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Articulatory plurality is a property of lexical plurals in sign language

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Introduction

Human language comes in two modalities: the auditory-vocal modality of spoken language and the visual-gestural modality of sign language. In the signed modality, multiple articulators, including the two hands, are used simultaneously. Accordingly, the lexical signs of any sign language can be either one- or two-handed. Though this distinction has traditionally been seen as a purely formal feature, in this study, we develop a principle of *articulatory plurality* to show that the two hands are systematically recruited to encode lexically plural concepts, across sign languages. We demonstrate this by drawing from lexically two-handed signs across a sample of 10 sign languages in five sign language families.

1. Background

1.1. Lexical plurality and sign language

Lexical plurality concerns the tendency for certain words to carry intrinsically plural meaning (Acquaviva, 2008), and spans a wide range of phenomena, whether semantic (e.g., Middleton, Wisniewski, Trindel, & Imai, 2004; Wierzbicka, 1988) or formal (e.g., *pluralia tantum*; Delbrück, 1893; Koptjevskaja-Tamm & Wälchli, 2001; Wisniewski, 2010). In lexical plurals, formal categories tend to cluster according to semantic properties; semantic considerations have even been shown to influence lexical paradigm structure, as when plural stems constitute the *unmarked* form for concepts that are inherently associated with plural semantics (Tiersma, 1982).

Though a number of spoken language phenomena have been examined under the heading of lexical plurality, this domain is surprisingly under-researched in sign language linguistics. Inflectional pluralization across sign languages has been described as either not being overtly marked or expressed through reduplication of either the head noun or an accompanying classifier (Pfau & Steinbach, 2006). However, the possibility of sign languages also having a lexically specified category of plurals has not yet been examined in much depth. Here, building from a previous observation that notions of plurality and quantity recur among the

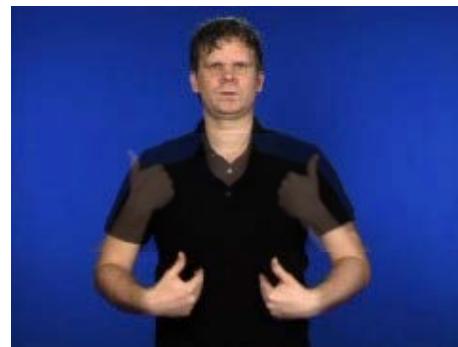
phonological class of two-handed signs across sign languages (Lepic, Börstell, Belsitzman, & Sandler, 2016), we pursue the hypothesis that two-handedness is conditioned (in part) by lexical plurality, cross-linguistically.

1.2. The phonological structure of sign language

Research on sign language structure since the 1960s has shown that sign languages exhibit the same abstract phonological organization as spoken languages, such that lexical signs consist of recurring sublexical elements analogous to spoken phonemes. Stokoe's (1960) analysis of American Sign Language (ASL), for example, showed that any sign consists of combinations of formatives along three parameters: a) the place of articulation: where in physical space the hands move; b) the hand configuration: the shape and orientation of the hands; and c) the movement: the direction and manner of articulation of the hands. Any sign can be minimally described by specifying each of these parameter values, and changing the value of any parameter potentially results in the formation of an unrelated sign. For other minimally different pairs of signs, the contrast lies in whether one or two hands are used. One such pair from Swedish Sign Language (SSL) is shown in Figure 1 below, with the one-handed sign DEAD contrasted against the two-handed sign PERSON(AL).



(a) SSL sign DEAD



(b) SSL sign PERSON(AL)

Figure 1: A minimal pair for number of hands in SSL (signs from Björkstrand, 2016)

Thus, a basic categorization of lexical signs in sign language is that they may be either one- or two-handed. The distribution of one- vs. two-handed signs in any sign language—for which such data is available—is also quite balanced between lexically one- and two-handed signs, regardless of looking at discourse (Nilsson, 2007) or dictionary data (Lepic et al., 2016; see Table 1), although corpus data suggests that phonetically one-handed sign tokens are somewhat more frequent (Crasborn & Sáfar, 2016, p. 244). There are also a number of signs that have changed diachronically, or vary synchronically, between a one-handed and a two-

handed form. Canonically one-handed signs being articulated with both hands have been analyzed as a case of context-dependent assimilation (Nilsson, 2007). Canonically two-handed signs being articulated with one hand have been analyzed as having undergone the phonological process of *weak drop*, and involve the signer’s non-dominant hand dropping to a lower (less distinct) place of articulation, or not involved in the articulation of the sign at all (Crasborn, 2011; Padden & Perlmutter, 1987; van der Hulst, 1996; van der Kooij, 2001). Many synchronically one-handed signs have also been linked to previously two-handed forms, suggesting that weak drop is also relevant for understanding how signs change over time (Frishberg, 1975; Woodward, Jr., 1976).

Table 1: The distribution of one- vs. two-handed forms in four sign language dictionaries.

Language	One-handed	Two-handed	Source
Swedish Sign Language	7603 (49.9%)	7626 (50.1%)	(Björkstrand, 2016)
Sign Language of the Netherlands	1639 (54.7%)	1358 (45.3%)	(Crasborn & Sáfar, 2016)
Finnish Sign Language	1108 (50.3%)	1096 (49.7%)	(“Suvi - Suomalainen viittomakielen verkkosanakirja,” 2003)
Al-Sayyid Bedouin Sign Language	73 (53.7%)	63 (46.3%)	(Meir, Sandler, Padden, & Aronoff, 2012)

Two-handed signs can also be further divided into *balanced signs*, in which the hands move individually and *unbalanced signs*, in which one hand serves as the place of articulation for the dominant, active hand (see e.g. van der Hulst, 1996). An example of this in SSL is given in Figure 2, with the balanced two-handed sign ROAD (with both hands moving forward) contrasted against the unbalanced two-handed sign THROUGH (in which one hand moves forward and the other hand serves as the place of articulation).



(a) SSL sign ROAD

(b) SSL sign THROUGH

Figure 2: A balanced vs. unbalanced pair of two-handed signs in SSL (signs from Björkstrand, 2016)

1.3. Semantics of two-handed forms

Based on the statistical distribution described above, it would appear as though two-handedness is a chance phenomenon, such that the choice between employing one or two hands for any new sign is arbitrary. However, two-handed signs have been shown to be preferentially associated with certain semantics, across sign languages. First, a number of studies investigating morphological processes in different sign languages have shown that *doubling*, the addition of a second hand to a canonically one-handed sign, is often used to express emphasis and/or different aspects of plurality, especially *pluractionality* (e.g. Bergman, 1983; Börstell, 2011; Johnston & Schembri, 1999; Kuhn, 2015; Pfau & Steinbach, 2003, 2006). Second, a study of three unrelated sign languages—American SL, Israeli SL, and Swedish SL—has shown that sign languages agree regarding which concepts should be lexically encoded with a two-handed form, and that this preferential iconic pattern is driven by several semantic properties regarding quantity, and one such property being plural conceptual semantics. This iconic expression of plurality is achieved by configuring the two hands to visually represent relationships that obtain between individual entities (such as reciprocal or transitive situations), and between the component parts of single entities (such as dual-part artifacts) (Lepic et al., 2016). While that study took two-handed forms as the starting point, in this study we start with meaning, in order to see whether the lexical plurality of certain concepts can predict two-handed forms. Our aim with this study is thus to single out lexical plurality as a semantic property which can help explain the distribution of two-handed forms across sign languages, and to test if this form-meaning relationship is indeed predictable in the lexicons of a larger sample of sign languages.

2. Method

We set out to answer two questions with this study: a) Are lexically plural concepts associated with two-handed forms to a higher degree than with one-handed forms across sign languages? and b) Given that two-handed signs encompass both *balanced* and *unbalanced* signs, does either type preferentially encode lexically plural concepts in sign languages?

To answer these questions, we focus on concepts that have been documented as typically bearing lexically plural semantics, and collected data from 10 sign languages from five sign language families.

2.1. Concepts

In order to identify lexically plural concepts, we turned to the spoken language literature for lists of concepts that can be considered intrinsically plural (Attardo, 2007; Haspelmath, 2007; Wisniewski, 2010). From this literature, we compiled a target list of 50 lexically plural concepts, from three different categories:¹ a) *reciprocals* (situations/relations involving more than one participant; e.g. ‘argue’, ‘friend’); b) *collectives* (individuals grouped together; e.g. ‘team’, ‘family’); c) *duals* (gestalts consisting of two paired parts; e.g. ‘scissors’, ‘eyes’).² The full list of items is given in Table 2 below.³

¹ Our initial list of lexical plurals contained approximately 100 concepts, and we arrived at our 50-item list by collapsing near-synonyms ('a crowd' and 'a mob') and removing low-frequency items (e.g. archaic or technical concepts), which we do not expect all languages to distinguish or encode lexically.

² We treat duality as a subtype of plurality, following the principle of “more than one” (Acquaviva 2008), and we consider only the semantic/conceptual plurality of a lexical item, regardless of whether the individual items may (also) take overt plural morphology.

³ While the majority of our concepts are nouns, sign languages are known to feature nouns and verbs that are semantically and formally similar, and do not differ in the number of hands employed (cf. Supalla & Newport, 1978). The concepts are listed according to the part of speech form given in the sources, which is the form used when searching the dictionaries.

Table 2: 50 lexically plural concepts (by category).

Lexical reciprocals	Collective nouns	Dual entities
argue	army	binoculars
colleague	audience	ears
combine	class	eyes
compare	club	glasses
different	committee	gloves
fight	company	goggles
friend	council	hands
marry	crowd	headphones
(to) match	data	legs
same	enemy	pants
separate	family	scissors
similar	government	shoes
	library	shorts
	media	socks
	nation	suspenders
	opposition	tights
	press	tongs
	public	underwear
	staff	
	team	

2.2. Language sample

Ten languages were selected on the basis of available dictionaries (Table 3). Some of these sign languages have some shared history, or have been in some type of contact historically. Thus, we divided the languages in our sample into groups of related sign languages to compensate for possible biases from patterns in any specific group.⁴ The resulting groups are the following: Group I, consisting of languages descended from/influenced by Old French Sign Language (Frishberg, 1975; Millet, Niederberger, & Blondel, 2015; Neidle & Poole Nash, 2015; Van Herreweghe, De Meulder, & Vermeerbergen, 2016)—ASL, VGT, and LSF; Group II, consisting of languages known to have a shared history, and often referred to as the BANZSL language family (McKee & Kennedy, 2000)—Auslan, BSL, and NZSL; Group III consisting of languages that are said to have been influenced by Danish Sign Language (Bergman & Engberg-Pedersen, 2010; Greftegreff & Handberg, 2015; Thorvaldsdóttir & Stefánsdóttir, 2015)—ÍTM and

⁴ The results were also checked on a language individual basis, for which our statistical method showed no language individual biases that would disappear with the grouping of languages. Rather, the method showed a high similarity across all languages in the sample.

NTS; Group IV consisting of a single language, ISL, claimed to be a creole with German Sign Language as a lexifier (Meir & Sandler, 2008); and Group V, also consisting of a single sign language, SSL, belonging to a “family” of sign languages including Finnish Sign Language and Finland-Swedish Sign Language (Bergman & Engberg-Pedersen, 2010).⁵

Table 3: The languages of our sign language sample organized by “language group”.

Group	Sign language	Source
I	American Sign Language (ASL)	(Tennant & Gluszak Brown, 2010 + deaf consultant)
	Flemish Sign Language (VGT)	(Van Herreweghe, Vermeerbergen, De Weerd, & Van Mulders, 2004)
	French Sign Language (LSF)	(“LSF Dico,” n.d., “Sematos,” n.d.)
II	Australian Sign Language (Auslan)	(Johnston, 2014)
	British Sign Language (BSL)	(Fenlon et al., 2014)
	New Zealand Sign Language (NZSL)	(McKee, McKee, Pivac Alexander, Pivac, & Vale, n.d.)
III	Icelandic Sign Language (ÍTM)	(“SignWiki Ísland,” n.d.)
	Norwegian Sign Language (NTS)	(“Tegnordbok,” n.d.)
IV	Israeli Sign Language (ISL)	(Savir, 1992 + deaf consultant)
V	Swedish Sign Language (SSL)	(Björkstrand, 2016 + deaf consultant)

2.3. Data and coding

The sign language data were collected using online, video-based dictionaries, as well as by consulting with deaf signers of ASL, ISL, and SSL (Table 3). The original target list of concepts was compiled as a list of English words (Table 2). For the sign language dictionaries not using English words as entries/translations, the target list was translated by the authors into the appropriate language.

⁵ The issue of genealogical relatedness between sign languages is not resolved, and the exact details of the closeness/relatedness between languages are often obscured due to inadequate historical sources.

Each concept was coded as either having a *two-handed* or *not two-handed* form in each of the ten sign languages. The type *not two-handed* included cases of one-handed signs, fingerspelled signs, and multi-sign items (e.g., compounds) for which not all elements were two-handed. Two-handed signs were also coded as being either *unbalanced* or *balanced*, that is, whether one or two hands served as active articulators. Then, since the languages were sorted into five familial groups, we established a preference for each language group. If $\geq 50\%$ of the languages in a group used a two-handed form for a concept, the group was labeled as having a *two-handed preference* for that concept; if $\leq 50\%$ of the languages in a group used a two-handed form for the concept, the group was labeled as having *no two-handed preference* for that concept.

3. Results

Our results show a clear bias toward two-handed sign forms for the majority of the lexically plural concepts we collected. Across all language groups, the distribution of concepts exhibiting two-handed preference vs. concepts that do not is 193:50 (79.4% vs. 20.6%).⁶ As explained in section 1.2, had the target concepts come from a random sample, we would have expected something close to a 50/50 distribution; a binomial test gives a significant difference between the distribution due to chance and the observed distribution ($p < .001$). Figure 3 shows the distribution of two-handed and not-two-handed signs for each of the five language groups. Individual binomial tests for each language group shows a significant difference from the assumed 50/50 distribution for Groups I, III, IV and V ($p < .001$) as well as for Group II ($p < .05$).⁷

⁶ Concepts for which no sign entry was available for the language group ($n=7$) were excluded from the preference counts.

⁷ There is also a significant difference in the distribution ($p < .05$) for all individual languages except NZSL ($p=0.09$).

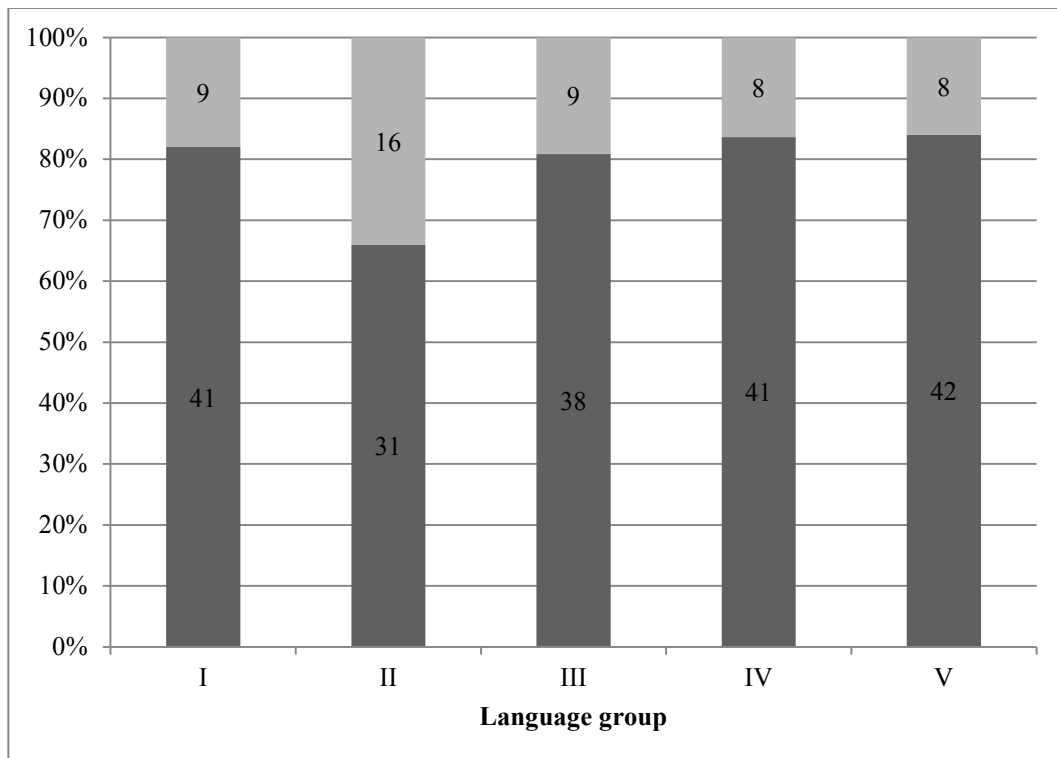


Figure 3: The distribution of concepts with *two-handed* (dark grey) vs. *not two-handed* (light grey) preference for each of the five language groups.

Figure 4 shows the two-handed vs. not two-handed preferences for each of the 50 concepts. As is visible from this graph, 43 out of the 50 concepts exhibit a two-handed preference in the majority of the sign language groups, whereas only 7 out of 50 concepts are preferably not-two-handed in the majority of the groups. We take this as strong evidence to support the idea that inherent plurality is a semantic property that can predict two-handed forms across sign languages.



Figure 4: The number of sign language groups preferably using a *two-handed* (dark grey) vs. *not two-handed* (light grey) sign for the target concept list.

Looking specifically at each of the three plural categories (Table 2), we see some differences: for *lexical reciprocals*, 12 out of 12 concepts showed a two-handed preference in more than half of the five language groups; for *collective nouns*, this figure was 18 out of 20 concepts; and for *dual entities*, 13 out of 18.

Thus, the reciprocals appear to be highly correlated with two-handed forms. What we find, across sign languages, is the tendency to use each of the two hands to iconically represent one of the two sides of the reciprocal situation. One example of this is found in Figure 5, in which the SSL sign TO-MATCH represents two entities moving in towards each other to illustrate that they have a similar shape and fit.



Figure 5: The SSL sign TO-MATCH.

For the category of collective nouns, we see cases in which the two hands represent the delimitation or distribution of individuals, and that the individual members may or may not be represented by, for instance, the choice of handshape. For example, in Figure 6, the SSL sign AUDIENCE shows the spatial distribution of people in the seats of an auditorium, but also the individuals by using a handshape with spread, individuated fingers. This sign simultaneously expresses spatial distribution and plurality with the help of the two hands, and the multiplicity of individuals by the handshapes.



Figure 6: The SSL sign AUDIENCE.

Notably, the items that appear to be the least strongly linked to two-handed forms are found in the category dual entities, specifically the body part items within this category. We believe that this can be explained by two factors: first, for several of the sign language dictionaries, the entries for the body parts were listed as singulars rather than plurals (for example, *eye* instead of *eyes*); second, in sign languages, which make use of the body as a formal place of articulation, body parts are typically referred to by pointing to them. For some of these pointing signs, we see a strategy for which the place of articulation is plural, but the number of articulators is not, such that one hand moves from one place of articulation (in this case, pointing to one body part) and to another place of articulation (pointing to the paired body part). This is indeed a case of expressing plurality in an iconic fashion, albeit without involving the hands as paired articulators. An example is given in Figure 7, with the sign EYES from SSL.



Figure 7: The SSL sign EYES, a one-handed sign with dual locations.

Furthermore, the sign ‘scissors’ (which happens to be more or less identical across all sampled sign languages) uses the V-handshape to represent the shears of the

scissors, moving in a clipping motion. Thus, this sign form makes use of the plurality of fingers (here, the index and middle fingers) to represent the dual parts of the object (see Figure 8).



Figure 8: The SSL sign SCISSORS, a one-handed sign with a dual finger configuration.

Regarding balanced vs. unbalanced signs, we again find that the distribution is not what we would expect following the even distribution found in dictionary data. Data from the Swedish Sign Language Dictionary suggest that the distribution of balanced vs. unbalanced forms among two-handed signs is fairly balanced (56.4% vs. 43.6%). In our data, we find the distribution of two-handed forms across all language groups to be heavily skewed towards balanced forms, the number of balanced (n=155) being clearly higher than unbalanced (n=18) forms.

This preference for balanced over unbalanced forms is found across language groups. Figure 9 shows the distribution of balanced vs. unbalanced forms for each group, showing that the amount of balanced signs is around 90% across groups.

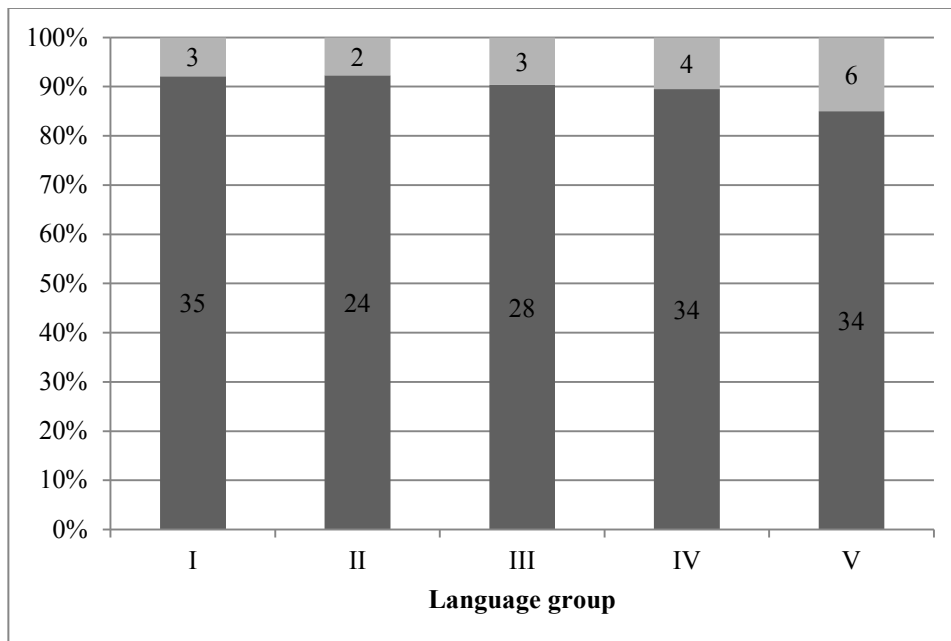


Figure 9: The distribution of *balanced* (dark grey) vs. *unbalanced* (light grey) forms within concepts with two-handed preference for each language group.

4. Discussion

Looking at signs for lexically plural concepts across five sign language families, we find that lexically plural concepts are overwhelmingly encoded with two-handed forms. Our explanation for this distribution is that sign languages make use of *articulatory plurality*, recruiting multiple articulators to represent (relationships among) multiple referents, often in ways that are impossible in spoken language. The association between morphological reduplication and plurality is well-known for both spoken (e.g., Bybee, Perkins, & Pagliuca, 1994; Cabredo Hofherr & Laca, 2012; Inkelas, 2006) and signed (e.g., Pfau & Steinbach, 2006) languages. This is also an instance of articulatory plurality, as the linguistic signal itself is pluralized to express plurality. However, for signed language, we have several more possibilities of expressing plurality iconically in the articulation of a sign. In this paper, we have focused on the two hands as plural articulators as one such subtype of articulatory plurality, and argued that two-handedness reliably maps onto lexically plural concepts. Furthermore, we find examples of signs such as the SSL sign SCISSORS (Figure 8), in which the internal plurality of a dual-part artifact is expressed by plural fingers (one for each blade), and the SSL sign EYES (Figure 7), in which the paired body parts are expressed by articulating the index finger pointing at two distinct locations in space (one for each eye). Thus, the visual modality of signed language allows for more subtypes of strategies within the notion of articulatory plurality, because it

employs distinct, individuated articulators, and affords the possibility to move its articulation in physical space around the signer.

Spoken language is also spatial, but in a more restricted sense. We acknowledge that place of articulation contrasts found in ablaut reduplication (e.g., English *zig-zag* and *criss-cross*) and other ideophonic expression could partly represent an iconic plural mapping by contrasting plural parts/entities with the use of plural places of articulation (i.e. spatially contrasted articulation), but this type of word formation is apparently more restricted in spoken languages than in sign languages. Table 4 below compares the possibilities of articulatory plurality in the two modalities: signed vs. spoken.

Table 4: Subtypes of articulatory plurality in the signed vs. spoken modality.

Subtype of articulatory plurality	Signed	Spoken
<i>Plural articulation (e.g. reduplication)</i>	✓	✓
<i>Plural places of articulation</i>	✓	?
<i>Plural articulators</i>	✓	×

The finding that specifically *balanced* two-handed signs are highly frequent in the encoding of lexically plural concepts is interesting. The concepts that we sampled are mostly “symmetrical” plurals, such that the reciprocals entail two (or more) parties engaging in equal actions, the collectives forming a whole consisting of many uniform members. The symmetry found in the semantics is a property that is encoded in the sign form too, as evidenced by the bias towards balanced two-handed signs in our data.

5. Conclusion

Here we have argued that *articulatory plurality* is an iconic strategy that is available in the visual-gestural modality to directly represent semantic plurality with concrete, visually salient plurality. The accessibility of two identical, paired articulators differentiates the sign modality from the modality of spoken languages; the use of the two hands for articulatory plurality is directly related to the meaning of lexical plurals, showing that sign languages have the opportunity to create iconic sign forms in their lexicons, and indeed do so systematically. The question of the potential differences between using “plural hands”, “plural fingers” or “plural movements” as the specific type of articulatory plurality in different contexts is left for future studies, as is the interaction between lexical and morphological plurality, more generally. Both lines of research will benefit greatly from considering increasingly larger datasets from an increasingly larger sample of languages.

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Abstract (119/120)

Sign languages make use of paired articulators (the two hands), hence manual signs may be either one- or two-handed. Although two-handedness has previously been regarded a purely formal feature, studies have argued morphologically two-handed forms are associated with some types of inflectional plurality. Moreover, recent studies across sign languages have demonstrated that even lexically two-handed signs share certain semantic properties. In this study, we investigate lexically plural concepts in ten different sign languages, distributed across five sign language families, and demonstrate that such concepts are preferentially represented with two-handed forms, across all the languages in our sample. We argue that this is because the signed modality with its paired articulators enables the languages to iconically represent conceptually plural meanings.

Keywords: sign language, two-handed signs, iconicity, articulatory plurality, lexical plurality

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