020 for examples of linguistic investigation). However, such studies are still preliminary and in need of richer linguistic description. Among these emerging sign languages used by isolated communities far from urban centres we find Cena, literally *scene*, the word used to refer to what signers recount with their hands as they sign and the term that has come to be used as a name for the language in its community. Cena is a sign language in its third generation used by deaf (and many hearing) inhabitants of Várzea Queimada, a community with a population of about 900. Várzea Queimada is located in the eastern part of Piauí, a mostly landlocked state of north-eastern Brazil. Cena, like other languages of its kind, has emerged within a context of a high rate of congenital deafness and is unrelated to the national sign language of its country. It is in the PhD thesis of Everton Pereira (2013)

that we find the first published mention of Cena¹¹. From an anthropological perspective, he details the use of Cena as it interacts with aspects of daily life and society in Várzea Queimada: work, religious practices, family life, and local artisanal crafting. The majority of residents, deaf and hearing alike, subsist on agriculture, animal husbandry, local commerce, and government benefits¹². In claiming that many hearing people sign, and in drawing any parallels between the work-related livelihoods of deaf and hearing inhabitants of the community, it is important to be careful to not perpetuate idealistic notions of a ‘deaf utopia’ in villages such as Várzea Queimada, as warned by [Kusters \(2010\)](#). She explains the risk of flattening many nuanced asymmetries between the social, economic, educational, and professional realities of deaf and hearing people in such contexts by over-emphasising the integration of deaf community members relative to Western urban contexts. In Várzea Queimada, deaf access to education has historically been subpar or non-existent, and the community is not immune to negative attitudes towards deafness from within their ranks. Anthropological and linguistic work on Cena is undoubtedly in its infancy, but suffice it to say for now that the gap of social and economic stratification between deaf and hearing inhabitants of Várzea Queimada is far smaller than that of urban centres around Brazil, which is of course in no small part likely due to the upper limits of such stratification within the confines of the village.

There are 34 known deaf inhabitants as of 2021¹³, most of whom use Cena as their primary language although there is variation in the exposure to and use of Libras, particularly with younger signers. Most deaf inhabitants are clustered in three villages, each a few kilometres apart. The first deaf woman in the community was born in 1949, and soon after another six deaf children were born into a different family. Cena is not a homesign system, but we hypothesise that like many similar languages, it likely started as one. As is common with sign languages of this sociocultural context ([de Vos and Pfau 2015](#)), an unknown number of hearing people in the community sign to varying degrees of competency. Many deaf adults have hearing children—known as CODAs (children of deaf adults)—who are proficient signers, and some hearing members of deaf individuals’ families are competent signers. At the time of publication, the youngest deaf signer is 15, with no other known deaf children born in the community since. There is some use of Libras among younger signers since many temporarily attended schools in the community, where they had weekly classes in Libras. Younger signers also have access to the internet and numerous social networks to varying degrees, and signers of a variety of ages use lexical borrowings from Libras. Despite the increased and perhaps increasing presence of Libras in the community through education and the internet, age remains a determining factor; older signers do not, and have not historically, attended school and thus use of Libras among them is often minimal.

Whilst Pereira’s thesis discusses matters of deaf social life and integration in detail, [Almeida-Silva and Nevins \(2020\)](#) provide the first linguistic overview of the language. Their data is comprised of 330 signs including nouns, verbs, adverbs, adjectives, and functional items. Pronominal markers rather expectedly use self-anchored pointing to mark first person, and pointing using real-world location to mark the second or third person of any present referent. In all existing data including that in the current study, no absent third-person pronouns have been observed. The authors also present evidence of adverbial modification (shown in Figure 7) in the use of facial expression and body movement to intensify manual signs, much like uses of similar non-manual features for intensification purposes in other urban sign languages, such as the ‘ee’ mouth gesture in BSL ([Sutton-Spence and Woll 1999](#)) and Auslan ([Johnston and Schembri 2007](#)), and the furrowed brows and hunching of the torso used in intensification in Libras ([Xavier 2017](#)). Concerning word order, there appears to be little overall convergence. Yet ‘overall’ may be the operative word in this case, as work on Central Taurus Sign Language ([Ergin et al. 2018](#)) and ABSL ([Meir 2010](#)) suggests consistency of word order in emerging sign languages can be dependent on syntactical properties of the verb events in question, as well as on signing cohort. [Almeida-Silva and Nevins \(2020\)](#) encountered various minimal

pairs such as the example shown in Figure 8, where one should note that the difference of left- and right-handedness between the signers is irrelevant to lexical contrast. As expected from languages that have emerged among low or unreliable rates of literacy, there is no manual alphabet nor any attested native alphabetised signs present thus far, though several signers know the Libras manual alphabet to varying extents—it is not uncommon for signers to use it for their own names or the names of others. Although there exist lexical borrowings from Libras, both the findings of Almeida-Silva and Nevins (2020) and data in the current study provide evidence for a vocabulary largely comprised of local Cena signs, including compounds unattested in Libras. Based on our observations over many field visits, signers are predominantly monolingual. This description is corroborated by self-reports from signers (Almeida-Silva, forthcoming), and by interviews with those who worked as teachers with the deaf members of the community, one going so far as to say Cena signers “reject” Libras (Franco 2022, p. 7).



intensification
MORNING
'very early'

Figure 7. A case of modification utilising the 'ee' mouth shape and body posture.



Figure 8. A minimal pair in Cena differing in handshape: (a) GOAT; (b) TO BETRAY.

This preliminary linguistic sketch of Cena found considerable robustness of various domains of the lexicon, notably food, animals, and religious terminology (which details the numerous saints and religious festivals observed by the mostly Catholic inhabitants of the community). Despite this, variation prevails. It is primarily along inter-familial and inter-generational lines where lexical variation is found, but phonetic variation is widespread

among signers. This comes as no surprise (cf. [Israel and Sandler 2011](#) for ABSL). It is known that for language in general, degrees of social intimacy and shared communal knowledge has a bearing on the resulting types of linguistic structures ([Wray and Grace 2007](#)). The lives of the inhabitants of Várzea Queimada are highly intertwined. People spend a great deal of daily time in each other's company doing domestic or farm work. From this repeated interaction sprouts a high degree of knowledge and intimacy concerning the lives and families of others, shared reference points, events and practices of cultural importance, and a knowledge of the surrounding area. The communication patterns of Várzea Queimada would fall squarely into what [Wray and Grace \(2007\)](#) and [Thurston \(1989\)](#) call *esoteric*, inward-facing language use on topics of mutual familiarity among those who are known to each other. This shared knowledge and relative homogeneity is what enables languages in such communities to tolerate high rates of variation ([Meir and Sandler 2019](#)), and is primarily what motivates our Hypothesis 2, predicting greater variation in Cena.

1.3.3. Typological Considerations

Considering the above sociocultural and linguistic outline of Cena, we turn briefly to the issue of language typology. Typological classification is a useful exercise as it enables us to compare phenomena across languages of the same type. Of course, *type* can refer to many aspects of linguistic structure—tonal languages are a type, as well as those with or without agglutinative morphology. Given what is known about the effects of sociocultural and geographical context on linguistic structure in young sign languages, the existing literature has commonly sought to categorise them along these lines. Broadly speaking, two main categories appear in the literature following the distinction first made by [Meir et al. \(2010\)](#): *deaf community sign languages*, and what we will term *village sign languages* (although there is more debate around the labels for sign languages of this general kind). Deaf community sign languages are the result of a group of deaf people of varied backgrounds coming together for some (often institutional) purpose, and often coincide with the establishment of a deaf school. NSL is one often-cited example of a deaf community sign language (see [Senghas 1995](#) and [Kegl et al. 1999](#) for early work) as the establishment of the school that galvanised its development was relatively recent. The historical development of several national sign languages including ASL also meets the criteria for this label, though these are often referred to as *urban sign languages*.

It should already be clear that Cena is not a deaf community sign language. As it has emerged among its users of the same background within the community in which it is used, Cena does not meet this description. Concerning the second type, there are many overlapping terms, including *village sign language* ([Zeshan 2011](#)), *shared sign language* ([Nyst 2012](#)), *indigenous sign language* ([Woodward 2000](#)), and *micro-community sign language* ([Schembri 2010](#)), which generally overlap in their criteria of a high rate of congenital deafness and a geographically rural context. The label *shared sign language* foregrounds the tendency for a large number of hearing people in such communities to sign, with varying degrees of fluency and regularity. Similarly, the name *indigenous sign language* aims to highlight the origin of such languages as the same region or country as that in which they are used. All such features are true of Cena, meaning perhaps it is a question of what we wish to foreground. For the current study, we follow [Almeida-Silva and Nevins \(2020\)](#) in using the label *emerging sign language* with the caveat that Cena does broadly fit the typical profile of a village sign language, since it is primarily the difference of time depth that is relevant for our aims. That is, we wish to compare Cena with a language in the same national and therefore to some degree cultural context, but one that has a stable and conventionalised lexicon and linguistic structure.

Whilst Almeida and Nevins provide an invaluable preliminary overview of the language, there is to date no mention of classifiers in any work on Cena. With the exception of [Brentari et al. \(2012\)¹⁴](#), there is little in the existing literature on classifiers in young or emerging sign languages. Although not an emergent language, in her description of Adamorobe Sign Language (a village sign language used in Ghana), [Nyst \(2007\)](#) details the

gestural and linguistic resources signers exploit for depiction of size and shape. Nyst's striking finding that Adamorobe Sign Language lacks entity classifiers highlights the importance of village sign language data in investigations of language typology and in questioning linguistic universals. Similarly, [de Vos \(2012\)](#) describes some classifier constructions in Kata Kolok—another non-emergent village sign language (she posits that Kata Kolok is in its fifth generation) used on Bali, Indonesia. De Vos finds that entity classifiers in Kata Kolok exploit a more restricted set of handshapes than urban sign languages; instead of handshape, entity classifiers in Kata Kolok are primarily defined by different features of movement or orientation (cf. [de Vos 2012](#), p. 101; [Marsaja 2008](#)). Again, her findings demonstrate that village sign languages can exhibit typologically unique or unusual properties in the realm of classifiers and the distribution of the features that comprise them¹⁵. The current study contributes another such investigation into classifiers in a young language, and the distribution of some elements that comprise them. It also provides the first English-language work on Cena, and the first comparative study of Cena with any other language.

2. Materials and Methods

2.1. Participants

The participants consisted of 19 deaf, predominantly monolingual Cena signers aged 13–59¹⁶ who all live in or around Várzea Queimada, and 19 deaf adult native Libras signers based in Rio de Janeiro. Cena signers generally do not have fluency in written Portuguese, and many are not fully literate. The Libras participants in our study all have a strong grasp of written Portuguese as it forms a part of their daily lives.

2.2. Materials and Task

The current study used the Haifa Clips stimuli set, designed by [Sandler et al. \(2005\)](#), to elicit recounts of short events from participants. The task consisted of 30 short (1–3 s) video clips depicting a variety of intransitive, transitive, and ditransitive actions, such as a ball rolling, a woman looking at a man, and a man throwing a ball to a girl. Participants were asked to relay each event to an interlocutor, another deaf signer and native user of the language in question. Participants then later functioned as interlocutors for following participants. Although many hearing individuals can sign to varying degrees of competency within the community where Cena is used, we chose to limit participants to only deaf monolingual signers to avoid any potential effects of linguistic accommodation between deaf and non-native or non-fluent hearing signers. This also ensures the utterances most closely mirror language used in its natural form—in a communicative context with comprehension as a desired target. To maintain consistency across the two groups, all Libras signers in the study were also deaf native signers.

Once a participant had relayed the event to the interlocutor, the interlocutor chose the corresponding event from three options depicted in images. All response options were still images—no part of the form relied on written language. An example page of the interlocutor's task is shown in Figure 9. Usually, the options differed in one argument of the verb and/or the verb itself. For example, for the stimulus with a rolling ball, the events depicted in the three choices are a ball falling, a bottle rolling, or a ball rolling. Once the interlocutor made a choice, this response was recorded as the first attempt. If correct, the researchers showed the following clip. If the interlocutor did not understand or chose incorrectly, the participant was prompted to explain the clip again. Participants were allowed as many attempts as needed to relay the event successfully. If none of these were successful, the attempt was marked incorrect and we played the next clip. The data for both languages was glossed by two fluent hearing Libras signers who have exposure to and knowledge of Cena through fieldwork. In light of the ongoing COVID-19 pandemic and lack of internet connection in Várzea Queimada, it was unfeasible to have any native Cena signer or our bimodal bilingual consultant in the community involved in the glossing process.

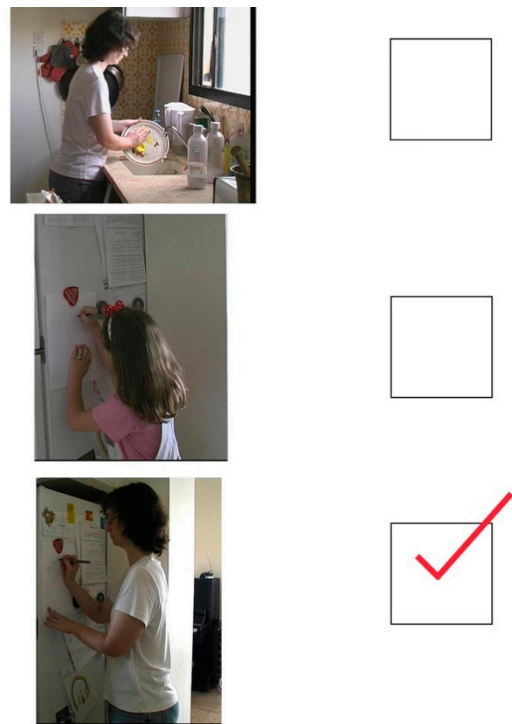


Figure 9. Multiple choice options for the stimulus ‘woman writes on refrigerator’.

2.3. Analysis

In our investigation of classifier handshapes, we analyse responses to one stimulus clip of a bottle falling (shown in Figure 10). Finding a target item in our data set that consistently elicited classifiers from a high number of signers was difficult, a problem made more obstructive by the small number of possible Cena participants. The bottle clip most consistently elicited use of classifiers, meaning that we had usable responses from all but one participant. We coded handshapes used to depict the referent when it is involved in some verb event as entity classifiers. Any classifiers that only depicted the extension of the object were coded as SaSSes. These could be static (perhaps depicting the height of the object) or have movement tracing its shape. For a classifier with movement to be classified as a SaSS, the movement must only depict the dimensions of the object, and no verb event. All tokens of a variable of interest in a participant’s response were coded. For example, if a participant used two entity classifiers with different handshapes to represent the bottle (perhaps one as the bottle wobbled and one as it fell), both were coded separately and used in the analysis.



Figure 10. Still images from the stimulus video depicting a bottle falling.

In the analysis of movement, we looked at five of the Haifa clips: a ball bouncing, a ball rolling, a girl running in a circle, a woman walking, and a woman running. We assigned

one possible value out of two for movement encoding: *simultaneous* in cases where path and manner were encoded in the same classifier construction, *sequential* when a verb event was split into two signs within a phrase, one providing the manner and the other the path. If a participant provided both a simultaneous and a sequential depiction of a verb event in their response, both were coded. In some responses, signers provided both a simultaneous encoding and another additional sign encoding manner or path only. For such responses the simultaneous construction was recorded, and the additional sign excluded from the analysis. Responses that only included manner or path were also excluded.

3. Results

3.1. Accuracy

We saw similar rates of response accuracy from interlocutors across both groups, with both Cena and Libras interlocutors identifying the correct target clip in 91% of cases. The similarity in these figures serves as a confirmation that the productions in response to the task were highly successful from a communicative standpoint. Correct comprehension tended to fail in cases of reversible transitive (such as *woman looks at man*) or ditransitive (*man throws ball to girl*) events or in non-agentive intransitive events (*ball rolls*). In transitive and ditransitive cases of communication breakdown, it was usually due to a need to disambiguate who was the subject and who was the object. We imagine that incorrect comprehension of non-agentive intransitive events may be because telling a friend or family member ‘a ball rolled’ with no additional information or context is a strange communicative interaction perhaps with the potential to confuse.

3.2. Handshape

First, we present results for the analysis of classifier handshapes. As a reminder, we coded handshapes that were used to depict that the referent in some verb event were coded as entity classifier handshapes. Handshapes used only in depicting the extension of the object (in other words, not in a verb event) were coded as size and shape specifier handshapes. We recorded 91 tokens of some type of classifier depicting the bottle from Cena signers, with at least one from every participant. Fourteen of these were handling classifiers used in a construction depicting the act of opening a bottle to specify the object; as we believe this is in the process of becoming a conventionalised lexical sign for *bottle*, we exclude this as a classifier variant. This leaves 77 tokens: 44 entity classifier handshapes used in verb events and 33 SaSS handshapes used only to depict the extension of the bottle. We observed five variants of entity classifier handshapes (Table 3) and four SaSS handshapes (Table 4) in the Cena data, displayed below with number of tokens and frequency, as well as the number of participants who used the variant.

Table 3. Cena entity classifier handshapes for the bottle stimulus.

Still Image	Handshape	Tokens	Proportion	No. of Signers
		15	0.34	12
		13	0.30	10

Table 3. *Cont.*

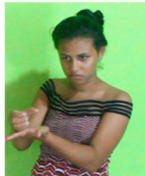
Still Image	Handshape	Tokens	Proportion	No. of Signers
		11	0.25	9
		3	0.07	2
		2	0.04	1

Table 4. Cena SaSS classifier handshapes for the bottle stimulus.

Still Image	Handshape	Tokens	Proportion	No. of Signers
		20	0.61	9
		6	0.18	5
		4	0.12	1
		3	0.09	3

For the Libras signers, we recorded 56 tokens of some classifier depicting the bottle, with at least one from every participant. In this case, the breakdown was 28 entity classifier handshape tokens used in some verb event and 27 SaSS handshape tokens used only to depict the extension of the referent. The 3 attested entity classifier handshape variants are shown in Table 5, and the 4 SaSS variants in Table 6.

Table 5. Libras entity classifier handshapes for the bottle stimulus.

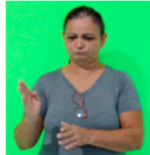
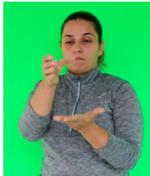
Still Image	Handshape	Tokens	Proportion	No. of Signers
		15	0.53	11
		8	0.29	8
		5	0.18	3

Table 6. Libras SaSS classifier handshapes for the bottle stimulus.

Still Image	Handshape	Tokens	Proportion	No. of Signers
		13	0.48	13
		7	0.26	5
		5	0.19	3
		2	0.07	1

Quantitatively, we find more handshape variants in entity classifiers in Cena than in Libras. All handshapes used in entity classifiers in Libras form a subset of those used in the same context in Cena. Four handshape variants were attested in SaSSes in both Cena and Libras, with three of the four handshapes being the same across the two languages. The least frequent handshape in each varied only in its degree of openness, the thumb-opposed  handshape appearing in Cena entity classifiers, and the slightly open version  in Libras entity classifiers. At a glance, the results seem to support our prediction for Hypothesis 2 (that of greater intersigner variation in Cena) when considering entity classifiers, since more handshape variants were attested in Cena than Libras. For size and shape specifier handshapes, our prediction was not borne out as the number of handshapes attested across the languages was the same. An evaluation of Hypothesis 1 (that of greater handshape complexity in Cena classifier handshapes) requires assigning complexity scores and determining whether there is a statistically significant difference in the distribution of scores across the two languages, which follows in Section 4.1.

3.3. Movement

Next, we turn to movement feature encoding, where we predicted both languages to show a preference for simultaneous encoding of manner and path for the reasons outlined in Section 1.1.3. Figure 11 shows the proportion of movement encoding strategies across the two groups, demonstrating that in both languages, signers overwhelmingly preferred the simultaneous strategy: 80% of Cena tokens encoded movement manner and path simultaneously, compared to 94% in Libras.

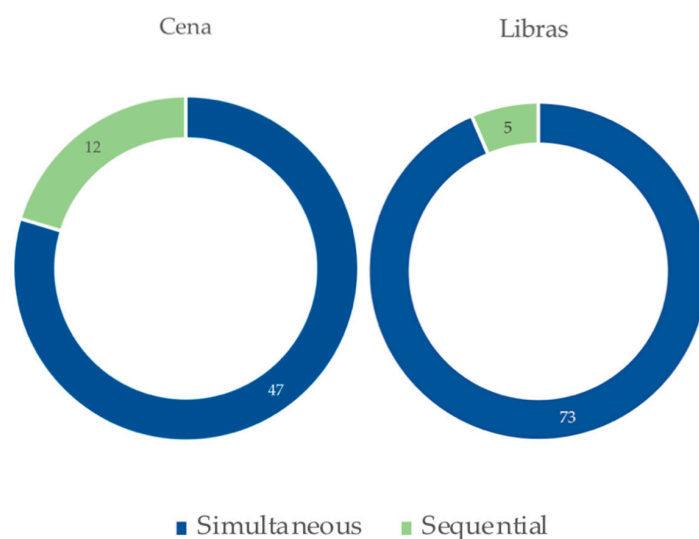


Figure 11. Movement encoding in Cena and Libras by token frequency.

4. Discussion

4.1. Handshape

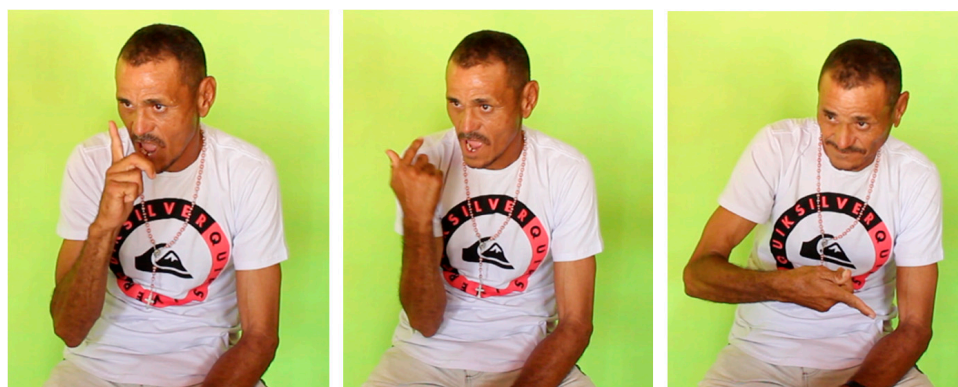
In order to find out whether the handshapes observed in the data are articulatorily easy or simple, we return to the quantification of complexity formulated by [Brentari et al. \(2012\)](#), which we outlined in Section 1. All handshapes attested within entity classifiers in Cena and their resulting finger and joint complexity scores are shown in Table 7, listed in descending order of frequency. The three most frequent entity handshapes have the lowest possible finger and joint complexity scores. Only the two least frequent handshapes have a finger or joint complexity score above the lowest possible value. Such a distribution upholds the general prediction of phonological markedness ([Battison 1978](#)) that there should be an inverse relationship between frequency and complexity; that is, the more complex a handshape, the less frequent we expect it to be. Conversely, we expect the most frequent handshapes to be the least complex. This prediction is borne out in the results.

Table 7. Entity classifier handshapes in Cena with finger and joint complexity scores.

Handshape	Frequency	Finger Complexity	Joint Complexity
	0.34	Low	1
	0.30	Low ¹	1
	0.25	Low	1
	0.07	Medium	1
	0.04	Low	4

¹ Though not specified in [Brentari et al. \(2012\)](#), the closed-fist handshape meets all the listed criteria for low complexity: it is among those first acquired by learners ([Boyes Braem 1981](#)), one of the most frequently occurring crosslinguistically ([Rozelle 2003](#)), and has a relatively simple structure in the prosodic model of representation ([Brentari 1998](#), p. 112).

Aside from influence from a preference for ease, we can speculate further about the distribution of the data and the presence of the two least frequent handshapes. If it is the case that over time signers may choose to substitute iconic but difficult handshapes for less iconic easier ones, this alone would not explain the presence of  in the data, which is a departure from both iconicity (having no obvious semantic motivation) and finger and joint simplicity. Looking at the classifier within the phrase provides clues. The handshape was only attested ($n = 3$ from two different participants) in cases where the sign WATER—which is specified for the same handshape, although the thumb is not visible in the first image in the following example—preceded the classifier. An example sequence is shown in Figure 12. This appears to be a case of handshape assimilation. Similar to spoken languages where a feature of a particular sound (such as place of articulation, or voicing) may spread onto its neighbour, sublexical features of a particular sign may also spread onto adjacent signs. In this case, the handshape in WATER remains throughout the following classifier.

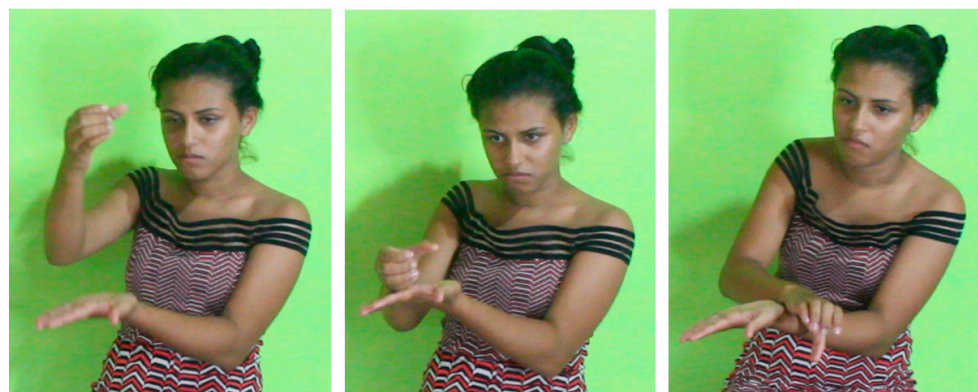


WATER CL: UPRIGHT-OBJECT-FALLS

A water bottle falls

Figure 12. Handshape assimilation in an entity classifier.

Similarly, the curved  handshape only appears as an entity classifier when preceded by a SaSS depicting the bottle's cylindrical shape using the same handshape ($n = 4$ from one participant), as in Figure 13. Of course, a phonological explanation is not the only type possible. Such variants could be motivated by reasons of semantics¹⁷, in that the handshapes signers select may be motivated by semantic properties determined by certain experiences (or lack thereof) with objects, or certain semantic properties the signers feel to be salient in the object in the stimulus. To tease this apart, one could elicit depictions of different types of the same object, perhaps forms varying in colour, material, or intended use. This would not only foreground different semantic associations, but ideally also encourage varied lexical items preceding or following the classifiers to further investigate a hypothesis of assimilation. However, when we revisit one specific production, additional evidence for assimilation emerges. In Figure 14, a signer produces an account of the bottle falling. It begins with the sign WATER, with its  handshape remaining over a string of several subsequent signs including a lexicalised sign, two classifiers, and an indexical point. DRINK, which appears in the middle of this string, is a conventionalised sign with the  handshape, yet the presence of the extended index finger in this production is evident. We take this as robust evidence for assimilation, and thus apply the same hypothesis to the case of the curved  handshape in entity classifiers, given its similar distribution only following another classifier with the same handshape. It seems that in entity classifiers that used  and , any constraints on markedness or complexity were violated by virtue of other influences from phonology—assimilation. In the case of WATER, the influence of phonology in pulling sign form away from faithfulness to semantics or iconicity is particularly clear.

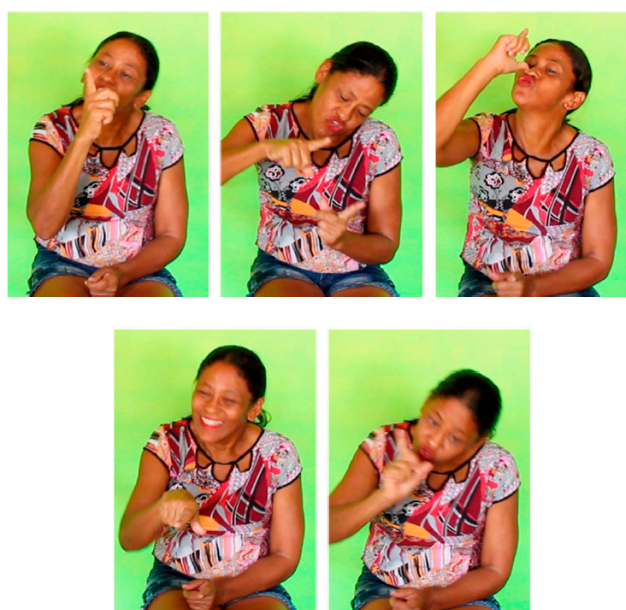


CL:SaSS(vertical trace) CL:OBJ-FALL H1

CL:FLAT-SURFACE_____ H2

A cylindrical on a flat surface object falls.

Figure 13. Handshape assimilation of  in an entity classifier.



WATER CL:SaSS(height) DRINK IX-COMPUTER CL:OBJ-FALL

The bottle of water falls

Figure 14. Handshape assimilation of  across several signs.

Turning to SaSS handshapes in Cena (Table 8), we see two handshapes with high joint complexity scores, both depicting the cylindrical shape of the bottle. The more frequent curved  handshape has only high joint complexity since all the fingers are selected and act in unison. The less frequent thumb-opposed  handshape scores highly both in finger and joint complexity. There are many handshapes available to signers to depict curvature: , ,  to list a few in addition to those in the data. Iconic depiction of curvature using handshape is likely to tip the balance out of favour with articulatory ease. As the quantification models of both Brentari et al. (2012) and Ann (2006) show, extended, closed, and flat handshapes all require less articulatory effort than curved ones. Within this small subcategory of handshapes in the data that depicted curvature, we still see the easiest one prevail—the curved  handshape. In the choice of handshape to depict the form of the bottle overall, iconicity may have won the trade-off initially, but within the variants selected for that choice, pressures from ease endure.

Table 8. SaSS classifier handshapes in Cena with finger and joint complexity scores.

Handshape	Proportion	Finger Complexity	Joint Complexity
	0.61	Low	3
	0.18	Low	1
	0.12	Low	1
	0.09	High	4

Next, we consider complexity in the Libras data. Complexity scores for Libras entity handshapes are given in Table 9, and SaSSes in Table 10. All entity classifier handshapes had all fingers or the index finger selected, resulting in the lowest possible finger complexity score. The curved  handshape is the only entity classifier handshape to receive a high joint complexity score. Every token of this entity classifier directly followed a SaSS depicting the object's curvature, of the form shown in Figure 13. This was a common strategy among Libras signers, to first depict the object's extension before depicting the verb event: 82% of Libras entity classifiers involved in verb events were directly preceded by a SaSS that depicted the size or form of the bottle, e.g., CL:SaSS(height) CL:TALL-OBJECT-FALL, as opposed to only 30% of Cena entity classifiers. The greater relative consistency with which Libras signers used this ordered construction may have had an effect on the distribution of handshapes with regards to assimilation, considering the evidence for assimilation in the same environment in Cena. Among the SaSSes, handshapes receiving high finger or joint complexity scores were involved in depictions of curvature. As the most frequent SaSS handshape fell into this category, the curved  handshape, it seems iconicity and semantics won this particular trade-off.

Table 9. Entity classifier handshapes in Libras with finger and joint complexity scores.

Handshape	Proportion	Finger Complexity	Joint Complexity
	0.53	Low	1
	0.29	Low	1
	0.18	Low	3

Table 10. SaSS classifier handshapes in Libras with finger and joint complexity scores.

Handshape	Frequency	Finger Complexity	Joint Complexity
	0.48	Low	3
	0.26	Low	1
	0.19	Low	1
	0.07	High	4

Last, we summarise the distribution of complexity scores (Figures 15 and 16) to return to Hypothesis 1—that of greater complexity in Cena classifier handshapes. Overall, classifier handshapes in Cena do not exhibit greater complexity relative to Libras. The languages showed a very similar distribution of finger complexity, in that handshapes

across both languages in both types of classifiers were overwhelmingly of low finger complexity. In both languages, the depiction of curvature explains the presence of high finger complexity handshapes, which comprised roughly the same small proportion of SaSS handshapes across Cena (9%) and Libras (7%).

Finger complexity score by classifier type and language

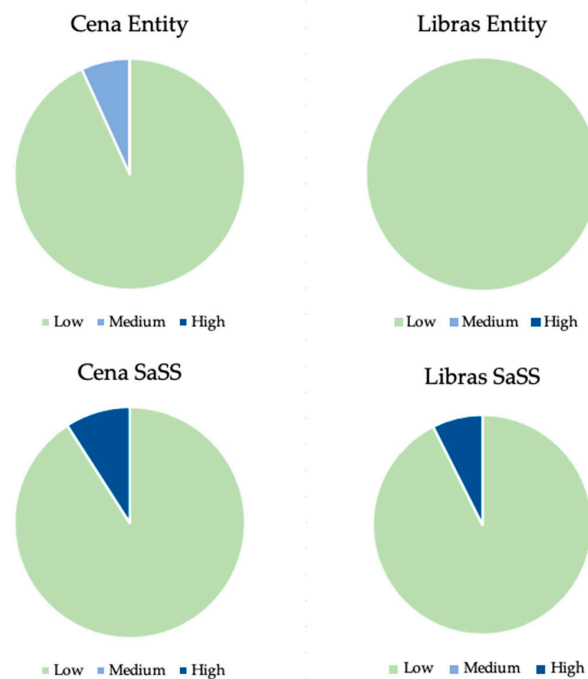


Figure 15. Finger complexity score by classifier type and language.

Joint complexity score by classifier type and language

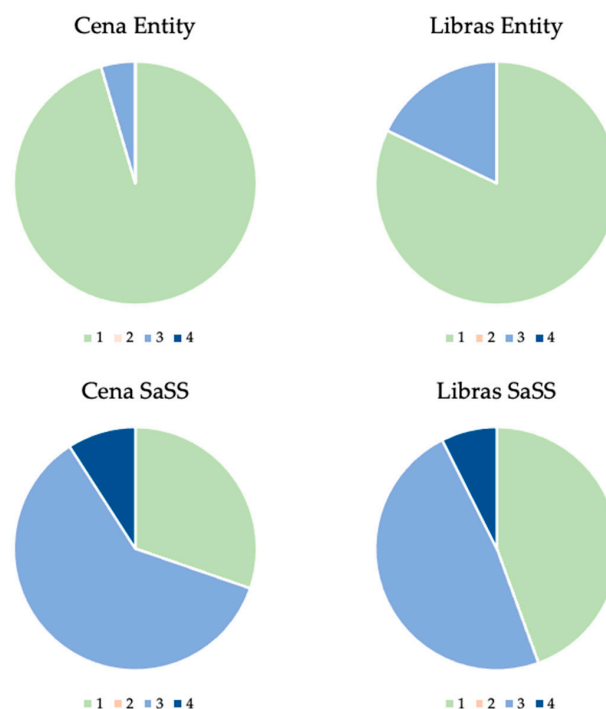


Figure 16. Joint complexity score by classifier type and language.

For joint complexity, the picture is not so similar, but the two languages still share some tendencies (Figure 16). Whilst entity classifier handshapes were predominantly of low joint complexity across both languages, we see more entity classifier handshapes with higher joint complexity in Libras. SaSS handshapes saw the highest proportion of handshapes with high joint complexity in both languages. The curved  handshape was the most populous across both languages, accounting for the large proportion of scores of 3. Handshapes with the highest joint complexity (with a score of 4) were those that are stacked, also depicting the curvature of the referent.

In terms of our expectation to find greater complexity in Cena, there was no statistically significant difference between the two languages for finger or joint complexity, across both types of classifier. A Fisher's exact test was used in lieu of a chi-square, since the data set contains low numbers of observations in some cases. In comparing variance between languages for each type of complexity in each type of classifier, the p-value was greater than 0.05 in all cases. The high complexity scores in both groups shows plainly how the semantic property of curvature affected the distribution of handshape complexity in the trade-off between ease (or simplicity) and iconicity. Moreover, we argue the distribution of medium finger complexity and high joint complexity handshapes in entity classifiers in Cena can be partially accounted for by phonological assimilation. In some sense, this finding leads us even further away from our initial hypothesis, suggesting that in the absence of signs with marked handshapes earlier in the phrase, in other words all else being phonologically equal, like Libras signers Cena signers aim for simple unmarked handshapes. The prevalence of the curved  handshape does not appear to exemplify this idea, seeing as it has a relatively high joint complexity score. However, if we recall that it is crosslinguistically frequent and is considered unmarked, it appears more as a discrepancy between using a model of complexity primarily based on representational simplicity, as opposed to models based on markedness or ease of articulation. That is, measures of complexity based on representational complexity (such as that of [Brentari et al. 2012](#)) do not capture certain realities of usage that likely affect handshape distribution in classifiers, including the pervasiveness of the curved  handshape as a manual configuration for grasping objects outside of the linguistic system. The prevalence of such a handshape in the data may seem surprising when considered through the lens of complexity as defined by representational complexity alone, but its ubiquity both as a handshape crosslinguistically, and as a configuration for the non-linguistic manipulation of objects goes far in accounting for this.

Next, we address Hypothesis 2, which predicted greater intersigner variation in Cena. For size and shape specifier handshapes, we see the same number of variants in both languages, with a similarly proportional distribution. The picture is slightly different with entity classifier handshapes. Cena signers produced five variants in contrast to the three from Libras signers, and distribution of these variants patterns differently between the groups. In Cena, three variants accounted for 89% of tokens, with the proportion of each variant being fairly similar. For the Libras data, one variant accounts for over half the tokens (53%), showing greater consistency between signers in their selection of a handshape to represent the referent. Overall, the results do not demonstrate greater variation in Cena for handshapes in SaSSes, but for entity classifier handshapes we see more variants in Cena and more equal weighting between them in terms of proportion. However, considering that two variants (interestingly, the most complex variants) may be accounted for by assimilation, the presence of more variants does not necessarily mean that Cena signers have a larger and less conventionalised repertoire of handshapes available for depiction of whole entities.

4.2. Movement

Recall that the tendency to encode movement path and manner simultaneously was found more commonly in gesturers and earlier cohorts of NSL, whilst sequential encoding

emerged increasingly with later cohorts. A linguistic context different to that of later-cohort signers for both Cena and Libras led us to Hypothesis 3, wherein we predicted a preference for simultaneous manner and path encoding in both Cena and Libras. Indeed, we found that 93% of Libras responses encoded path and manner simultaneously, as did 80% of Cena responses. In both languages, results pattern more akin to those of gesturers and first-cohort NSL signers, where temporal iconicity prevails in trade-offs against the potential articulatory difficulty of encoding manner and path together. Even in depicting the girl running in a circle, the majority of Cena and Libras signers chose an upright person classifier with running legs whilst moving their arm in a circle, despite this being articulatorily difficult (Mandel 1979).

However, results diverge from those of hearing gesturers in Senghas et al.'s (2004) study in the mere presence of linear segmentation (in Cena, Libras, and NSL alike), supporting the idea that there is something inherently linguistic about such a process. We acknowledge possible influence from the fact that the stimuli clips were not designed with an analysis of movement in mind¹⁸. As such, clips may not be balanced in their likelihood to elicit either manner or path in a given clip or in the set as a whole. An entity moving along a marked path but in a predictable manner (e.g., a ball rolling in a zig-zag) may be more likely to elicit path than manner, for example. Indeed, we found that in a small number of cases, some tendencies emerged based on the stimulus item itself. As an example, the girl running in a circle was the most likely to elicit simultaneous encoding; 85% (29 out of 34) of responses across both groups depicted this using a person classifier running in a circle. The woman running was the most likely to be represented sequentially, with 27% (9 out of 33) of responses across both groups encoding in such a way. There may be some effect from telicity at play here, whereby telic predicates prefer sequential encoding. The woman running across the screen could be construed as the most goal-oriented of the stimuli we analysed. Conversely, the woman walking elicited the strongest preference for simultaneous encoding across both languages—both in proportion and the overall number of tokens, as almost every signer produced a response using this strategy. Many signers depicted the walking as continuous or aimless, with slow movement and pursed lips—both of which are attested markers of continuative aspect (e.g., Oomen 2016, who describes such marking in Sign Language of the Netherlands). The distribution of strategies in all responses by stimulus can be seen in Tables 11 and 12. Overall, both groups preferred simultaneous encoding, but we saw greater variation among Cena signers for the girl running in a circle and the woman running.

Table 11. Distribution of Cena encoding strategies by stimulus.

	Ball Bouncing	Ball Rolling	Girl Running in Circle	Woman Walking	Woman Running
Sim.	9	1	12	16	9
Seq.	0	0	4	1	7

Table 12. Distribution of Libras encoding strategies by stimulus.

	Ball Bouncing	Ball Rolling	Girl Running in Circle	Woman Walking	Woman Running
Sim.	16	8	17	18	14
Seq.	0	1	1	0	3

An ANOVA analysis of encoding strategy and age uncovered a statistically significant correlation ($p = 0.03$), in that older signers showed a greater tendency to encode sequentially (Figure 17). The signers in the upper age brackets in our study are roughly second cohort, as the first signer of Cena was born in 1949. This shows a pattern distinct from results of Senghas et al. (2004), in that it is older or earlier-cohort signers who display a preference for

sequential encoding. As many homesigners with distinct idiolects come together, segmentation and linearisation may be but one effect of the rapid restructuring deaf community sign languages will undergo in their initial stages of emergence. Such restructuring may be phonological, grammatical, or otherwise. These are not the conditions under which Cena has emerged. Libras on the other hand does have an analogous genesis, but this initial period of restructuring likely took place well over a century ago. As such, our results do not suggest that the linear sequential encoding of motion events is a property that emerging languages in general will acquire as they develop, but perhaps rather a product of some specific environmental criteria that NSL, among its second and third cohorts, seemed to meet, and that Cena and Libras as they exist at this moment in time do not. Concerning the tendency of later-cohort child signers of NSL to reanalyse manner and path as sequential, [Senghas et al. \(2010\)](#) observe that “it is as if [the] children see structure where there is none”. Perhaps because there are no child signers in our data, and as such we are not seeing widespread segmentation as a by-product of children restructuring language from an unconventionalised input, temporal iconicity is retained.

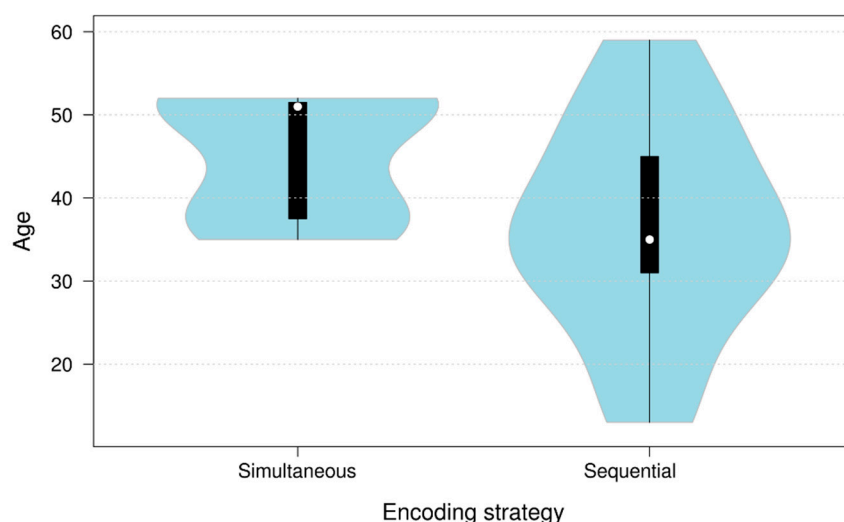


Figure 17. Violin plot of age and encoding strategy showing frequency along the X axis.

One question that emerged during analysis was whether the domain of non-manual features could encode the manner of motion as the hands encoded the path. In response to a stimulus clip of a plastic bag floating, multiple signers traced a path straight downwards with their hand (contrary to the floating motion in the clip) whilst puffing their cheeks or blowing. This stimulus clip did not form part of our chosen stimuli for the current study, and as such we made no decision on whether this non-manual information was aspectual, adverbial, or could otherwise be subsumed into a model of sequential movement encoding, but remaining open-minded as to what can be considered a viable slot for movement encoding will undoubtedly be pertinent in any future studies.

5. Conclusions

Overall, we see a very similar selection of handshape variants used in entity classifiers and size and shape specifiers across Cena and Libras. Thus, the distribution of complexity scores for classifier handshapes of each language largely resembled one another, by virtue of the same or similar handshapes populating each data set. Without additional data it is difficult to tell whether the similar attested handshapes across both groups are a product of the influence of ease of articulation, or semantic categorisation—perhaps both (one can imagine how a signer might choose an index finger extended handshape over a middle finger extended handshape for an upright long thin object, though both are iconic). What the results do tell us is that in this instance, there is no evidence for Cena signers prioritising

iconic representation at the expense of ease, in lieu of conventionalised classifiers. We do, however, present evidence for another aspect of phonology having a direct influence on the handshapes selected for classifiers: assimilation. This phenomenon highlights the robustness of handshape as a phonological component in signs even in young sign languages that potentially lack systematic phonological organisation. We show how such assimilation may influence or even dominate handshape selection, in this case winning out over other influences from articulatory ease, iconic representation, or semantics that converge in a trade-off for handshape selection. This has implications for our findings on variation. Overall, we saw more handshape variants used by Cena signers in entity classifiers, but no difference between the groups for SaSSes. On the surface, a larger repertoire of handshapes in entity classifiers may suggest that classifier handshape is, for now, less restrained by conventionalisation in Cena. As we have shown, assimilation may account for this discrepancy in number of variants between groups. We conclude that we do indeed see one influence of phonology on the selection of classifier handshapes (as the  handshape of WATER spread over a whole phrase by one Cena signer), just not from the source we had anticipated.

Last, our results show a pattern different to that of NSL signers in the encoding of movement (Senghas et al. 2004), in that second- and third-cohort Cena signers prefer to encode manner and path simultaneously, akin to gesturers and signers of urban sign languages, including the Libras signers in our study, as well as first-cohort NSL signers. This does not reflect the preference for sequential linearisation of path and manner found in younger NSL signers, those of comparable cohorts to the Cena signers in our study. A relevant variable that differs between Cena and NSL signers is that, unlike Cena signers of a comparable cohort, the vertical language input¹⁹ that second-cohort NSL signers received was from previously unconnected homesigners. The different preferences between Cena and Libras on one hand and NSL on the other in encoding manner and path could well be a result of the rapid restructuring a language undergoes in response to relatively disorganised vertical input from disparate homesigners, in which some motivation other than temporal iconicity tips the balance of the trade-off between encoding strategies. Cena signers did not receive such vertical input. Such an explanation would account for why later-cohort NSL signers seemed to be the exception in their preferences for linear sequencing, and why Cena and Libras signers patterned akin to all other groups. We also found a significant correlation between age and movement encoding strategy, with older Cena signers segmenting manner and path in motion events at a greater rate than younger Cena signers. Such inter-signer variation (in this case along the axis of age) invites future questions about whether this pertains to other domains such as syntax. We have seen in other studies using the Haifa clips that different preferences in word order and argument structure disambiguation emerge at different rates among cohorts of signers of emerging sign languages when compared to those of the corresponding national sign language of their country (Meir 2010). Considering the existence of several studies on young sign languages using the Haifa clips for this aim (Meir et al. 2017; Ergin et al. 2018), we hope that word order elicitation along these lines may yield further opportunities to draw direct comparisons between an incipient sign language and a national sign language on the same basis.

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Data Availability Statement: Supplementary data in the form of video examples of all discussed phenomena and corresponding glosses can be found at: <https://github.com/ucjudst/Cena-Data>.

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Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Table A1. Handshape Index.

Handshape	Example in Text
	BSL vehicle classifier/Cena SaSS
	ASL vehicle classifier
	HKSL airplane classifier (old)
	HKSL airplane classifier (new)
	Low finger complexity handshape/Cena entityclassifier
	Low finger complexity handshape
	Medium finger complexity handshape
	Medium finger complexity handshape
	High finger complexity handshape

Table A1. Cont.

Handshape	Example in Text
	High finger complexity handshape
	High finger complexity handshape
	Flat handshape
	Extended handshape
	Curved handshape
	Bent handshape
	Stacked handshape
	Crossed handshape
	Cena SaSS
	Libras SaSS

Notes

- ¹ See [Zwitserlood \(2012, p. 175\)](#) for discussion of the similarities and differences of classifiers in signed and spoken languages.
- ² See Appendix A for a list of all handshapes appearing in the text.
- ³ Entities can be specified for manner and path movement features, which may or may not be encoded at all, and if so, sequentially or simultaneously. Therefore signers have more choices available in the encoding of movement features. Discussion on this topic will follow later in this section.
- ⁴ See [Brentari et al. \(2012, p. 7\)](#) for a justification of this choice concerning potential alternate results using other models.
- ⁵ We guide the reader to [Van der Hulst and van de Weijer \(2017\)](#) for an overview of the theory of Dependency Phonology.
- ⁶ We thank the editor for this observation.
- ⁷ The most notable being that in Ann's model, flat handshapes receive a difficulty score one increment lower than that of extended handshapes.
- ⁸ Recall that *object classifiers* broadly correspond to entity classifiers.
- ⁹ [Supalla \(1990, p. 132\)](#) provides 'person limping in a circle' as one such example in ASL.
- ¹⁰ cf. [de Quadros \(2020\)](#) for a recent and detailed volume dedicated to studies on Libras.
- ¹¹ We also direct readers to the short film *Jogos Dirigidos* ('Directed Games') by Jonathas de Andrade ([Internationale Filmfestspiele Berlin 2020](#)), in which deaf signers recount narratives and play theatre games in Várzea Queimada.

- ¹² Introduced in 2003, the Bolsa Família program provides financial aid to low-income families provided they meet certain conditions, such as sending their children to school. Many families in Várzea Queimada are recipients, travelling to the nearest city Jaicós to collect this aid.
- ¹³ We thank Telma Franco, Bruna da Silva Neres, Silvana, and Marcilene for recording the census data with the community.
- ¹⁴ Meir and Sandler (2019) discuss a classifier-like suffix in ABSL in the context of compound formation.
- ¹⁵ The implications within language typology from the study of Kata Kolok and Adamorobe Sign Language are still very relevant to our study since Cena and Libras do not just differ in age, but also along the axis of being a village and an urban sign language, respectively.
- ¹⁶ Ages are approximate as reported verbally to our research team by members of the community.
- ¹⁷ We thank our reviewer for this insightful suggestion.
- ¹⁸ We guide readers interested in a stimuli set specifically designed to elicit linguistic and gestural depictions of motion events with a focus on manner and path towards Özyürek et al. (2001). Few tokens appear for the ball rolling stimulus, as signers often only depicted the path of the movement or the cause of the event, i.e., BALL THROW. As these are neither simultaneous or sequential, we excluded such responses from the analysis.
- ¹⁹ See Brentari et al. (2021) for discussion of the importance of vertical contact in the emergence and development of various levels of linguistic structure in young sign languages.

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