One grammar or two? Sign Languages and the Nature of Human Language

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Linguistic research has identified abstract properties that seem to be shared by all languages—such properties may be considered defining characteristics. In recent decades, the recognition that human language is found not only in the spoken modality but also in the form of sign languages has led to a reconsideration of some of these potential linguistic universals. In large part, the linguistic analysis of sign languages has led to the conclusion that universal characteristics of language can be stated at an abstract enough level to include languages in both spoken and signed modalities. For example, languages in both modalities display hierarchical structure at sub-lexical and phrasal level, and recursive rule application. However, this does not mean that modality-based differences between signed and spoken languages are trivial. In this article, we consider several candidate domains for modality effects, in light of the overarching question: are signed and spoken languages subject to the same abstract grammatical constraints, or is a substantially different conception of grammar needed for the sign language case? We look at differences between language types based on the use of space, iconicity, and the possibility for simultaneity in linguistic expression. The inclusion of sign languages does support some broadening of the conception of human language—in ways that are applicable for spoken languages as well. Still, the overall conclusion is that one grammar applies for human language, no matter the modality of expression. © 2014 The Authors. *WIREs Cognitive Science* published by John Wiley & Sons, Ltd.

INTRODUCTION

Almost two decades ago, an overview article on the phonology of sign languages was called 'One Phonology or Two? Sign Language and Phonological Theory'.[1] A few years later, another overview appeared, called 'One Syntax or Two? Sign Language and Syntactic Theory'.[2] Although this article cannot attempt to include every aspect of the grammar of sign languages in its purview, the major question addressed remains the same: Does the existence of natural human language in the visual modality radically change our conception of what human language fundamentally is? In other words, do we need to think about language as coming in two types—spoken and signed—with significantly different properties depending on the modality; or are the grammars of sign languages and spoken languages fundamentally the same? Our conclusion will be that 'one grammar' will do, but that by including the study of sign languages in our work of constructing a notion of 'natural human language', we expand and modify that notion in important ways. There are many, many areas of interest within sign language linguistics, but we take the question of how different sign languages are from spoken languages to be of crucial interest for linguistics and cognitive science more broadly, and make it our focus here.

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The natural sign languages of deaf communities are now widely seen as comparable to spoken languages in virtually all respects (see Box 1 for background). For linguists who focus on the abstract universal properties of language, sign languages contribute new data but in large part not radically different data.[3–5] We stress here that sign languages show systematic structure at the lexical, phonological, morphological, syntactic, and semantic levels, as do spoken languages. Sign languages have been argued to adhere to proposed linguistic universals, and they are acquired, processed, and represented in the brain in largely the same way as spoken languages are.[6–8]

However, there are some aspects of sign languages which do seem to take on important different characteristics from spoken languages, due to differences between the oral/aural and manual/visual modalities. These modality effects have been the focus of much attention in the literature, for understanding them is key to understanding which characteristics previously thought to be essential to language are actually modality-dependent. To start with the most obvious example, as recently as 1960, use of the vocal-auditory channel was a 'design feature' of language according to Hockett.[9] Hockett also included 'arbitrariness' among his design features, building on ideas of Saussure.[10] While we feel completely justified in rejecting the premise that language must be spoken, what about Hockett's requirement for arbitrariness? Is this violated in the presence of iconicity—the use of elements that might be considered at least partially non-arbitrary? While sign languages have many arbitrary features, they also do, in fact, display iconicity in various ways. Does the presence of iconicity in sign languages require another major shift in our understanding of the nature of language? Does it force us to think that sign languages are subject to substantially different grammatical constraints than spoken languages are? Later in this article, we will discuss some details about iconicity in sign languages and how it is both different from and similar to iconicity in spoken languages.

Our article also treats in some detail two other modality effects—ways in which the visual modality allows for linguistic phenomena that make sign languages look crucially different from spoken languages: the way that the space around a signer is incorporated into linguistic units, and the possibility for greater simultaneity in expressing distinct linguistic pieces. Although we highlight the potential modality effects here too, we also show that in many ways, one grammar will do.

FIGURE 1 | ASL sign BOOK.

ICONICITY

Iconicity is the resemblance between a symbol and its intended referent. It is a phenomenon that is attested in spoken languages and signed languages alike. A common—though not universal[11]—view is that in spoken languages, iconicity is a relatively peripheral phenomenon. The few examples include onomatopoeia, words that seem to sound like or imitate what they represent such as *ding* or *meow*, and sound symbolism, a direct representational link between a sound quality and a concept. An example of sound symbolism is Ohala's[12] Frequency Code, according to which there is a cross-linguistic tendency for words that express smallness to contain high, front vowels and words that express largeness to contain low, back vowels. On the other hand, it is generally agreed that iconicity is a much more pervasive phenomenon in sign languages, including American Sign Language (ASL).[13] In many cases, it is not hard to see a visual resemblance between a sign of ASL and its intended referent. Consider, as an example, the sign BOOK (illustrated in Figure 1), which is formed by pressing two hands together and opening and closing them as one would a book (following convention, signs are glossed using upper-case English words with

overlapping interpretation—but readers should bear in mind that signs do not necessarily have the same meaning as the English words used to gloss them). Though such iconicity is easy to find in ASL signs, what role these resemblances play in the lexicon and grammar of ASL and other sign languages is a matter of frequent and vigorous debate.

The heat of these debates may be traced back to the history of the study and perception of sign languages. A common misconception about sign languages is that they merely involve a kind of elaborate pantomime in which signers draw pictures in the air that others may interpret. That is to say, many believed that sign languages were not languages in the true sense, but purely iconic, relying on transparent resemblances of hand shapes and movements to objects and actions to convey meaning. Such views were common even among scholars and the American deaf community,[14] until Stokoe's[15] pioneering work in the 1960s demonstrating that the signs of ASL showed linguistic structure similar to the words of spoken languages. After Stokoe's work became known, the idea that sign languages were natural human languages with grammatical rules gradually began to take root. A focal point of much research in the 1970s was the question of how much ASL relied on iconicity as a device for making connections between form and meaning.[3] The standard view about human languages, expressed in Hockett's design feature Arbitrariness, was that form-meaning connections were mediated by arbitrary associations at the level of words (or morphemes). A classic series of experiments by Klima and Bellugi addressed this issue and set the terms of the debate for years to come.

The Role of Iconicity in ASL

Klima and Bellugi[3] (K&B) acknowledge the presence of iconicity in ASL, but seek to test its relevance to the use of the language. One way iconicity of signs could be relevant to sign language use would be if the meaning of the signs was self-evident, or transparent in K&B's term. To test the transparency of signs, K&B presented 90 signs of ASL to 10 non-signing hearing subjects and asked them to guess the correct meaning. Only nine signs were guessed correctly by at least one subject and in many cases the 'correct' guesses were far from an accurate translation. From this, K&B concluded that the preponderance of ASL signing is not transparent, as would be apparent to any non-signer who attempted to understand a typical ASL conversation. In a follow-up experiment, K&B did find that a large number of signs exhibit a property they call translucency. In this experiment, K&B showed hearing non-signers a sign of ASL along

with its meaning and asked them to explain why that sign had that meaning, to identify its iconic basis. The same 90 signs were used, but this time there was broad agreement among subjects on the iconic origins of more than half of the signs.

These results are compatible with the view that iconicity in signs is not determinate. There are many ways in which one could choose to represent some attribute of an object or action. Mandel,[16] for example, catalogs many different kinds of iconic representations that are found in ASL. As K&B note, this means that even iconic signs display a high degree of arbitrariness; there is no reason one iconic representation should be selected over another. Consequently, many sign languages may have an iconic sign for some concept and yet have very different signs, depending on what kind of iconic representation is chosen. Thus, it may not be possible to guess the meaning of an iconic sign, though it is easy to recognize the iconic connection when the meaning is revealed. Consequently, many signs are seen as iconically 'motivated' rather than iconically determined.[17]

These results suggest that form-meaning pairs are largely conventional and arbitrary in both signed and spoken languages and that iconicity plays a limited role. Furthermore, K&B proposed that grammatical processes might cause iconicity to become 'submerged'. For example, the movement of the sign YEAR resembles the movement of the earth around the sun. The modified sign, NEXT-YEAR, however, which incorporates a point forward indicating the future, causes the orbiting movement to be suppressed. Likewise, Frishberg[18] argued that there is a tendency for iconic signs to become less iconic over time in ASL. The importance of iconicity in the generation of new signs[19] and this tendency toward non-iconicity predict that younger sign languages should exhibit greater iconicity in their vocabularies. Recent confirmation of this prediction comes from studies of the very young sign language Al-Sayyid Bedouin Sign Language.[20,21] All in all, this line of research is suggestive of the limitations on the role of iconicity in sign language lexicons. A similar trend can be seen in the analysis of grammatical principles in ASL. For example, early analyses of classifier predicates (see below) suggested that they were little more than pantomime. More recently, significant grammatical properties of classifier predicates have been discovered, reducing the role of iconicity in the analysis—though iconicity still plays a major role, as discussed below.

Extensions of Iconicity

As defined above, iconicity is understood as applying in the cases of resemblance of linguistic forms to

FIGURE 2 | ASL sign LEARN.

objects and actions, in both spoken and signed languages. It has been observed, however, that there are phenomena that are similar to iconicity but involve the use of linguistic form to demonstrate abstract or conceptual entities and events. Haiman[22,23] discusses what he calls 'diagrammatic iconicity' in which linguistic form is used to sketch out conceptual structures. These structures may represent abstract relations among referents or the sequence of events as they occurred. Diagrammatic iconicity is closely related to another kind of extension through metaphor. Taub[24] argues in detail that the shape of signs may be influenced by conceptual metaphors. For example, it is quite common for languages to conceive of communication as kind of physical transfer of a concrete object. Consider the spatial language in the English sentences, 'We were tossing ideas back and forth', and, 'I can't get that into my head'. ASL exhibits many phenomena that incorporate diagrammatic or metaphorical iconicity. For example, the sign LEARN (illustrated in Figure 2) involves the closing of the dominant hand in the direction of the forehead, going away from the open palm of the non-dominant hand. The acquisition of new information is iconically represented as the movement of a concrete object into the head.

Recent Reconsiderations of the Role of Iconicity

Since the status of sign languages as true natural human languages has been strongly confirmed, there

has been renewed curiosity about the role of iconicity in ASL grammar and processing. Recent studies have revealed, for example, that iconicity plays a role in lexical processing as demonstrated in tasks like similarity judgment,[25] picture-sign matching[26] and picture naming.[27] In this section, we return to the question of 'one grammar or two?' by examining some recent work on the role of iconicity in the grammatical interpretation of ASL.

Event Visibility Hypothesis

In a series of papers, Wilbur[28–31] has investigated the role of a form of iconicity in the morphological system of ASL verbs. Vendler[32] proposed dividing the kinds of eventualities referenced by verbs into states, activities, accomplishments, and achievements. Following work by Grose,[33] Wilbur proposes an articulated representation of ASL verbs depending on which kind of eventuality they denote. In this system, there are inclusion relations between the representations of predicates of different kinds. Achievements and accomplishments, for example, properly contain the features that identify activities, which in turn properly contain the features of states. Achievements and accomplishments are differentiated by assuming different values for a particular feature. Wilbur proposes that these semantic representations place direct constraints on the possible phonological representations of verbs. For example, what states and activities lack in their semantic representations, in contrast to accomplishments and achievements, is the specification of an end state. Wilbur hypothesizes that this puts constraints on the form of verbs denoting states and activities. These kinds of verbs are limited to a representation in which there is no significant change in phonological features, e.g., handshape, during the articulation of the sign. Movements are limited to continuous, unbounded movements, such as cyclic, alternating (trilled), or unbounded linear motions. An example is RIDE-BICYCLE, which involves movement of hands in alternating circles. Accomplishments and achievements, on the other hand, contain a representation of an end-state map to signs that involve a change from a form associated with an initial (or preparatory) state to a form associated with the end state. The phonological changes may occur, for example, in the orientation or location of a sign. An example is the two-handed sign HAPPEN, an achievement, which involves a change in the orientation of both hands that have the index finger extended. Wilbur dubs her theory about the form-meaning mapping in verbs of ASL, the Event Visibility Hypothesis (1). She suggests that sign languages have greater resources for making visible the parts of an event described by a verb.

(1) Event Visibility Hypothesis

In the predicate system, the semantics of event structure is visible in the phonological form of the predicate sign.

This system of verbal morphology is motivated, in the sense that there is a mapping between the spatiotemporal properties of signs and the spatiotemporal properties of the events they describe. Wilbur suggests that as the resources used in representing verbal semantics are drawn from the universal domains of geometry and physics (lines and motion), it would not be surprising to see many different sign languages make use of these resources in similar ways. This, she suggests, may lie behind the oft-repeated observation that unrelated sign languages resemble each other more than unrelated spoken languages.[34]

Iconicity in Pronominal Reference

Some aspects of iconicity in pronominal reference have been noted by Schlenker et al.[35] Anaphora refers to the relation of a pronoun to its antecedent. In spoken languages, the connection must be inferred from context and is subject to a variety of grammatical restrictions. In the English sentence pairs in (2a and b) below, the pronominal subject of the second sentence may be linked anaphorically to the subject of the preceding sentence. In this case, it is easy to take the pronouns to refer to the students who came to class, as this group is quite salient.

(2) **a.** Few students came to class today. They are very dedicated.
   b. Most students came to class today. They are very dedicated.

It is more difficult to read the pronouns as referring to the students who did not come to class. In (3) below, we see that the noun phrase 'few students' lends itself more easily to such a reading than does 'most students'. To the extent that such anaphora is possible, it is referred to as 'complement set anaphora'.

(3) Complement set anaphora

   a. Few students came to class today. ?They stayed home instead.
   b. Most students came to class today. #They stayed home instead.

In ASL, pronominal anaphora works somewhat differently. ASL utilizes spatial loci as a go-between for antecedents and anaphors, as discussed in more detail in the section on Referential Space below. The

association between a locus and a noun phrase may come about through signing the noun phrase in that location. Subsequently, an ASL pronoun may establish an anaphoric link to the antecedent by being directed at the same location. Consider the example below.

(4) POSS-1 STUDENT FEW a-CAME CLASS. IX-arc-a a-ASK-1 GOOD QUESTION.
'Few of my students came to class. They asked me good questions'.

A locus, here marked 'a', becomes associated with the subject of the first sentence through the movement of the verb COME. In the next sentence, the subject pronoun is produced in the same location. This pronoun is written 'IX-arc-a' to indicate that it is produced in location 'a' and that the pronoun traces a region in an arc to represent the group referred to.

(5) Complement set anaphora in ASL

   a. POSS-1 STUDENT FEW a-CAME CLASS. ?IX-arc-a a-STAY HOME.
   'Few of my students came to class. They stayed home'.
   b. POSS-1 STUDENT MOST a-CAME CLASS. *IX-arc-a a-STAY HOME.
   'Few of my students came to class. They stayed home'.

Based on these data, ASL appears to behave much like English. Schlenker et al. observe, however, that the geometric properties of ASL pronouns make something possible that is not possible in English, as illustrated in Figure 3. When a locus is given by an arc, parts of the region described may serve as loci as well. Thus, by setting up the loci differently, complement set anaphora becomes available in ASL. In the sentence below, a large locus composed of areas 'a' and 'b' is set up to represent the students. The group that came to class is established in a locus that covers area 'a'. This leaves area 'b' to represent the students who did not come to class.

(6) Complement set anaphora with embedded loci

POSS-1 STUDENT IX-arc-ab MOST IX-arc-a a-CAME CLASS.

'Most of my students came to class'.

IX-arc-b b-STAY HOME

'They (the rest) stayed home'.

Locus ab: the students

Locus b: the students that did not come

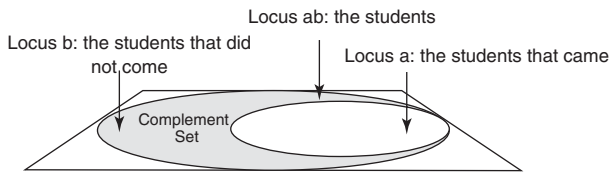Locus a: the students that came

Complement Set

FIGURE 3 | Loci in ASL complement set anaphora.

In this example, the spatial overlap relation between loci diagrammatically represents the inclusion relations between the sets of individuals referred to. Schlenker et al. propose that the geometric properties of loci may directly influence variable assignment—a parameter of interpretation that governs pronominal reference. The variable assignment is partially determined by features of context such as salience and discourse coherence. The spatial properties of pronominal signs may be seen as just such a salient feature of context that influences the variable assignment and, therefore, the referents of the pronouns themselves.

Classifier Predicates

Nearly all sign languages make use of a special set of expressions often referred to as classifier predicates. Classifier predicates are composed of verbs of motion and location combined with handshapes that represent particular classes of items. In many cases, the connection between the handshape and the class of items it represents is iconically based on, for example, the size and shape of the object represented or how it would be handled. For example, an upright person may be represented by the 1-handshape (1) which is signed with a vertically extended index finger. Classifier predicates are so named due to their similarity to verbal classifiers used in some Native American languages such as Cayuga.[4,36]

By locating the classifier predicate in or moving the classifier predicate through signing space, the signer can convey information about the location or movement of the represented object in real space. Consequently, sign language classifiers depict movement and spatial arrangement in a more iconic way than spoken languages with classifiers do.[37] There has thus been a great deal of debate about the status of classifier predicates, with opinions ranging from classifiers being a separate mimetic, extra-linguistic system[38] to classifiers and their movements being morphemes that combine according to ordinary linguistic principles.[39]

Recent work has suggested that the classifier system involves both linguistic and extra-linguistic components. There are rules that govern possible combinations of classifier predicates. For example, a person classifier 1-handshape cannot be placed on top of a vehicle classifier 3-handshape to depict a man standing on top of a car.[40] Furthermore, judgments about classifier predicate handshapes and their relation to the objects they represent are categorical in a way that is reminiscent of judgments about linguistic form.[41] On the other hand, signers' judgments concerning the locations and movements of classifiers suggest that these are gradient analogs of the places and actions they are intended to represent.[39,42]

This combination of linguistic and non-linguistic means for conveying information in classifier constructions raises interesting questions for semantics, and in particular whether there is a substantive difference between the principles of interpretation in signed and spoken languages.[43] An interesting proposal for integrating the two sources of meaning is made by Ceccheto and Zucchi (C&Z).[44] Much like Schlenker et al., C&Z propose that information conveyed through iconic means, like the movement of a classifier predicate, may be integrated into the interpretation of a formal linguistic expression through fixing the value of a variable in the semantic representation with salient contextual information. Specifically, C&Z propose that a classifier predicate denotes a predicate of events that (i) have an individual as participant with the characteristic properties associated with the handshape (extended, circular, etc.) and (ii) involve a motion that is similar to the movement demonstrated by the classifier predicate. In a sense, on this analysis, classifiers point at the movement of the sign as exemplifying the movement of the object referred to.

Iconicity Summary

Each of the three cases discussed above—event visibility, complement set anaphora, and classifier predicates—reinforces the idea that sign languages have greater iconic resources at their disposal for conveying meaning, including information about verbal aspect, anaphoric relations, and motion/location. The consequences of this for grammar remain to be settled. Consider the case of complement set anaphora. In that case, Schlenker proposes that ASL and LSF pronouns have the same semantic representation as spoken language pronouns. However, he proposes a pragmatic principle that constrains their interpretation based on salient, iconic properties of the sign pronouns' production. Similar remarks apply to C&Z's analysis of classifier predicates. Their analysis of classifier meaning uses no tools that are not available to spoken languages. But it is the interaction of these grammatical components with the greater iconic resources of classifier signs that yield an apparently novel construction. Much work remains to be done.
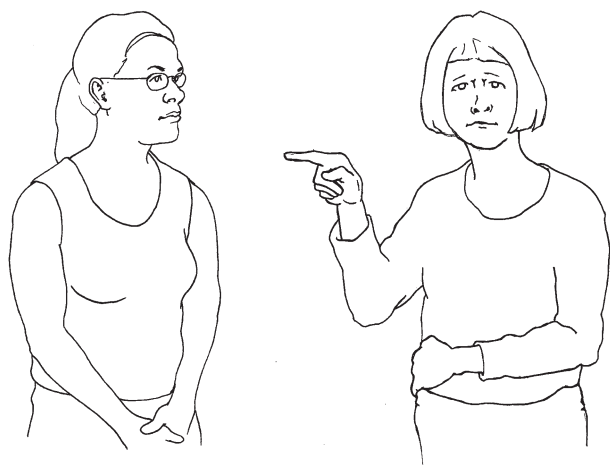
FIGURE 4 | Signer pointing to a present referent. The sign, glossed IX, can be interpreted as 'she' or 'her' in this context.

USE OF SPACE

The physical space immediately in front of a signer is known as signing space. Many signs are simply specified for production in 'neutral space', such as the ASL sign HOUSE. However, space is also used within the linguistic system of sign languages in ways that have no direct parallel in spoken languages. We will describe ways in which the use of space challenges the view that sign language grammars are no different from the traditional conception of grammar based on spoken languages alone.[45]

Referential Space

When a signer seeks to refer to the people being discussed in a discourse, a pointing sign glossed IX (for 'index') may be used. IX may be directed toward the locations of physically present referents, as illustrated in Figure 4. For non-present referents, arbitrary locations in signing space are set up as associated with those referents, as illustrated in Figure 5. Pointing to these loci often serves the same function as the use of pronouns in spoken languages, and these points are generally analyzed as pronouns.[3,46–50]

The loci that are associated with referents are also used in the system commonly analyzed as verb agreement.[3,4] Certain verbs can be produced so that they move between the referential loci, usually starting at or toward the locus of the grammatical subject, moving toward the locus of the grammatical object. An example is given in Figure 6.

The use of spatial loci has received a great deal of attention in the sign linguistics literature—including arguments against the pronoun and verb agreement analyses and defenses of these views. Here, we point out several of the reasons for this debate.[51–53]

FIGURE 5 | Signer pointing to a location without a present referent. The IX sign would be interpreted as 'she', 'her', 'he', 'him', or 'it', depending on the context.

Liddell[51,54–57] argues that usually the relationship between a locus and a referent is not simply referential equality between a point in space and the person associated with that location. For one thing, the relevant 'location' is not a geometric point, but an area with some depth. This is because verbs differ phonologically according to whether they are directed toward a higher or lower location (e.g., ASL INFORM, at the forehead, vs GIVE, at chest height). Moreover, sometimes it is necessary to conceptualize a 'surrogate' for the referent's actual physical location in order to direct points or verbs appropriately—when the referent is taller, on a ladder, or hanging from a tree limb, versus shorter, sitting on the floor, etc. Because of the need to bring in a conceptualized version of the physical space involved, Liddell and coworkers reject
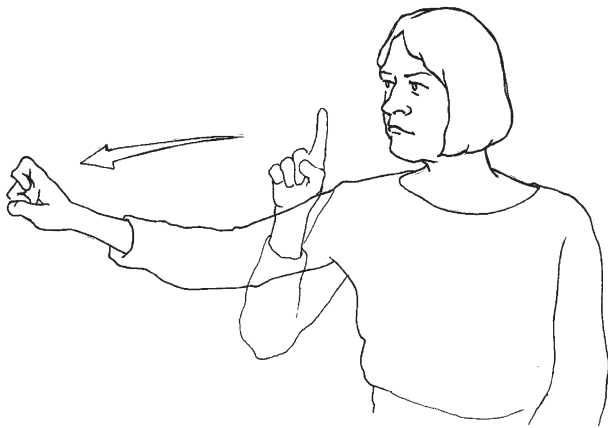
FIGURE 6 | Signer producing the ASL sign ASK, moving from a location near her own body, toward a non-first person locus. If the locus had previously been associated with a referent, say, 'Bill', the sign would be interpreted as 'I ask Bill'.

the idea that these locations are part of a linguistic system of pronouns or verb agreement.

These issues about how particular spatial loci are determined must be resolved. Some authors have proposed that the linguistic system closely interfaces with gesture—for both sign languages and spoken languages—and that relying on such an interface would allow a pure linguistic analysis to be maintained.[50,58] Others have proposed that (at least some aspects of) sign-specific use of space can be formalized as sign-specific grammatical components (see, e.g., Schlenker's[59] proposal regarding incorporating height distinctions in the semantics). In either case, these authors maintain that once we abstract away from this problem, there is a coherent linguistic system analogous to the systems of pronouns and agreement in spoken languages.

Still, there are some linguistic challenges remaining. For example, it is not clear that a formal linguistic distinction between second and third person is warranted—some authors claim that all second-person forms behave linguistically the way third-person forms do, with the distinction being simply whether the referent is an addressee or not.[60,61] This issue continues to be debated;[62,63] it is important because of the observation that (virtually) all spoken languages do make a formal distinction between second and third person somewhere in their grammars—so if sign languages fail to make this distinction, they would be different from spoken languages in an important respect.

Another challenge concerns just how the different non-first forms are interpreted. As noted, signers can associate referents with locations in space, then refer back to these referents through (pronominal)

points or (agreeing) verbs. Unlike spoken language pronouns, which pick out a set of referents (e.g., third person masculine entities), the signed pronouns pick out whatever referent has just been associated with the location. In a particular discourse, a spoken language pronoun is often unambiguous, as it picks out a relevant previous referent. However, it is also quite possible for the spoken language pronouns to be vague or ambiguous, as illustrated in (7) below.[64] In context, prosodic information such as stress or a co-speech point might be used to distinguish the cases, but a neutral, ambiguous version is still possible.

(7) a. John called Mary a Republican and then she insulted him.

b. John called Sam a Republican and then he insulted him.

This type of ambiguity is not found in sign language pronouns. This is not to say that sign language pronouns are never ambiguous[65]—ambiguity (or vagueness) may arise in some contexts, but generally examples like (7) in sign languages are not ambiguous. With this in mind, it has been proposed that sign language pronouns are interpreted through a function that assigns a variable to a potential antecedent—say Mary(x)—and the same variable to pronouns used to pick out this antecedent—here, IX(x).[43] In principle, this same interpretation process would apply to both sign languages and spoken languages. The primary difference is that the sign languages overtly realize the difference between the variables through different spatial loci, whereas in spoken language the variables are covert.

Topographic Space

In the referential use of space just described, locations can be associated with referents in an arbitrary way—perhaps Kim on the right and Lee on the left, or just as well vice versa. However, it is also possible to use signing space to represent meaningful spatial relationships—for example, Kim might be placed on the right because an event is being described in which Kim actually was on the signer's right. Such meaningful spatial relationships are even more likely in contexts of describing a physical layout, such as the furniture in a room or the route from one town to another.

Researchers have dubbed this use of signing space 'topographic', and some work has emphasized that referential and topographic uses of space are processed by signers in different ways.[66] However, there is no clear dividing line between referential and

topographic space, as referents set up in meaning-ful spatial relationships can be referenced using the same grammatical mechanisms as those set up in arbitrary locations. Pronouns and verb agreement, as described above, can be used in both contexts. Classifier predicates are also used to convey the location and movement of referents through topographic space, as discussed above.

Use of Space Summary

Debates about how the use of space should be analyzed in sign languages are continuing, with some pursuing the fully gestural analysis and others maintaining a fully grammatical analysis. We tentatively conclude that one grammar is sufficient, in that the computational processes that apply to pronouns and verb agreement in sign languages seem to be the same as those used for spoken languages. However, just as in the case of iconicity, the availability of a mechanism to make referential intentions explicit adds a layer of communication to what is found in speech alone. It seems that considerations of spoken language together with co-speech gestures make for a more direct comparison to sign languages in this regard.

SIMULTANEITY

There is a third area for possible modality effects in sign languages: their greater potential for simultaneous expression of multiple linguistic components.[67] In particular, sign languages make use of multiple articulators—two hands, face, and body. In spoken languages, the articulators allow for simultaneous production of segmental and 'suprasegmental' properties, such as prosody and tone. Tone is used in many East Asian and sub-Saharan African languages, in many cases to distinguish lexical items, and in some languages tone is used for grammatical marking such as negation. Prosody (intonation, rhythm, pausing) is overlaid on a sequence of linguistic elements, such as the rising intonation found with yes/no questions in many of the world's languages. Thus, simultaneity in itself is by no means unique to the sign modality.

However, spoken languages are primarily sequential, particularly when the role of word order is considered. Order has typically been taken to be a fundamental property of syntax. On the other hand, under some theories of linguistic structure, hierarchical organization—not order—is primary, with order determined through a linearization process which is forced only because of the constraints of the articulatory system.[68–70] If sign languages have different articulatory constraints, different outcomes might be possible.

Two Hands

Some signs are normally produced using two hands, but others are usually made with just one hand. Although signers typically use their dominant hand for one-handed signs, there are contexts in which the other hand is used (linguistic contexts, such as contrasting points of view, or physical contexts, such as one hand being occupied). Therefore, as it is possible to produce a sign using only one hand or the other, is it possible to produce two lexical signs simultaneously, one with each hand, as in the examples in (8) below? (In these examples, the dashes preceding and following the signs indicate that the signs are produced simultaneously.)

(8) a. Dom. Hand: ----MOTHER----
   Non-dom. Hand: ----GO------------
   'Mother went'.

  b. Dom. Hand: ----EAT-------
   Non-dom. Hand: ----APPLE----
   '(S/he) ate an apple'.

Examples such as these are not acceptable—signers do not produce two different lexical signs simultaneously. Thus, even though the sign modality would physically allow for the production of two signs at the same time—a kind of reduction in linearization—the linguistic system seems to preclude it. This indicates that linearization as a process is not only motivated by articulatory requirements. (There are in fact some examples of two distinct manual signs cited in the literature, but these are rare and special uses of signs, such as neologisms.)[71]

On the other hand, there are contexts in which one hand is signing one thing while the other hand is signing something else. One type of example is a lexical sign plus a pointing sign. Earlier, we described pointing signs as pronouns (such as me, you, s/he). Pointing signs are also used as locative pronouns (such as here, there), and demonstrative pronouns (such as this, that). While one sign may start moments before the other, it is commonly observed that a pointing sign may be held on one hand during the production of another sign using the other hand, as in the examples in (9) below. Example (9c) is illustrated in Figure 7.

(9) a. Dom. Hand: ----BOY-------
   Non-dom. Hand: ----IX(left)----
   'A boy is there'.

FIGURE 7 | Signer producing the ASL sign DEAF with her dominant hand while simultaneously holding an IX sign with her non-dominant hand.

b. Dom. Hand: ----GIVE-ME----
    Non-dom. Hand: ----IX(obj)-------
                  'Give me that object'.

c. Dom. Hand: ----DEAF----------
    Non-dom. Hand: ----IX(person)----
                  'She is Deaf'.

Holding a sign (or the non-dominant hand of a sign) during the articulation of additional signs is not limited to pointing signs. In sign phonology, it has been observed that the non-dominant hand of a two-handed sign may hold in its position until the end of a phonological phrase.[72] In Figure 5, the signer's non-dominant hand reflects such a hold. In such cases, the hold has a prosodic nature, but it might not have any effect on interpretation. In other cases, the simultaneous production of new signs while a non-dominant hand is held may serve a clear discourse function.

For example, the sequence IX DOLL, with a hold on the IX, might be used in a naming context ('this is a doll'), or in a questioning context ('do you mean this doll?'). Another context would be the use of a series of signs to describe the referent picked out by the point, such as IX BEAUTIFUL, CHEAP, FANCY, with hold

on the IX throughout the following signs, to describe a car.

Researchers discuss one use of such sign holds as a way to indicate a discourse topic, and return to the topic after a stretch of signing.[73] For example, the signer might bring up the topic PICTURE—a two-handed sign—and hold the base sign throughout a narrative, referring back to it again by an index sign or by repeating the sign PICTURE. In this way, the topic stays active in the background of the discourse and is easily retrieved.

This backgrounding use of a held non-dominant hand is frequently associated with the use of classifiers. This type of backgrounding has been reported for many sign languages, and it has also been studied experimentally. Using the probe recognition technique, Emmorey[7] found that signers keep the referent of the held classifier active and are more quickly able to react to the probe than signers who watched similar sentences without a held classifier.

Classifiers are also involved in another type of simultaneous construction, in which the two hands are used for two different classifiers, the first one expressing the 'ground', which is then held while the second one shows the action of the 'figure'. For example, the signer might produce the sign for a FENCE, then hold the classifier for a fence on the non-dominant hand while the dominant hand signs the lexical sign BIRD, followed by a classifier to indicate the bird perched on the fence.

Finally, another commonly cited simultaneous construction involves using the non-dominant hand to represent a list 'buoy'[51]—a ranked set of items, such as the siblings in a family or items in a to-do list. The buoy may be held in place while each list item is articulated; in some cases, the dominant hand may articulate the list items at the location of each list item (for example, when the items are numerals, such as dates).

All of these examples of simultaneous constructions tell us that strict linearization of lexical elements is not a requirement of the sign linguistic system, even if it is for speech. In these examples, it is usually easy to see that one or the other hand articulates its sign first—so there is a sort of linearization. It is the holding of the sign that would not be captured in a mechanism that only permits strictly sequential elements. The fact that the held element is relevant, even if backgrounded, suggests that some components of the human capacity for language can handle multiple pieces of information at the same time.

Hands Plus Non-Manual Articulations

In fact, it is not just the two hands that show sign languages have the potential for multiple simultaneous

articulators: signers employ facial expressions and head/body movements for linguistic functions, and these too may be produced simultaneously with manual signs. Sign language researchers have long argued that non-manual markers play a linguistic role in sign language grammars—unlike what is usually assumed about the role of, say, facial expression co-occurring with spoken language. However, exactly what that role is has been under discussion. In particular, while some researchers argue that these are syntactic elements in sign languages,[74] others analyze them as prosodic elements without syntactic presence.[75]

Many researchers now agree that different types of non-manual markers contribute to sign languages in ways parallel to the contribution prosody makes for spoken languages.[4,76] For example, certain movements of the brows and head are used to mark yes/no questions, content questions, and topics, in many sign languages. Such markers may be the sign analog to intonational markers for such discourse structures in spoken languages. It is revealing that discoveries regarding how to analyze these structures in sign languages have been taking place alongside greater attention to the analysis of spoken language intonation, at phonological, discourse, and syntactic levels.

Despite the apparent similarities between sign language non-manuals and spoken language intonation, the possibility that as a consequence of this dimension sign languages are structured significantly differently than spoken languages has been explicitly raised. For example, Cecchetto and colleagues[77] have proposed that sign languages have a modality-specific option for marking specific syntactic dependencies—i.e., non-manual marking—and therefore, that a different syntax is possible for sign languages. In particular, they examine the structure of content questions, known as WH-questions, in Italian Sign Language (LIS). They observe that LIS makes use of the sentence-final position for WH-words, along with non-manual WH-marking that marks a syntactic dependency in the question. An example is given in (10).

(10)   GIANNI t_{WHAT} $\overline{\text{EAT WHAT}}^{wh}$

        'What does Gianni eat?'

In (10), the symbol t_{WHAT} indicates the structural position where the WH-word 'WHAT' originated—it is the object of the verb EAT, and in LIS objects come before their verbs. The non-manual marking for a WH-question occurs simultaneously with the signs EAT and WHAT. According to Cecchetto et al., this is

because it is marking the dependency between the original position of the WH-phrase and the sentence-final position.

Spoken languages generally do not use the sentence-final position for WH-questions. According to Cecchetto et al., sign languages are exceptional because they use non-manual marking for dependencies. If the WH-word had moved to the beginning of the sentence [as it does in the English translation of (10)], the non-manual marking would not be able to mark its dependency, as it needs to extend through the end of the sentence for independent reasons.

It is not clear whether the specific proposal that Cecchetto et al. make on the basis of data from LIS will extend to similar phenomena in other sign

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BOX 1: SIGN LANGUAGES AROUND THE WORLD

The natural sign languages discussed in this article arise when deaf people converge and form a community. Often this happens in conjunction with the development of a school for deaf children. Hearing people who interact with deaf people on a regular basis (such as family members) are also members of signing communities. Usually, the sign language is a minority language used in a broader community where the majority language is spoken/written. It is important to bear in mind that the sign language is not a representation of the spoken language on the hands, although such transliterations are sometimes used, and signers are generally bilingual in the sign language and the (written form of) the majority language. In addition, the discussion in this article includes evidence from a wide variety of sign languages around the world. Still, the extent to which sign and spoken languages are structured linguistically similarly is not yet clear.[34]

Because a community is often formed when a school is established, sign languages often trace their histories through schools for the deaf—whether or not the sign language is actually used in the classroom. Through such connections, it is known that many European sign languages and ASL are linguistically related, but this relationship does not include British Sign Language.

In a few cases, modern linguists have been able to observe the emergence of a sign language through the establishment of a new deaf community. WIRES Focus Article 'What sign language creation teaches us about language' by Brentari and Coppola reviews such studies.

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languages. For example, ASL and Libras also use the sentence-final position for some WH-questions, but they do not use non-manual marking for scope in such cases.[78] The jury is still out on the proposal that sign languages permit exceptional syntactic structures due to the presence of non-manual marking.

Simultaneity Summary

Both sign and spoken languages have multiple ways to simultaneously articulate linguistic elements. Only sign languages have the potential to simultaneously articulate two distinct lexical elements—and this potential is realized only in specifically limited ways, such as holding an element on one hand while the other hand continues to sign. Both sign and spoken languages can simultaneously layer prosodic and syntactic information. While it has been proposed that in sign languages, this potential also leads to modality-specific word-order effects, we take such a conclusion to be unjustified. Thus, again, we see that the sign modality does take some advantage of its unique possibilities, but not in an unconstrained way.

CONCLUSION

The natural sign languages of deaf communities are full-fledged human languages with full expressive power. For the most part, they are structured in ways familiar from the linguistic analyses of spoken languages. The study of sign languages adds to the arsenal of data about the extent to which languages vary, and the extent to which they are the same—for the most part, without requiring linguists to change what they think is fundamental about language. In this sense, 'one grammar' suffices.

Yet, sign languages emerge from and reflect the visual modality of their expression. Aspects of the way that sign languages are produced and perceived do in fact affect aspects of their structure. The study of these modality effects tells us not just that sign languages are special in such-and-such a way—they tell us that certain characteristics are shared by all languages, regardless of modality, while other characteristics are shaped by whether the spoken or signed modality is used. In this respect, the study of sign languages takes the field farther ahead than the study of spoken languages alone. Such study pushes the edges of what is known about language, contributing vital information to an expanding vision of what is deep and what is surface. Both deep and surface aspects of language are important and relevant to linguistic theory. Understanding just where modality effects are found is crucial for all aspects.

The scientific study of language is an essential component of cognitive science. Whether language is an illustration of how the mind works, or a specialized module, understanding it is crucial to understanding human cognition. It is now clear that such an understanding is incomplete without the contribution made by the study of signed languages.

There are many questions remaining to be addressed. If, in general, one grammar will do, how do we interpret the areas where modality effects are observed? How much variation is there across sign languages—are they essentially of a type, for reasons that include modality as well as factors such as age and means of transmission?[4,21] What are the modality effects of spoken languages? Once sign and spoken languages are considered together, what are the true linguistic universals, and where do they come from? These and many other questions will continue to engage sign linguists as their work continues to mold our conception of the nature of human language.

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