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Natasha Abner, Molly Flaherty, Katelyn Stangl, Marie Coppola, Diane Brentari, Susan Goldin-Meadow

Language, Volume 95, Number 2, June 2019, pp. 230-267 (Article)

Published by Linguistic Society of America
DOI: *https://doi.org/10.1353/lan.2019.0030*

THE NOUN-VERB DISTINCTION IN ESTABLISHED AND EMERGENT SIGN SYSTEMS

Natasha Abner
University of Michigan

Molly Flaherty
Swarthmore College

Katelyn Stangl
University of Chicago

Marie Coppola
University of Connecticut

Diane Brentari
University of Chicago

Susan Goldin-Meadow
University of Chicago

In a number of signed languages, the distinction between nouns and verbs is evident in the morphophonology of the signs themselves. Here we use a novel elicitation paradigm to investigate the systematicity, emergence, and development of the noun-verb distinction (qua objects vs. actions) in an established sign language, American Sign Language (ASL), an emerging sign language, Nicaraguan Sign Language (NSL), and in the precursor to NSL, Nicaraguan homesigns. We show that a distinction between nouns and verbs is marked (by utterance position and movement size) and thus present in all groups—even homesigners, who have invented their systems without a conventional language model. However, there is also evidence of emerging crosslinguistic variation in whether a base hand is used to mark the noun-verb contrast. Finally, variation in how movement repetition and base hand are used across Nicaraguan groups offers insight into the pressures that influence the development of a linguistic system. Specifically, early signers of NSL use movement repetition and base hand in ways similar to homesigners but different from signers who entered the NSL community more recently, suggesting that intergenerational transmission to new learners (not just sharing a language with a community) plays a key role in the development of these devices. These results bear not only on the importance of the noun-verb distinction in human communication, but also on how this distinction emerges and develops in a new (sign) language.*

Keywords: sign language, homesign, Nicaraguan Sign Language, American Sign Language, phonology, morphology, lexical categories, language evolution

1. Introduction. Grammatical categories are found across human languages, though the inventory of the categories themselves, the linguistic behavior of a category, and the categorical classification of a concept (or translational equivalent) all exhibit crosslinguistic variation. One core (and potentially universal) distinction between grammatical categories is the contrast between verbs and nouns. Indeed, Jackendoff (2002) identifies this distinction—which may be conceptually grounded in the fundamental difference between actions or relations among objects (verbs) and labels for objects themselves (nouns)—as a '"basic body plan" for language'.[1] While the contrast

* We are grateful to the Deaf individuals in the United States and Nicaragua who shared their time and languages with us; without them, this work would not have been possible. This research was supported by NIH R01 DC00491 from the NIDCD and 1654154 from the NSF to Susan Goldin-Meadow, NSF BCS 0547554 to Diane Brentari and NSF BCS1227908 to Diane Brentari and Marie Coppola, an NSF Graduate Research Fellowship as well as a Newton International Fellowship from the Royal Society of the UK and the British Academy to Molly Flaherty, and by the Center for Gesture, Sign, and Language at the University of Chicago. We thank Emily Miiller, Carolyn Mylander, Mark Resnick, and Markie Theophile for their assistance with the project, as well as our many colleagues who have discussed this research with us. We are also grateful to audiences at Theoretical Issues in Sign Language Research and Formal and Experimental Approaches to Sign Language Linguistics, as well as to the editors of *Language* and two anonymous referees for their helpful feedback and discussion. Any remaining errors are our own.

[1] Other characterizations and framings of the noun-verb distinction have been proposed in the literature (e.g. Geach 1962, Gupta 1980, Croft 1991, Jackendoff 2002, Baker 2003, Pustet 2003, Kayne 2008, Barker 2010, among others), and the theoretical landscape on this topic is complicated and not without controversy. The cursory distinction between labels for actions on objects or relations between objects versus labels for the objects themselves is a sufficient conceptual grounding for the studies at hand. We do not, however, intend to suggest that there is a one-to-one correspondence between objects versus actions and nouns versus verbs across human language.

between nouns and verbs (as with other categories) may not be equally apparent across languages (or within a language, as with the apparent flexibility of English *fish*), claims that a given language lacks a noun-verb distinction have failed to hold up to closer inspection (see, for example, Koch & Matthewson 2009 for Salish and Tagalog, or Baker 2003 for a general discussion). Finally, even if lexical items do not bear an inherent grammatical category, as argued by, for example, Marantz (1997), Borer (2004), and others (but see Travis 2017 for a recent rebuttal), it is clear that languages—signed and spoken—distinguish nouns and verbs at some level of the grammar.

In English, for example, we know that the action-denoting term *race* is nominal because it can be pluralized (*races*), it can be modified by adjectives (*brutal race*), and it can cooccur with the definite article (*the race*). Similarly, in American Sign Language (ASL), the visual-gestural language of the Deaf in the United States (and most of Canada), quantifiers like SCADS can be used to modify nouns (or noun phrases), like CAT in 1 (here and in other examples key signs are in boldface), but not verbs (or verb phrases), like HAVE CAT in 2 (Padden 1988).[2]

(1) SISTER HAVE **SCADS CAT**
'My sister has many cats.'

(2) *SISTER **SCADS HAVE CAT** (Padden 1988:103)

Such patterns make it clear that the distinction between categories is grammatical and not solely conceptual. In signed languages, it is common to find that language-specific phonological parameters are reliably associated with one, but not the other, of these lexical categories. That is, the form of the sign itself may provide cues to its categorical status as a noun or verb.

In the series of studies presented here, we use a novel experimental elicitation paradigm to investigate the systematicity, emergence, and development of noun-verb contrasts in an established sign language (ASL), an emerging sign language (Nicaraguan Sign Language, NSL), and in homesigns, the gestural precursors to sign language that are invented by deaf individuals living in hearing households (Newport & Supalla 2000, Goldin-Meadow 2003, Coppola & Senghas 2010). We show that a distinction between nouns and verbs (qua objects and actions) is so central to linguistic communication that it is present even in the earliest stages of a communicative system. Nevertheless, cross-group comparison reveals systematic differences between American (ASL) and Nicaraguan (NSL, homesign) language groups in how the noun-verb contrast is manifested in sign form. Documentation and investigation of such differences thus inform the still-nascent field of sign language typology (Brentari et al. 2015, Pfau & Zeshan 2016) and the study of crosslinguistic variation within and across language modalities. Finally, the present studies also offer insight into the patterns that arise with increased conventionalization in later stages of language development.

1.1. THE NOUN-VERB DISTINCTION ACROSS SIGN LANGUAGES. As noted earlier, a grammaticalized distinction between nouns and verbs is a candidate for a universal

[2] Following convention, individual signs are represented in small capital letters and glossed using the closest spoken language translation equivalent: SCADS. When multiple words are necessary to capture the meaning of the sign, they are connected by a hyphen: PUT-ON-RING. Here, we use English language equivalents to gloss the data from all language groups studied. Throughout our discussion, we use 'Deaf' to refer to individuals affiliated with a Deaf community and 'deaf' to refer to individuals who are audiologically deaf and not affiliated with a Deaf community (see contributions to Kusters et al. 2017 for a recent discussion of this distinction).

property of human languages, independent of the modality of language production and perception. There is, however, a pattern in how this distinction is grammaticalized that appears to be common across sign languages and potentially characteristic of languages of this modality: the marking of lexical category in the surface form of the sign itself. This pattern was first observed by Supalla and Newport (1978), who documented 100 noun-verb pairs exhibiting this surface regularity in ASL (e.g. SIT/CHAIR, CLOSE-WINDOW/WINDOW, and STAPLE/STAPLER). They observed that the movement used to produce the verbal members of the pairs (e.g. CLOSE-WINDOW) exhibited variability in form based on the meaning (lexical aspect) of the predicate, whereas the nominal members of the pairs (e.g. WINDOW) consistently exhibited repeated movement of a certain quality that they termed 'restrained manner'. The restrained manner of the nominal forms resulted in a shortened movement (relative to the verbal form) with a tense and bouncy character. Thus, the verb CLOSE-WINDOW, referring to a single, telic event, is produced with a single continuous movement to contact with the nondominant hand. Its nominal counterpart, WINDOW, however, is produced with restrained repetition of a shortened version of this movement to contact. This contrast is shown in Figure 1. Setting aside the linguistic analysis of the relationship between these noun-verb pairs,[3] it appears that these small, restrained, repeated movements constitute a nominal marker in ASL.

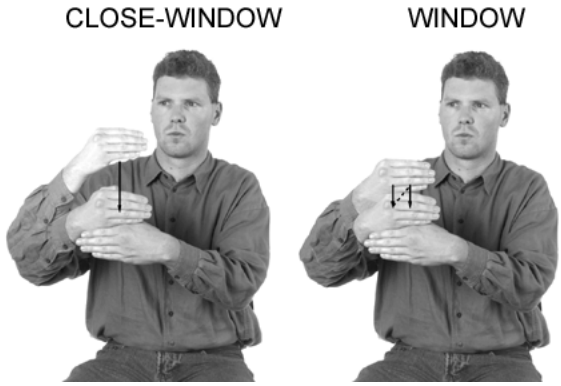

FIGURE 1. Illustration of the noun-verb alternation first identified by Supalla and Newport (1978) for ASL. The verbal form CLOSE-WINDOW (left) exhibits a single, longer movement, whereas the nominal form WINDOW (right) exhibits a smaller, restrained movement that is repeated. Figure reprinted with permission from *A prosodic model of sign language phonology* (Brentari 1998:13, figure 1.9), published by The MIT Press.

Subsequent to Supalla and Newport's work, researchers identified similar patterns in other sign languages. The form distinctions themselves, however, vary somewhat across signed languages. In Russian Sign Language (RSL; Kimmelman 2009), Australian Sign Language (Auslan; Johnston 2001), and Jordanian Sign Language (LIU; Hendriks 2008), nouns are marked by repetition of the movement (as in ASL), whereas in Turkish Sign

[3] Supalla and Newport (1978) analyze both nominal and verbal forms as deriving from a categorically underspecified underlying form, along the lines of what others have proposed for language more generally (e.g. Marantz 1997, Borer 2004). Abner (2017), remaining neutral as to whether the root of these forms has a category, argues that the nouns are derived from their associated verbal counterparts. Our research asks whether distinctions between noun and verb labels are found in an emergent sign system, a question that must be answered before future research can explore the potentially derivational relationship between these labels or their fine-grained morphosyntactic structure.

Language (TİD; Kubus 2008) and the Sign Language of the Netherlands (NGT; Schreurs 2006), it is the elimination of movement repetition that marks nouns as distinct from verbs (although most noun-verb pairs in NGT are not distinguished in form). The restrained or tense manner of movement that Supalla and Newport found in ASL nouns has also been reported by Hendriks (2008) for LIU. Larger movement has also been documented for verbs (as compared to nouns) in RSL (Kimmelman 2009), Auslan (Johnston 2001), and Italian Sign Language (LIS; Pizzuto & Corraza 1996). Verbs have been shown to have a longer duration than nouns in LIS (Pizzuto & Corraza 1996), Austrian Sign Language (ÖGS; Hunger 2006), and TİD (Kubus 2008) as well. Finally, nouns in a number of signed languages have been found to cooccur more frequently with mouthing of the ambient spoken language (see Kimmelman 2009 for RSL and Voghel 2005 for Quebecois Sign Language, LSQ). Table S1 in the online supplementary materials, which are available at http://muse.jhu.edu/resolve/67, summarizes these findings.

Nevertheless, the degree of similarity in this domain across signed languages remains intriguing. In any case where the phenomenon has been studied in a Deaf community sign language, that sign language has been found to use sign form in this way (though there is variation in inventory and in productivity across the lexicon). Thus, using properties of word form to signal lexical category is a pattern that may be characteristic of sign languages. Indeed, Brentari (1998) and Abner (2017) document instances of restrained, repeated movements on nouns that lack a verbal counterpart, suggesting that it may be functioning as a noun marker in general. Similar patterns are not altogether unattested in speech; English, for example, uses stress to distinguish a small class of nouns (*pérmit*) and verbs (*permít*). Spoken languages also sometimes exhibit patterns such as sound symbolism (e.g. the association of word-initial *gl-* with shininess, as in *glimmer*, *glisten*, and *glint*), and the phonological neighborhoods of speech sometimes reflect grammatical information. For example, morphemes that can function as stems frequently exhibit a wider range of phonological contrasts than those that function as affixes (Hoijer 1942, Speas 1985, Smith 2001). Thus, language form is not entirely divorced from its function, even in speech. Across sign languages, however, properties of sign form systematically, pervasively, and, oftentimes, productively function to indicate category information. Moreover, as just observed, not only is this connection between form and meaning robust across unrelated sign languages, but the form properties used to signal lexical category meaning in these languages are also strikingly similar (though again not identical; see e.g. Padden & Perlmutter 1987, as well as the references listed in Table S1). The fact that movement is commonly called upon to distinguish verbs from their corresponding nouns may be a reflection of Wilbur's (2003) EVENT VISIBILITY HYPOTHESIS, which claims that formational properties of predicates are constrained by the need to iconically represent properties of event semantics. This idea is echoed by Kimmelman (2009), who proposes that the larger movement of verbs (vs. nouns) in RSL is a consequence of the pressure for verbs to embody the action they represent. Together, these observations suggest that the marking of lexical category in these (possibly iconic) properties of sign form may be an outgrowth of language modality.

Indeed, such patterns are so common that Tkachman and Sandler (2013:272), in their study of the noun-verb distinction in Israeli Sign Language (ISL) and Al-Sayyid Bedouin Sign Language (ABSL, an emerging village sign language in southern Israel[4]), observe that '[a]ll known sign languages contain a subset of iconically-motivated nouns

[4] Section 1.2 describes the situations that foster sign language emergence and distinctions in the types of sign languages that emerge in different situations.

and verbs that are related to one another both semantically and formationally'. Their research reveals that related nouns and verbs are reliably distinguished in ISL (nouns have restrained manner and increased frequency of mouthing). They did not find statistically significant formational distinctions between nouns and verbs in ABSL, but did observe a tendency for verbs in ABSL to be produced with larger movement (as in other sign languages). They also found a tendency for nouns to cooccur in a construction with a separate size-and-shape classifier sign, a structural pattern that has also been reported in Zinacantecan family homesign (Z; Haviland 2013) and in Yucatec Maya Sign Languages (Safar & Petatillo Chan 2020). Note that cooccurrence with a classifier is a distinction of morphosyntactic environment, not sign form. In the present studies, we assess whether nouns and verbs differ in their placement within the utterance, another environmental distribution distinction.

Although not found in ABSL, a nascent language, sign form distinctions between labels for objects and labels for actions (qua nouns and verbs) have been identified in the idiosyncratic system of a homesigning child. Goldin-Meadow and colleagues (1994) found that an American child homesigner was more likely to use gestures with reduced motion in his labels for objects (nouns), and to produce them in neutral space, as compared to his labels for actions (verbs), which tended to be spatially produced near one of the verb's arguments. Hunsicker and Goldin-Meadow (2013) found that, early in development, this same child used one type of handshape (object handshapes, handshapes representing some physical property of the object) in labels for objects and a different type of handshape (handling handshapes, handshapes representing the hand as it manipulates the object) in labels for actions. Similar patterns of handshape preference were also found in ASL and LIS by Brentari and colleagues (2015), though not in Hong Kong Sign Language (HKSL) or British Sign Language (BSL). The handshapes of nouns have also been found to be significantly more stable than those of verbs in children acquiring ASL (Brentari et al. 2013) and in homesigners and two groups of NSL signers in Nicaragua (Goldin-Meadow et al. 2015).

A formationally marked noun-verb distinction is thus so pervasive in sign languages that it is found even in child homesign, arguably the precursor to all signed languages (Newport & Supalla 2000, Coppola & Senghas 2010). Nevertheless, it is difficult to piece together a unified picture of how the noun-verb distinction emerges in sign languages from the disparate studies in the literature, which focus on different aspects of form and use different techniques for elicitation. We begin by developing an elicitation technique that we validate with an established sign language, ASL. We then use this technique to study NSL as it emerges. Finally, we apply the technique to the gesture systems created by Nicaraguan homesigners, which resemble those that served as input to NSL.

1.2. Current studies. Unlike 'new' spoken languages, which emerge only as a consequence of divergence from, and contact with, other spoken languages, new sign languages can emerge with very little influence from the spoken language surrounding them and minimal to no contact with other sign languages. The emergence of a sign language is fostered by two social contexts: (i) isolated villages with high rates of hereditary deafness (Nyst 2012), and (ii) Deaf communities that form after the establishment of schools for the Deaf (Meir, Sandler, et al. 2010). Contemporary instances of sign language emergence are relatively robustly documented in both of these contexts, although documentation of the linguistic and communicative patterns and their development in each of these scenarios is still understudied (but see Padden et al. 2010 and Tkachman

& Sandler 2013 for recent discussions of grammatical patterns in a Deaf community sign language (ISL) and a village sign language (ABSL) that are the same age).

Here we focus on two sign languages that have emerged in Deaf communities as a consequence of newly established schools for the Deaf (for a discussion of village sign languages, see contributions to Zeshan & de Vos 2012): an established sign language, ASL, and an emerging sign language, NSL. In 1817, the American School for the Deaf—the first school for the Deaf in the United States—was founded in Hartford, Connecticut. Opening the school fostered the emergence of ASL, now the conventionalized and established sign language of the Deaf community in many parts of North America. A similar scenario played out in Nicaragua in the 1970s when a universal schooling policy established the first special education programs, including classes for deaf students in the capital city of Managua. Although the emergence and development of ASL in the nineteenth century is not extensively documented (though see Frishberg 1975, Shaw & Delaporte 2010, and Supalla & Clark 2015, as well as Groce 1985 for a discussion of Martha's Vineyard Sign Language, an early contributor to the development of ASL), the emergence and development of NSL is relatively well documented (Senghas 1995, Polich 2005, Senghas et al. 2005). ASL thus stands as a sign language hallmark of one way in which grammatical patterns may stabilize within a linguistic system (insofar as they do), whereas NSL serves as an illustration of how grammatical patterns emerge and develop over the course of the linguistic system's early history.

Our findings make four important points: (i) We quantitatively confirm the previously described morphophonologically marked distinction between nouns and verbs (qua objects and actions) in ASL using new elicitation and analysis techniques. (ii) Applying the same techniques, we show that a distinction between nouns and verbs is present in each generation of NSL. (iii) We further show that the noun-verb distinction is so central to linguistic communication that it arises even in communication systems developed by deaf individuals, homesigners, who live in hearing households and thus do not have a linguistic community or a model for sign language. (iv) Comparing across groups, we identify patterns of variation, some of which may be the consequence of the unique factors in, and pressures on, (sign) language genesis. Taken together, our studies provide a more complete perspective on the emergence, development, and stabilization of grammatical patterns.

2. THE NOUN-VERB ELICITATION TASK. We developed a video-based elicitation tool to collect the sign forms analyzed; because the same basic design was used across all three studies, we describe it once here.[5] Though a nonlinguistic elicitation tool of this type is beneficial for sign language fieldwork in general (Fischer 2009), it is especially appropriate for data collection with emergent sign systems. Moreover, using the same video-based elicitation tool across all of the language groups studied ensures the validity of cross-group comparisons.

2.1. STIMULI AND PROCEDURE. Our stimuli (see Table S2 in the supplementary materials for a complete list) were brief vignettes of objects manipulated by human agents in typical and atypical contexts. We chose objects and actions that we expected to be familiar to both Nicaraguan and United States participants, that are commonly encoded by related noun-verb pairs in established sign languages (e.g. SIT and CHAIR), and that we

[5] Similar stimuli were developed to assess morphological knowledge of the noun-verb distinction in ASL in *The test battery for American Sign Language morphology and syntax* (Supalla et al. 1995). We thank Ted Supalla for useful feedback and discussion when we were developing our stimuli.

expected to be represented using a variety of movement types (e.g. orientation change, path movement; see §2.2).[6] The typical contexts showed the target object being used in a routine way (e.g. opening an umbrella, swinging in a hammock, putting on an earring). These vignettes were designed to elicit a sign representing the typical action performed with the target object, and thus were expected to elicit verbs (e.g. OPEN-UMBRELLA, SWING-IN-HAMMOCK, PUT-ON-EARRING). We call these stimuli VERB-TARGET VIGNETTES. Within the verb-target vignettes, the actions performed with the object could be either iterable (e.g. a hammock may swing repeatedly) or noniterable (e.g. an earring can only be put on once). Crucially, we tried to ensure that the actions in the stimulus videos themselves were performed only once, regardless of the conceptual iterability of the action.[7] Thus, repetition in signers' responses (a common means of distinguishing nouns and verbs; see §1.1) is not likely to be driven by repetition in the stimuli themselves.

The atypical contexts showed the target object undergoing one of a small number of actions that are not routinely performed by or with that object, such as: a human dropping an umbrella into a trash can, a human putting a blanket over a hammock, or a human dropping an earring into a glass of water. Atypical-context vignettes were designed to elicit a label for the target object, and thus were expected to elicit nouns (e.g. UMBRELLA, HAMMOCK, EARRING). We call these stimuli NOUN-TARGET VIGNETTES. We also included a small number (three each) of vignettes without agents (an object falling off the table) and with agents using an object as an instrument (digging in the dirt); we did not find any patterns that correlated specifically with either of these two event types, and we include them here as responses to noun-target vignettes. Images from one pair of noun- and verb-target vignettes are shown in Figure 2.

FIGURE 2. Two images from sample verb-target (left) and noun-target (right) stimuli. In the verb-target stimulus, a man holds a camera in front of his face and pushes the button to take a picture. In the noun-target stimulus, the same man drops a camera into a trash can.

Participants viewed the stimuli on a laptop in pseudorandomized order with the adjustment that verb- and noun-target vignettes for the same object were not viewed sequentially. Before describing the target vignettes, participants viewed and described three familiarization items (a human from the stimulus vignettes dropping a pair of eyeglasses into a trash can, putting a blanket over a pair of eyeglasses, dropping a pair of

[6] The stimuli were not controlled for this (and these movement-type distinctions are not included in our analyses); indeed, for NSL signers and homesigners, the sign for a given action or object—and thus its phonological properties—could not be identified prior to conducting the study.

[7] Two stimulus items included repetition beyond our control: a video of a Nicaraguan man cutting a yucca with a knife and a video of a baby sucking a bottle.

eyeglasses into a glass of water) to ensure that they understood the task; if participants did not spontaneously produce lexical descriptions of the targets during the familiarization vignettes, they were encouraged to do so. After the familiarization items, participants received no feedback on their performance.

2.2. CODING. Participant responses were first segmented and glossed at both the sign and utterance level by a coder familiar with both ASL and NSL and trained in gesture and homesign coding (Goldin-Meadow & Mylander 1984b). ASL and NSL responses were glossed according to conventionalized lexicons of those languages; information about homesign glossing is provided in the discussion of study 3 in §5.2. We then identified signs for the target verb (e.g. OPEN-UMBRELLA) or noun (e.g. UMBRELLA) in each response.[8] Target signs produced in response to the noun-target vignettes were categorized as nouns; target signs produced in response to the verb-target vignettes were categorized as verbs. Though verb-target vignettes are designed to elicit a label for the typical action (e.g. TAKE-PICTURE), it would not be inappropriate to respond with a sign for this action as well as a sign for the target object (e.g. CAMERA TAKE-PICTURE). In the present analysis, both of these signs would be included in the analysis and classified as verbs.[9] Target signs were first coded for their position (stand-alone, initial, medial, final) within the utterance. We then coded each sign using the same form-based system across all studies; this coding system was informed by sign language phonology and by previous research on the noun-verb distinction in sign languages.

The crucial insight at the dawn of contemporary sign language research was that signs are not mimetic, holistic, or global representations of meaning, but rather exhibit sublexical structure analogous, at an abstract level, to that of spoken words (Stokoe 1960, Battison 1978). That is, sign languages exhibit duality of patterning (Hockett 1960). However, the components of sublexical structure are necessarily different in sign and speech; here, we provide a brief overview of the properties of sublexical structure in sign languages, focusing on aspects of this structure (and of our coding system) that are relevant for the results reported here.

Signs are typically described as having four core manual parameters: place of articulation, palm orientation, handshape, and movement, on which we elaborate in turn below.[10] Because the hands cannot move without having a shape, being in a place, and having the palm facing in some direction, all of the parameters of sign production occur simultaneously (similar to the simultaneous production of, for example, voicing and place of articulation in spoken language consonants). Palm orientation refers to where the palm faces during sign production (e.g. toward a particular location on the signer's body). Place of articulation (also called location) refers to where in signing space or on the signer's body a sign is produced. There is no documentation of palm orientation or place of articulation being used to distinguish nouns and verbs in any known sign language (though spatialization was associated with verbal gestures in the child homesigner de-

[8] Our coding and analysis thus operate over sign-level units. In doing so, however, we do not commit ourselves to the morphosyntactically simplex or complex status of these units. More fine-grained linguistic analysis is outside the scope of the present studies (but see Abner 2017 for a proposed decomposition of related nouns and verbs in ASL).

[9] This may add noise to our data, particularly in verb-target vignettes, and has the potential to yield type II errors. Nevertheless, it avoids the circularity of preassigning noun and verb status to subject responses in a study aimed at identifying the characteristics of nouns and verbs.

[10] Nonmanual features (e.g. facial expression, body lean) also play an important grammatical role in sign languages. The present study focuses only on the manual characteristics of the signs investigated. Certain nonmanual components of subjects' responses (e.g. mouthing) were coded but did not play a role in marking the noun-verb distinction.

scribed above; see §6.1), nor did these parameters track this distinction in the language groups studied here.

Handshape refers to the shape of the hand (one-handed sign) or hands (two-handed sign) when producing a sign. Interestingly, it is constraints on handshape that underlie Battison's (1978) observation that the two hands do not play an equivalent role in sign language articulation. Just as one of our two hands is dominant in many of our manual activities, so too is one of our two hands dominant in sign language production. The dominant hand functions as the primary articulator, while the other, nondominant hand functions as a secondary articulator.[11] We coded all two-handed signs for the relation between the hands in the production of the sign. In symmetric two-handed signs, both hands are equally active and involved in the production of the sign; these signs must match in handshape and movement.[12] Battison proposes that asymmetric two-handed signs are of two types. In one, the dominant and nondominant hands represent different components of an event using the same handshape.[13] In SIT and CHAIR (Fig. 5 below), for example, the dominant hand represents the legs of a sitting human, while the nondominant hand represents the surface being sat upon; again, the hands do not play a phonologically equivalent role: in SIT/CHAIR, for example, the nondominant hand is static while the dominant hand moves. In this case, however, both hands are specified as part of the so-called 'citation form' of the lexical sign. Another kind of asymmetry occurs when the signer introduces the nondominant hand to represent an additional component in an otherwise one-handed sign, using a different handshape.[14] For the otherwise one-handed sign HAMMER in Fig. 4 below, for example, the signer could have held up a flat nondominant hand to represent the surface being hit. Such 'optional' usages of the nondominant hand were identified and coded as a 'base hand'. Thus, target signs were coded as one-handed signs with a base hand, one-handed signs without a base hand, or two-handed signs (base-hand classification not applicable).

Movement refers to either how a sign moves through space or how the hands themselves move without necessarily crossing space (path vs. local movement; Brentari 1998). To code movement size and repetition,[15] we first operationalized movement size in terms of the joints (proximal vs. distal) used to produce the movement. Proximal joints (shoulder, elbow) are the joints close to the trunk of the body; moving proximal joints frequently gives rise to 'path' movements in which the hands cross signing space (e.g. raising/lowering the arm by movement of the shoulder joint). Thus, movement of proximal joints results in relatively 'large' signs. In contrast, movement of distal joints (wrist, knuckles) far from the body results in 'local' movement: relatively 'small' movement such as opening and closing of the hands or fingers (aperture change) and rotating or flexing the wrist (palm-orientation change). Proximal and distal joint movement can occur in isolation (SIT is produced with only the proximal elbow joint, whereas CHAIR is produced with only the distal wrist joint; Fig. 5) or can be combined to create complex movement. Finally, target signs were also coded for the presence or

[11] This characterization of the relationship between the dominant and nondominant hand is a simplified picture of their sign-level relationship and omits entirely the complex and multifaceted role of the nondominant hand in other areas of sign language structure. For recent discussions of the role of the nondominant hand, see Sandler 2006 and Kimmelman et al. 2016.

[12] These correspond to type 1 signs of Battison 1978.

[13] These correspond to type 2 signs of Battison 1978.

[14] These correspond to type 3 signs of Battison 1978.

[15] We did not assess the relative tension of sign movement, though future advances in optical analysis may provide us that ability (Malaia et al. 2016).

absence of repetition. A second coder annotated a subset of the data in all three studies, with high interrater reliability across coding categories and studies; we report these measures below.

3. STUDY 1: TESTING THE NOUN-VERB CONTRAST IN AMERICAN SIGN LANGUAGE. In this study, we use ASL as an exemplar of a relatively mature grammatical system. We are not assuming that ASL is a developmental target for NSL; sign languages, like spoken languages, exhibit crosslinguistic variation. Moreover, we do not assume that ASL is static and fossilized; ASL grammar is dynamic and continuously changing, as in other languages. However, the noun-verb distinction has been previously studied in ASL (Supalla & Newport 1978) and is robustly and productively present in contemporary ASL (Abner 2017). Thus, ASL is an ideal system within which to validate our elicitation paradigm.

3.1. PARTICIPANTS. Five adult signers of ASL participated in the study (two female, three male). One of the participants declined to provide an age, but the remaining participants ranged in age from twenty-five to forty-five years old (with a mean age of thirty-six, *SD* = 8.3 years). All five participants received early language exposure to ASL according to criteria in Newport 1990, and two were exposed to ASL from birth (mean age of exposure = 2.0 years, *SD* = 2.08).

3.2. DESIGN, PROCEDURE, AND CODING. Participants were videotaped describing the events to an experimenter who was a Deaf native signer of Mexican Sign Language (LSM) that has lived in the US for over twenty years and is an instructor and L2 signer of ASL. From their responses, 222 target signs were identified for sentence-position coding, 207 for joint involvement and movement-repetition coding, and 110 for base-hand coding. A second individual coded 15% of the responses. Interrater reliability was 86% for identifying target signs, and 90% or higher for other categories (identifying handshape 100%, Cohen's kappa (κ) = 1; handshape representation 86%, $\kappa = 0.84$; utterance position 100%, $\kappa = 1$; joint involvement 90%, $\kappa = 0.8$; repetition 90%, $\kappa = 0.8$; base hand 95%, $\kappa = 0.9$).

3.3. RESULTS. We examine sentence-level properties (WORD ORDER) as well as the distinctions in sign form (PROXIMAL MOVEMENT, MOVEMENT REPETITION, BASE HAND) of ASL signers' responses to the vignettes. The results of these analyses are depicted in Figure 3 (referenced in the sections that follow); responses to vignettes associated with iterable and noniterable actions are depicted separately.

WORD ORDER. Syntactic structures in a language sometimes give rise to broad patterns of linear word order that may be used for typological classification (e.g. Greenberg 1963). Current analyses group ASL with subject-verb-object (SVO) languages (Lillo-Martin 1986, Neidle et al. 2000, among others). However, ASL is historically an SOV language (Fischer 1975), and modern-day ASL is a 'flexible word order' language with a number of syntactic phenomena that give rise to verb-final constructions (Liddell 1980, Fischer & Janis 1992, Matsuoka 1997, Chen Pichler 2001). We investigated whether ASL signers exhibited systematic, global word-order differences in the utterance position of target noun and verb signs (the ASL data presented here and the emergent status of the communication systems in studies 2 and 3 do not lend themselves to more fine-grained syntactic analysis at this time).

The leftmost columns of Fig. 3 display the proportions of responses in which the target sign was produced in utterance-final position. Target signs produced in response to verb-target vignettes were more likely to occur in final position than those produced in response to noun-target vignettes. For example, in response to a verb-target vignette in which a man

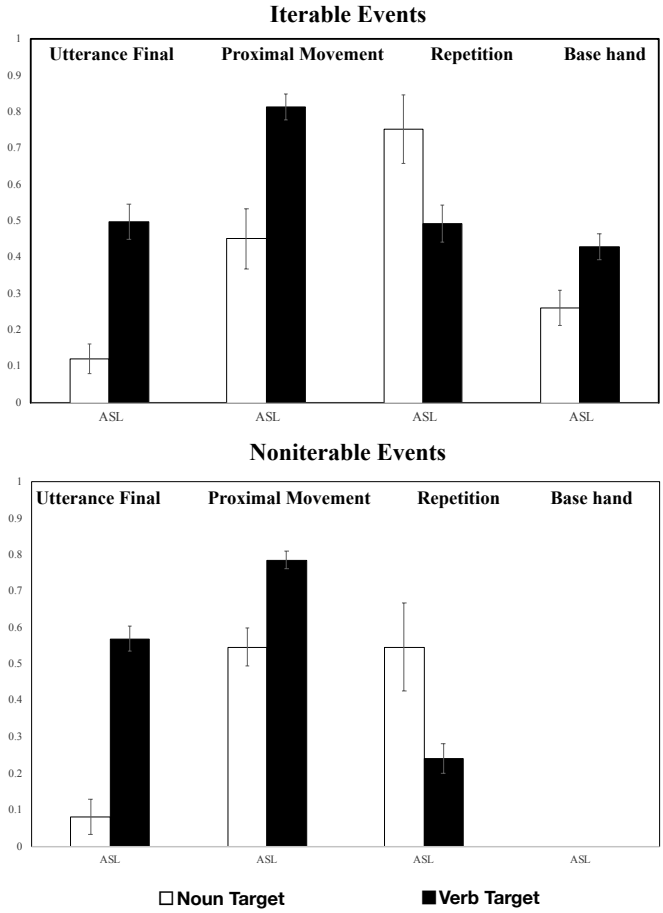

FIGURE 3. The proportions of target signs produced in response to noun- and verb-target vignettes that were placed in utterance-final position, or produced with proximal joint movement, repetition, or with a base hand by ASL signers. ASL signers were more likely to produce verb-target signs (black) in utterance-final position (first columns on the left, both top and bottom), with large movements of the proximal joints (second columns), and without repetition (third columns). Each of these three patterns was true for both iterable (top) and noniterable (bottom) events. ASL signers made little use of the base-hand function of the nondominant hand (fourth columns); none of the eighteen lexically one-handed target signs produced in response to target stimuli for noniterable events used a base hand (fourth columns, bottom).

uses a pair of scissors to cut a sheet of paper, an ASL signer produced example 3 ('PAPER-SASS' glosses a size-and-shape classifier representing the sheet of paper).

(3) PAPER MAN PAPER-SASS **CUT-WITH-SCISSORS**

In response to a corresponding noun-target vignette in which a man drops a pair of scissors into a cup of water, the same ASL signer produced the utterance in 4.

(4) MAN CUP WATER HALF-FULL **SCISSORS** DROP-IN-CUP FALL-IN-CUP

Using a logistic mixed-effects regression with random effects for participant (*SD* = 0.000) and stimulus item (*SD* = 0.000), we examined the statistical significance of this effect. Table 1 provides the estimated coefficients, standard errors, and significance of the fixed effects. In this model (and in all subsequent models exploring ASL), we investigate the effects of word class (noun-target vignettes, verb-target vignettes), iterability of the associated action (iterable, noniterable), and the interaction between word class

and iterability. The positive and negative coefficients (β) in the first column should be interpreted with respect to the intercept, which represents the value for signs produced in response to verb-target vignettes for noniterable events. A positive coefficient represents an increase in the likelihood of using an utterance-final sign with a one-unit change in that factor (stimulus item is a noun target, stimulus action is iterable).

	β	*SE*	*z*	*p*	
(intercept)	−1.9810	0.3771	−5.253	1.50e-01	***
Word class	1.9297	0.4399	4.386	1.15e-05	***
Iterable	0.5039	0.8270	−0.609	0.542	
Word class * Iterable	−0.8003	0.9134	0.876	0.381	

TABLE 1. Results from the logistic mixed-effects regression analysis for the production of utterance-final signs in ASL signers.

We found a significant effect of word class (β = 1.9297, $p < 0.001$), no effect of iterability (β = 0.5039, $p = 0.542$), and no interaction between word class and iterability (β = −0.8003, $p = 0.381$). The significant word-class effect indicates that ASL signers are statistically more likely to produce verb- (vs. noun-) target signs in utterance-final position, affirming the presence of verb-final structures in modern-day ASL, the utility of utterance position as a morphosyntactic indicator of category, and the success of our stimuli in eliciting distinct action (verb) and object (noun) labels.

PROXIMAL MOVEMENT. As described in §2.2, we used the joints of the body to operationalize the sign-size distinction—namely, we asked whether a sign included movement of proximal joints close to the body, which typically gives rise to large (path) movements. Given previous research (see §1.1), we expected more proximal joint involvement with target signs produced in response to verb-target vignettes and, indeed, this is the pattern exhibited by the participants (see Fig. 3, second columns). Figure 4 presents the target signs in an ASL signer's response to a pair of stimuli involving the object 'hammer': a verb-target vignette (a woman hits a hammer against a wall one time; top illustrations) and a noun-target vignette (a woman drops a hammer into a glass of water; bottom illustrations). The joints involved in the production of each target sign are circled. The signer's response to the verb-target vignette involves movement of the elbow, a proximal joint; her response to the noun-target vignette does not involve movement of any proximal joints (the wrist is a distal joint).

We used a logistic mixed-effects regression with random effects for participant (*SD* = 0.000) and stimulus item (*SD* = 2.138) to explore this pattern. Table 2 presents the estimated coefficients, standard errors, and significance levels for the fixed effects. We found a significant effect of word class (β = 3.0416, $p = 0.00953$), no effect of iterability (β = −1.2971, $p = 0.32813$), and no interaction between word class and iterability (β = −1.1424, $p = 0.55385$). Replicating previous research, we found that ASL signers are less likely to produce a noun-target sign with proximal movement (vs. a verb-target sign). In other words, responses to noun-target vignettes are produced with smaller movements than responses to verb-target vignettes.

	β	*SE*	*z*	*p*	
(intercept)	−0.7559	0.7328	−1.032	0.30225	
Word class	3.0416	1.1732	2.592	0.00953	**
Iterable	−1.2971	1.3265	0.978	0.32813	
Word class * Iterable	−1.1424	1.9297	−0.592	0.55385	

TABLE 2. Results from the logistic mixed-effects regression analysis for production of signs with a proximal joint movement in ASL signers.

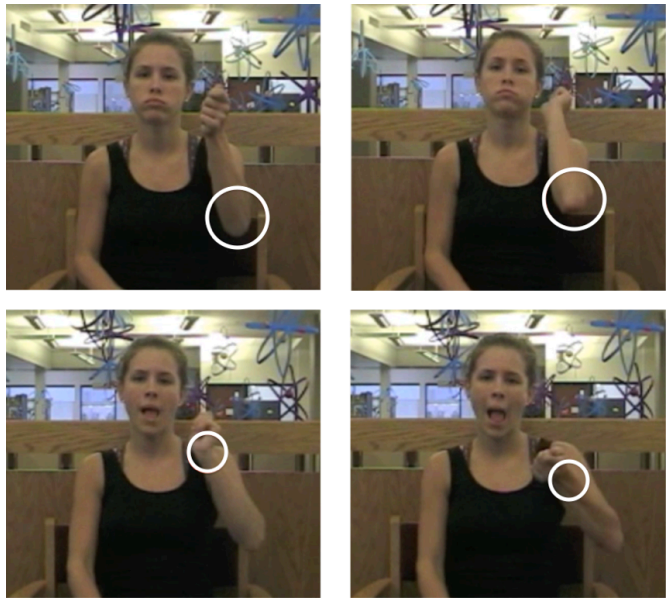

FIGURE 4. An example of an ASL signer producing a noun-verb pair distinguished by proximal movement. The top pair of pictures is from the sign HAMMER produced in response to a verb-target vignette. The sign is articulated by movement of the elbow, a proximal joint movement. The bottom pair is from the sign HAMMER produced in response to a noun-target vignette. The noun-target sign is articulated with movement of the wrist and lacks any proximal joint movement.

MOVEMENT REPETITION. Movement repetition is another form property that has been shown to distinguish nouns and verbs in ASL. The ASL signers in our study also exhibited this pattern and were more likely to produce target signs with repetition in response to noun-target vignettes than to verb-target vignettes (see Fig. 3, third set of columns). Figure 5 presents a response produced by one ASL signer to a verb-target vignette (a man sits down in a chair; left illustration) and to a noun-target vignette (a man puts a blanket over a chair; right illustration). The signer's response to the noun-target vignette (CHAIR) contains repeated movement, whereas the response to the verb-target vignette (SIT) contains a single movement only, as represented by the arrows on the figure.

FIGURE 5. An example of an ASL signer producing a noun-verb pair distinguished by repetition of movement. The verb-target sign (left), SIT, is produced with a single movement; the noun-target sign (right), CHAIR, is produced with repeated movement.

We examined this pattern using a logistic mixed-effects regression with random effects for participant (*SD* = 0.9919) and stimulus item (*SD* = 0.2912). Table 3 presents

the estimated coefficients, standard errors, and significance levels of the fixed effects. We found a significant effect of word class (β = 1.2212, $p = 0.04033$), no effect of iterability (β = 0.9782, $p = 0.18714$), and no interaction between word class and iterability (β = −0.6975, $p = 0.50984$).

	β	*SE*	*z*	*p*	
(intercept)	1.2592	0.4500	2.798	0.00514	**
Word class	1.2212	0.5956	−2.050	0.04033	*
Iterable	0.9782	0.7416	−1.319	0.18714	
Word class * Iterable	−0.6975	1.0583	−0.659	0.50984	

TABLE 3. Results from the logistic mixed-effects regression analysis for production of signs with repetition in ASL signers.

BASE HAND. Finally, we investigated whether the use of the nondominant hand as a base hand differentiated responses to noun-target and verb-target vignettes. Though previous research on the noun-verb distinction in sign languages has not mentioned a base-hand pattern (see §1.1), this use of the nondominant hand is a means of representing an event participant morphosyntactically and thus may be serving an 'argument-introducing' function. If so, a base hand might be more likely in verb-target responses. What the data revealed, however, was that ASL signers made little use of the nondominant hand as a base hand (Fig. 3, fourth columns). Of the 110 response signs that are lexically one-handed and thus have the potential to incorporate a base hand, only thirty-two did: twenty-two produced in response to verb-target vignettes, and ten in response to noun-target vignettes; interestingly, all base hands were produced in response to iterable events. As in previous analyses, we attempted a logistic mixed-effects regression with random effects for participant and stimulus item, but this model failed to converge; this could be due to the low incidence of base-hand use in the ASL signers' responses.

Overall, the paradigm that we developed worked well to elicit differentiated responses to noun-target and verb-target vignettes. Moreover, the differences we found replicate previous findings on ASL (Supalla & Newport 1978, Launer 1982, Brentari 1998, Brentari et al. 2015, Abner 2017). We add to these findings the tendency for verb-target signs to be produced in utterance-final position. Having confirmed the validity of the elicitation paradigm, we now use it to investigate whether noun-verb distinctions can be found in the developing grammar(s) of emergent sign systems.

4. STUDY 2: ELICITING NOUNS AND VERBS IN A DEVELOPING SIGN LANGUAGE. NSL provides a valuable opportunity to study how distinctions and structural patterns emerge and change at various points in the development of a linguistic system. Forty years ago, expanding programs in special education in Nicaragua brought together deaf children who were, at the time, homesigners, and NSL was born. NSL has continued to develop as new waves of children enter the community and learn the system developed by older peers. As a result, the language experience of the earliest students is qualitatively different from the experience of students who entered the school later: the first group of students was responsible for the creation of NSL, whereas later entrants had language input provided by their older peers. Thus, the language of students who entered the school more recently is shaped not only by their linguistic biases, but also by the language models they saw. Here, we examine the emergence and development of the noun-verb distinction in NSL.

4.1. PARTICIPANTS. The participants in study 2 were twenty-four adult users of NSL. NSL was the primary daily language of all participants. NSL, like other Deaf community

sign languages, is disseminated at school, although it was not taught in the education system. All participants entered the deaf school by the age of six (latest entry 6.9 years) and thus received early language exposure according to criteria in Newport 1990 (mean age of entry = 4.25, *SD* = 1.33 years). None of the participants had any known cognitive deficits. Any differences that we document between nouns and verbs are thus likely to be a consequence of grammatical variation and development of NSL, not late language exposure or cognitive impairment. Moreover, because the participants were tested as adults, any differences they display reflect the developing grammar of the language, not the developing grammar of a cognitively growing child (cf. Snedeker et al. 2007).

Following Senghas (1995, 2003), the signers may be grouped according to the year in which they entered the school for the deaf and, consequently, the signing community. The first group of children to enter the school entered before 1983 and are referred to as COHORT 1; COHORT 2 entered the school between 1984 and 1993, and COHORT 3 entered the school between 1994 and 2003. Eight members of each cohort participated in the study. All of the signers, regardless of year of entry, entered the school as homesigners and thus had not had exposure to NSL before they arrived. Additional information regarding participant gender, age, and age of entry into the school is provided in Table 4.

	M : F	YEAR OF ENTRY RANGE	AGE AT TESTING (range, *SD*)	AGE AT SCHOOL ENTRY (range, *SD*)
Cohort 1 (*n* = 8)	4 : 4	1973–1980	41.4 (35–46, 4.2)	4.6 (2.1–6.2, 1.5)
Cohort 2 (*n* = 8)	4 : 4	1986–1990	29.9 (27–32, 2.2)	4.1 (3.1–5.2, .85)
Cohort 3 (*n* = 8)	2 : 6	1993–1999	21.6 (19–25, 1.9)	4.3 (2.1–6.9, 1.5)

TABLE 4. Demographic information for NSL participants in study 2.

4.2. DESIGN, PROCEDURE, AND CODING. Participants were videotaped describing the events to either another NSL signer of approximately the same age (and thus year of entry) or an experimenter familiar to the participant. From their responses, 1,222 target signs were coded for word order, 1,136 for joint involvement, 1,138 for repetition, and 606 for base hand. A second individual coded 11% of the responses, and interrater reliability was 87% or higher for all properties reported (identifying handshape 89%, $\kappa = 0.88$; handshape representation 91%, $\kappa = 0.9$; utterance position 96%, $\kappa = 0.91$; joint involvement 88%, $\kappa = 0.75$; repetition 87%, $\kappa = 0.84$; base hand 87%, $\kappa = 0.73$).

4.3. RESULTS. We again examine sentence-level properties (WORD ORDER), as well as the distinctions in sign form (PROXIMAL MOVEMENT, MOVEMENT REPETITION, BASE HAND). The results are displayed in Figure 6; again, responses to vignettes associated with iterable and noniterable actions are depicted separately. The cohort divisions described in §4.1 structure some of the discussion that follows and are used in the graphical depiction of signers' responses. However, because these divisions are arbitrary, we use a signer's year of entry into the community (rather than the signer's cohort designation) as a continuous variable in our statistical analyses; graphical depictions of responses as a function of year of entry are provided in the supplementary materials.

WORD ORDER. We first investigated whether NSL signers exhibited systematic word-order differences in noun- and verb-target responses. The leftmost columns of Figure 6 display the proportions of target signs produced in utterance-final position. Target signs produced in response to verb-target vignettes were more likely to occur in utterance-final position than those produced in response to noun-target vignettes for signers in all three cohorts (see Flaherty 2014 for further evidence that NSL is a verb-final language). This contrast is illustrated by the NSL cohort 1 signer's responses in examples 5 and 6. In the

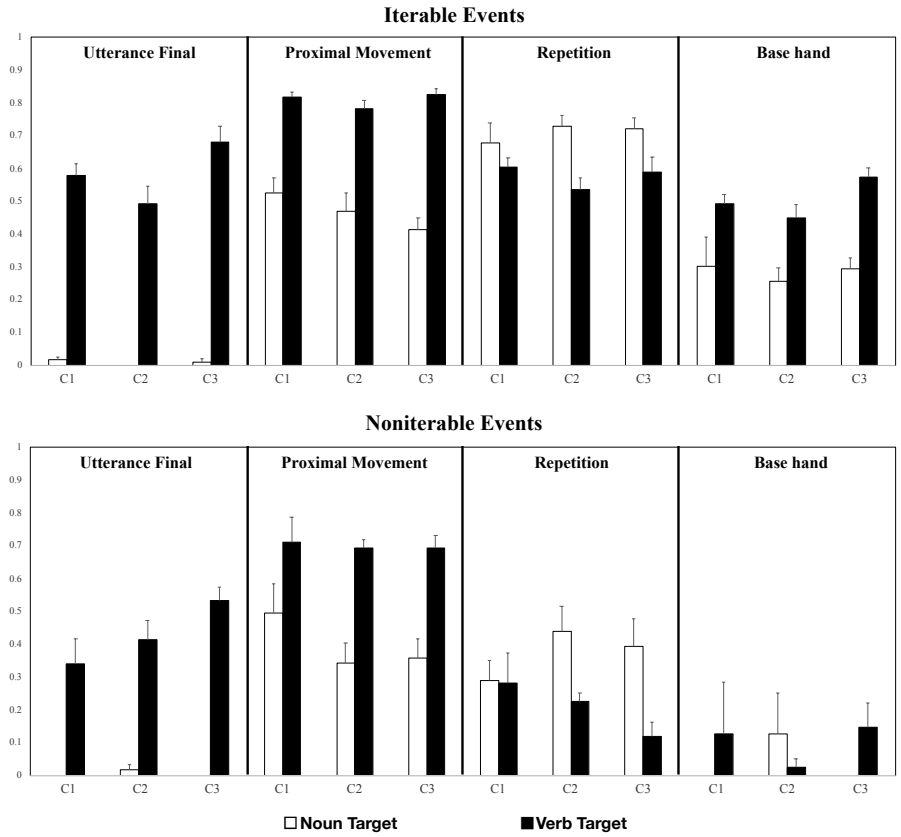

FIGURE 6. The proportions of target signs produced in response to noun- and verb-target vignettes that were placed in utterance-final position, or produced with proximal joint movement, repetition, or with a base hand by NSL signers. NSL signers are organized by year-of-entry cohort (C1 before 1983, C2 1984–1993, C3 1994–2003); for a depiction organized by individual year of entry, please see the supplementary materials. All cohorts of NSL signers were more likely to produce verb-target signs (black) in utterance-final position (first columns on the left, both top and bottom), with large movements of the proximal joints (second columns), and with a base hand (fourth columns). The tendencies to produce verb-target signs with movement of the proximal joints and with a base hand are stronger in cohorts 2 and 3. There was a significant main effect of iterability in repetition (third columns): all cohorts were more likely to produce iterable (top) events with repetition. Nevertheless, repetition was used differentially by signers in NSL cohorts 2 and 3, who were more likely to produce noun-target signs with repetition; NSL cohort 1 signers did not use repetition to distinguish target categories.

verb-target vignette for this pair, a man uses a machete to cut brush growing along a brick wall. In describing this vignette, 5, the signer produced the sign CHOP-WITH-MACHETE in utterance-final position. The signer's response to the noun-target vignette (a man drops a machete into a trash can) includes MACHETE but not in utterance-final position.

(5) TREE BIG MAN **CHOP-WITH-MACHETE**

(6) MAN TRASH **MACHETE** DROP

We explored the statistical significance of this effect using a logistic mixed-effects regression with random effects for participant (*SD* = 0.4122) and stimulus item (*SD* = 0.5546). Table 5 presents the estimated coefficients, standard errors, and significance levels of the fixed effects. In this model (and in all subsequent models for study 2), we investigate the effects of word class (noun target, verb target), year of entry (again, as a

continuous variable), iterability of the action in the verb-target vignette (iterable, noniterable), and the interaction between word class and year of entry.[16] The intercept represents the value for a signer entering in year zero (the year the first school opened and the year of entry for the first participant in this study) for signs produced in response to verb-target vignettes for noniterable events. The coefficients (β) in the first column are interpreted with respect to this value: a positive coefficient represents an increase in the likelihood of an utterance-final sign for a one-unit change in that factor (year of entry increases by one year, stimulus item is noun target, stimulus action is iterable).

	β	*SE*	*z*	*p*	
(intercept)	−4.27836	0.70773	−6.045	1.49e-09	***
Word class	4.16116	0.71562	5.815	6.07e-09	***
Iterable	−0.59030	0.25909	−2.278	0.0227	*
Year of entry	−0.05348	0.05669	−0.943	0.3455	
Word class * Year of entry	0.08493	0.05678	1.496	0.1347	

TABLE 5. Results from the logistic mixed-effects regression analysis for production of utterance-final signs in NSL signers.

We found a significant effect of word class (β = 4.16116, $p < 0.001$), no effect of year of entry (β = −0.05348, $p = 0.3455$), and no interaction between word class and year of entry (β = 0.08493, $p = 0.1347$). The significant word-class effect indicates that, independent of year of entry, NSL signers were more likely to produce the verb-target signs in utterance-final position (see supplementary materials Figure S1). We also found a significant effect of iterability (β = −0.59030, $p = 0.0227$), indicating that target signs describing iterable events were more likely to be utterance-final than target signs describing noniterable events.

PROXIMAL MOVEMENT. We next asked whether the NSL signers used proximal joint movement (i.e. large movements) differentially in response to verb- versus noun-target vignettes. NSL signers were, in general, more likely to produce proximal (large) movements in response to verb-target vignettes than to noun-target vignettes (see second set of columns in Fig. 6 and Figure S2 in the supplementary materials). Figure 7 presents a cohort 1 signer's response to a verb-target vignette (top illustrations, which contain proximal joint movement, SEW-WITH-MACHINE) and to a noun-target vignette (bottom illustrations, which contain distal joint movement only, SEWING-MACHINE).

We analyzed this effect using a logistic mixed-effects regression with random effects for participant ($SD = 0.4758$) and stimulus item ($SD = 1.6557$). Table 6 provides the estimated coefficients, standard errors, and significance levels of the fixed effects. We found a significant effect of word class (β = −1.20625, $p = 0.000588$). The negative coefficient indicates that NSL signers (like ASL signers) were more likely to produce signs using a proximal movement in response to verb-target vignettes than to noun-target vignettes. We also found a significant effect of year of entry (β = −0.04041, $p = 0.020481$). Here, the negative coefficient indicates that signers who entered the NSL community more recently were less likely to produce signs with a proximal movement than signers who entered the community during the earlier years of the language's formation, regardless of vignette target type (see Frishberg 1975 for a discussion of sign-size reduction in diachronic language change). We found no interaction between

[16] We were unable to include in the model the interaction between word class and iterability (which was included in our ASL models) because adding this factor in addition to year of entry (which was not relevant and thus not included in the ASL models) led to a lack of convergence due to insufficient data set size.

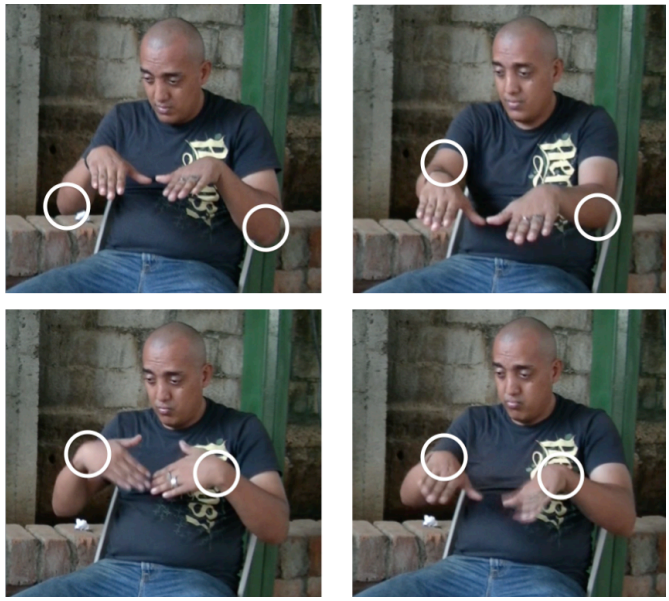

FIGURE 7. An example of an NSL cohort 1 signer producing a noun-verb pair distinguished by the presence of proximal joint movement. The articulation of the verb-target sign, SEW-WITH-MACHINE (top), involves a proximal joint, the elbow. The articulation of the noun-target sign, SEWING-MACHINE (bottom), involves distal joint movement only (the wrist).

word class and year of entry (β = 0.02985, p = 0.125428), and no effect of iterability (β = −0.31110, p = 0.252268).

	β	*SE*	*z*	*p*	
(intercept)	0.57593	0.38783	1.485	0.137545	
Word class	−1.20625	0.32780	3.437	0.000588	***
Iterable	−0.31110	0.27174	−1.145	0.252268	
Year of entry	−0.04041	0.01744	−2.317	0.020481	*
Word class * Year of entry	0.02985	0.01948	1.532	0.125428	

TABLE 6. Results from the logistic mixed-effects regression analysis for production of signs with a proximal joint movement in NSL signers.

MOVEMENT REPETITION. The third set of columns in Fig. 6 (see also Figure S3 in the supplementary materials) suggests that NSL signers who entered the community relatively recently (and had a language model to learn from, i.e. cohorts 2 and 3) produced repeated movements more often in response to noun-target vignettes than to verb-target vignettes for both iterable and noniterable actions. Figure 8 presents an example of an NSL cohort 3 signer's response to a verb-target vignette (left illustration, which contains a single movement, OPEN-DOOR, for the vignette in which a man opens a door) and to a corresponding noun-target vignette (right illustration, which contains repeated movements, DOOR, for the vignette in which a man puts a blanket over a door).

We investigated whether this difference was statistically significant using a logistic mixed-effects regression with random effects for participant (*SD* = 0.1715) and stimulus item (*SD* = 0.9278). Table 7 provides the estimated coefficients, standard errors, and significance levels of the fixed effects. We found a significant main effect of iterability (β = −1.63870, p < 0.001). NSL signers were more likely to use movement repetition if

FIGURE 8. An example of an NSL cohort 3 signer producing a noun-verb pair distinguished by repetition of movement. The verb-target sign (left), OPEN-DOOR, is produced with a single movement; the noun-target sign (right), DOOR, is produced with a repeated movement.

the action associated with a sign was potentially iterable. We found no effect of word class (β = 0.11125, $p = 0.70367$), but we did find an effect of year of entry (β = 0.02956, $p = 0.02058$) and an interaction between word class and year of entry (β = −0.06867, $p < 0.001$), indicating that signers who entered the Deaf community more recently did use movement repetition to distinguish noun and verb targets.

	β	*SE*	*z*	*p*	
(intercept)	0.68674	0.25393	2.704	0.00684	**
Word class	0.11125	0.29248	0.380	0.70367	
Iterable	−1.63870	0.23312	−7.029	2.07e-12	***
Year of entry	0.02956	0.01276	2.316	0.02058	*
Word class * Year of entry	−0.06867	0.01702	−4.035	5.46e-05	***

TABLE 7. Results from the logistic mixed-effects regression analysis for production of signs with repetition in NSL signers.

BASE HAND. NSL signers who entered the community more recently also used base hand distinctively, incorporating it more often in response to verb-target vignettes than noun-target vignettes (see the final columns of Fig. 6 and Figure S4 in the supplementary materials). Figure 9 presents an example of a noun-verb pair distinguished by the use of a base hand. In response to a verb-target vignette in which a man cuts a piece of paper one time, an NSL cohort 2 signer used her nondominant hand as a base hand (representing the sheet of paper) in producing the target sign CUT-WITH-SCISSORS (Fig. 9, left). In response to a noun-target vignette in which a man drops a pair of scissors into a glass of water, the same signer did not use a base hand in the production of the target sign SCISSORS (Fig. 9, right).

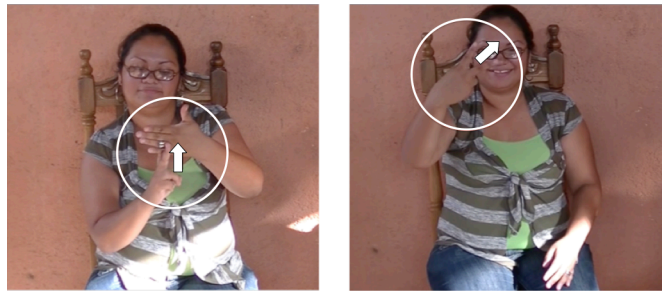

FIGURE 9. An example of an NSL cohort 2 signer producing a noun-verb pair distinguished by use of a base hand. The verb-target sign (left), CUT-WITH-SCISSORS, is produced with a base hand (representing the object of the event, paper); the noun-target sign (right), SCISSORS, is produced without a base hand.

We used a logistic mixed-effects regression with random effects for participant (*SD* = 0.7406) and stimulus item (*SD* = 2.1116) to explore the statistical significance of this effect. Table 8 provides the estimated coefficients, standard errors, and significance levels of the fixed effects. We found no effect of either word class (β = 0.83854, *p* = 0.19444) or year of entry (β = −0.02217, *p* = 0.42705), but we again found an interaction between word class and year of entry (β = 0.07231, *p* = 0.01641): signers who entered the school in its earliest years (and did not have a language model to learn from) were less likely to use a base hand differentially in response to noun- and verb-target vignettes. We also found an effect of iterability (β = −1.90449, *p* = 0.00292): NSL signers produced signs with base hands more often for iterable events than for noniterable events.

	β	*SE*	*z*	*p*	
(intercept)	−1.71088	0.65206	−2.624	0.00870	**
Word class	0.83854	0.64626	1.298	0.19444	
Iterable	−1.90449	0.63999	−2.976	0.00292	**
Year of entry	−0.02217	0.02791	−0.794	0.42705	
Word class * Year of entry	0.07231	0.03013	2.400	0.01641	*

TABLE 8. Results from the logistic mixed-effects regression analysis for the production of signs with a base hand in NSL signers.

To summarize thus far, we have found that, from the earliest years of entry into the Deaf community, NSL signers distinguish between nouns and verbs using utterance position and movement size, suggesting that transmission to a new generation of learners (and thus providing them a language model to learn from) is not necessary for a communication system to have a marked noun-verb distinction. Movement repetition and base hand present a different picture. Signers who entered the community relatively recently (and thus had the benefit of seeing what their predecessors had produced) used movement repetition and a base hand as additional markers of the noun-verb distinction, suggesting that these devices do require transmission to new learners. Study 3 examines the noun-verb distinction in an even earlier stage of language emergence, homesign.

5. STUDY 3: ELICITING NOUNS AND VERBS IN NICARAGUAN HOMESIGN, THE PRECURSOR TO NSL. The coexistence of several cohorts of NSL signers offers insight into the emergence and development of linguistic patterns, and the results of study 2 reveal that the noun-verb distinction is present in some form even in the earliest stages of NSL. In study 3, we enrich this developmental picture by looking at the communication of adult homesigners, who live in hearing households and have no regular contact with the Deaf community of Nicaragua (Coppola 2002). Previous work has shown that individual homesigners develop manual communication systems that have many, although not all, of the properties of natural language (Goldin-Meadow & Mylander 1984a, Goldin-Meadow 2003, Coppola & Newport 2005) and that display internally consistent, albeit idiosyncratic, structural patterns (Coppola & So 2005). Each homesigner thus produces a structured, language-like communication system. However, since the homesigners do not know one another, they do not share their systems. Moreover, none of the homesigners had a language model when developing their systems. Homesigners—not their communication partners—innovate the structural properties of their communication systems, and there is evidence that these innovations are not necessarily adopted by their communication partners (Coppola et al. 2013), who may communicate with homesigners using speech, which is inaccessible, and co-speech gesture, which has been shown to be structured differently from homesign (Goldin-Meadow & Mylander 1983, 1984a, 1998, Goldin-Meadow et al. 1995, Goldin-Meadow et al. 2007, Hunsicker &

Goldin-Meadow 2012). Even in Nicaragua, where communication partners of homesigners rely more on gestural (vs. spoken) communication (Coppola 2002, Flaherty et al. 2016), Carrigan and Coppola (2017) have found that the regular communication partners of homesigners show poor comprehension of the homesigner's communication system.[17] Thus, by examining the communication systems of homesigners, we have the opportunity not only to look at the kind of system that contributed to the genesis of NSL (NSL signers were homesigners when they entered school), but also to look at the types of structures found in a communication system that has not been learned from, nor shared with, others.

5.1. PARTICIPANTS. Participants in study 3 were four adult Nicaraguan homesigners (one female, three male) with a mean age of 30.8 years (range: twenty-eight to thirty-seven, $SD = 3.8$). None of the homesigners had any known cognitive deficits. These four adult homesigners did not interact with each other, were not members of the Nicaraguan Deaf community, and three of the four live relatively far from the Deaf community hub of Managua. Thus, their exposure to and interaction with other deaf individuals was limited or nonexistent. They had not attended school regularly, and none of the four had acquired NSL, nor had they learned any usable spoken or written Spanish. Daily communication for each was an idiosyncratic homesign system that they had created and used to communicate with the hearing individuals around them.

5.2. DESIGN, PROCEDURE, AND CODING. Homesigners were videotaped describing the vignettes to an experimenter familiar to the homesigner or to a member of their family with whom they regularly communicate. Three pairs of stimulus items (HAMMOCK/SWING-IN-HAMMOCK, MACHETE/CUT-WITH-MACHETE, YUCCA/CUT-YUCCA) were not viewed by two of the homesigners because the videos for these items were not available at the time of testing. As in the previous two studies, we segmented and glossed the utterance-level units of the participants' responses as well as the individual gestures they produced as the signs of their system. Three 'kinds' of meaning underlie these gestures (Goldin-Meadow 2003): (i) Gesture meaning may be deictic, where the gesture points out an object in order to refer to that object or to an object that shares properties with that object, such as pointing to a female experimenter to refer to that experimenter or to females in general. (ii) Gesture meaning may also be iconic, where the form of the gesture represents some aspect of its intended referential meaning, such as gesturing HAMMER by holding the hand in a fist shape to represent how someone holds a hammer. (iii) Finally, gesture meaning may be conventional, where the gesture is part of an established repertoire of meaningful gestures of a community (here, the co-speech gestures of the ambient hearing community). These meaning sources, which can also be used to describe co-speech gesture and signs of conventionalized sign languages, are not mutually exclusive, and multiple dimensions may work together to create the meaning of a given gesture (Kendon 2004, McNeill 2005). Although we did not code for deixis, iconicity, or conventionality directly, these three meaning sources did guide our assignment of gesture-level meaning to the homesigners' responses. Form properties of these

[17] Interestingly, however, Carrigan and Coppola (2017) found that ASL signers nevertheless showed relatively better comprehension of an unfamiliar homesigner's descriptions, further supporting the hypothesis that there are shared structural underpinnings of sign systems. Moreover, as a testament to the unique position of children in language creation (Senghas 1995), they found that communication partners who began using homesign at younger ages showed better comprehension of homesign utterances than did those who began learning at older ages (albeit still worse than ASL signers and poor relative to the comprehension standards of a truly shared system).

responses were coded using the same system used in studies 1 and 2 and described in §2.2. Homesigners produced 184 target signs that were codable for utterance position, 162 for joint involvement and movement repetition, and 99 for base hand. A second individual coded 10% of the responses, and interrater reliability was 87% or higher for all categories reported (identifying handshape 91%, $\kappa = 0.9$; handshape representation 91%, $\kappa = 0.89$; utterance position 100%, $\kappa = 1$; joint involvement 87%, $\kappa = 0.733$; repetition 100%, $\kappa = 1$; base hand 87%, $\kappa = 0.73$).

5.3. RESULTS. Here we investigate whether nouns and verbs are distinguished in the communication systems of four homesigners. As before, we examine distinctions in both distribution and sign form. An overview of the results is depicted in Figure 10. Because the homesigners did not know one another and thus did not share a communication system, the data of each individual are presented separately in Fig. 10. The results reported here include analyses of each individual homesigner as well as comparison between the homesigners (as a group) and the first cohort of NSL users (i.e. NSL users who, like homesigners, invented their system, but, unlike homesigners, share this system with a community of users).

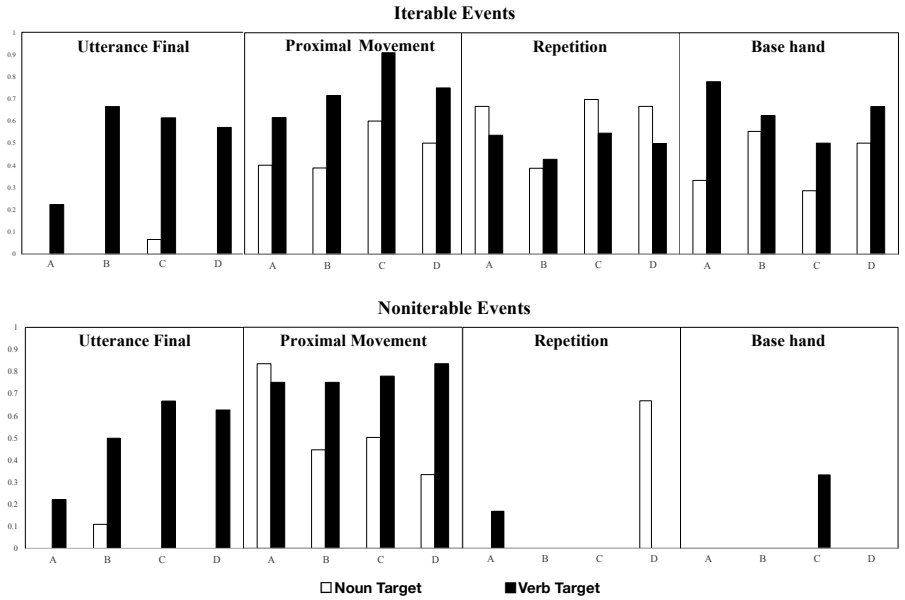

FIGURE 10. The proportions of target signs produced in response to noun- and verb-target vignettes that were placed in utterance-final position, or produced with proximal joint movement, repetition, or with a base hand by individual adult homesigners, labeled as homesigner 'A', 'B', 'C', and 'D'. All four homesigners were more likely to produce verb-target (black) signs in utterance-final position (first columns on the left, both top and bottom). All homesigners were more likely to produce verb-target signs with large movements of the proximal joints in iterable events, and three of four were also more likely to produce them in noniterable events (second columns). All homesigners produced more verb-target signs with a base hand in iterable events; there are not enough data to look at this pattern in noniterable events (fourth columns). Three of four Nicaraguan homesigners also used repetition differentially (third columns): noun-target signs (white) were more likely to be repeated than verb-target signs (black). However, this pattern was true only for noun-target signs associated with iterable events.

WORD ORDER. As in the previous two studies, we first compared the utterance position of target signs produced in response to noun- and verb-target vignettes, looking specifically at the frequency with which the target sign was produced in utterance-final

position. The first set of columns in Fig. 10 displays the data for each of the four homesigners and shows that each homesigner was more likely to produce the target sign in utterance-final position in response to verb-target vignettes (like ASL and NSL signers). For example, in response to a verb-target vignette in which a woman hits a wall a single time with a hammer, a homesigner produced the utterance in 7; the target response sign, HAMMER, is in utterance-final position.

(7) WALL WOMAN **HAMMER**

In response to a noun-target vignette in which the woman drops a hammer into a glass of water, the same homesigner produced the utterance in 8; the target response sign, also glossed as HAMMER, appears in the middle of the utterance.

(8) WATER CUP **HAMMER** DROP-IN-CUP

To explore the statistical significance of this effect, we applied a nonparametric test (Fisher's exact test) to each homesigner's data. Each of the four homesigners was significantly more likely (all ps < 0.05) to produce the target sign in utterance-final position in response to verb-target vignettes than to noun-target vignettes (data were collapsed over iterability for each individual to increase power): Fisher's exact test statistic = 0.0225 for homesigner A, 0.00 for homesigner B, 0.0001 for homesigner C, and < 0.00001 for homesigner D.

Cohort 1 signers, unlike homesigners, share their system with a community of users (and have done so for at least thirty-eight years). To explore the potential benefits (or stresses) of sharing a primary communication system with others, we also statistically compared the four homesigners to the NSL signers who were the first to enter the Deaf community (NSL cohort 1; leftmost entries in supplementary materials Fig. S1). We used a logistic mixed-effects regression with random effects for participant ($SD = 0.4593$) and stimulus item ($SD = 0.4430$). Table 9 provides the estimated coefficients, standard errors, and significance levels of the fixed effects. In this model (and in all subsequent models comparing the four homesigners to the members of NSL cohort 1), we investigate the effects of word class (noun target, verb target), language group (homesigner, NSL cohort 1), iterability (iterable, noniterable), and an interaction between word class and language group. The intercept represents the value for homesigners for signs produced in response to verb-target vignettes in noniterable events. A positive coefficient (β) represents an increase in the likelihood of producing a sign utterance-finally. We found an effect of word class ($\beta = -4.3002$, $p < 0.001$), no effect of language group (homesigner vs. cohort 1, $\beta = -0.4473$, $p = 0.6436$), and no interaction between word class and group ($\beta = 0.1487$, $p = 0.8773$). Both homesigners and NSL cohort 1 signers produced the target sign in utterance-final position more often in response to verb-target vignettes. We also found an effect of iterability ($\beta = -0.6423$, $p = 0.0269$). Both groups were more likely to produce target signs in utterance-final position in response to iterable (vs. noniterable) events.

	β	*SE*	*z*	*p*	
(intercept)	−3.8716	0.7654	−5.058	4.23e-07	***
Word class	−4.3002	0.7726	5.566	2.61e-08	***
Iterable	−0.6423	0.2903	−2.212	0.0269	*
Cohort 1	−0.4473	0.9668	−0.463	0.6436	
Word class * Cohort 1	0.1487	0.9628	0.154	0.8773	

TABLE 9. Results from the logistic mixed-effects regression analysis for production of utterance-final signs by adult homesigners and NSL cohort 1 signers.

PROXIMAL MOVEMENT. We examined whether proximal movements were used to differentiate signs produced in response to noun- and verb-target vignettes in each of the

four homesigners. The second set of columns in Fig. 10 above presents the data for the individual homesigners and shows that each of the four homesigners was more likely to produce a target sign with proximal movement in response to verb-target vignettes for iterable events, and three of the four showed this pattern for noniterable events as well. Figure 11 presents an example of a homesigner producing a proximal (large) movement in response to a verb-target vignette (PAINT) in which a man paints a single line of paint on a wall (top illustrations), and distal (small) movement only in response to a noun-target vignette (PAINTBRUSH) in which a man drops a paintbrush into a trash can.

FIGURE 11. An example of an adult homesigner producing a noun-verb pair distinguished by proximal movement. The verb-target sign, PAINT (top), is articulated with movement of the elbow joint, a proximal joint; the noun-target sign, PAINTBRUSH (bottom), is articulated with movement of the wrist, a distal joint.

To evaluate the statistical significance of this effect, we again applied a nonparametric test to each homesigner's data (data were collapsed over iterability for each individual in the analyses to increase power) and found that the pattern was reliable for homesigner B ($\chi^2 = 5.6384$, $p = 0.018$), marginal for homesigners C ($\chi^2 = 3.2834$, $p = 0.07$) and D ($\chi^2 = 3.4222$, $p = 0.06$), and not reliable for homesigner A ($\chi^2 = 0.8894$, $p = 0.35$).

We used a logistic mixed-effects regression with random effects for participant ($SD = 0.6597$) and stimulus item ($SD = 1.8370$) to compare the homesigners' responses to those of NSL cohort 1 signers. Table 10 provides the estimated coefficients, standard errors, and significance levels of the fixed effects. We found an effect of word class ($\beta = -1.7778$, $p = 0.000437$), no effect of iterability ($\beta = -0.6343$, $p = 0.097712$) or group ($\beta = 0.1357$, $p = 0.797467$), and no interaction between word class and language group ($\beta = -0.1533$, $p = 0.758478$). Both homesigners and NSL cohort 1 were more likely to produce a sign with a proximal movement in response to verb-target vignettes (vs. noun-target vignettes).

MOVEMENT REPETITION. We next asked whether the four homesigners differentially used repetition of movement to distinguish their responses (third set of columns in Fig.

	β	*SE*	*z*	*p*	
(intercept)	0.4608	0.5484	0.840	0.400780	
Word class	−1.7778	0.5055	3.517	0.000437	***
Iterable	−0.6343	0.3830	−1.656	0.097712	
Cohort 1	0.1357	0.5288	0.257	0.797467	
Word class * Cohort 1	−0.1533	0.4985	−0.307	0.758478	

TABLE 10. Results from the logistic mixed-effects regression analysis for production of signs with a proximal joint movement by adult homesigners and NSL cohort 1 signers.

10). Three of the four homesigners produced target signs with repetition more in response to noun-target vignettes with iterable associated actions; homesigners rarely used repetition for vignettes with noniterable associated actions. Figure 12 presents an example of a homesigner using movement repetition to distinguish his responses to a noun-target vignette of a man dropping a camera into a trash can (CAMERA, right illustration) and a verb-target vignette of the man pushing down on the button of a camera a single time (TAKE-PICTURE, left illustration).

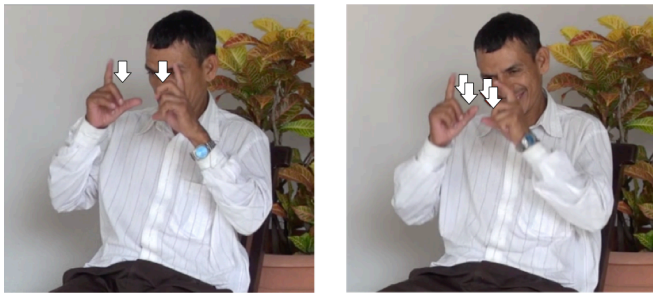

FIGURE 12. An example of an adult homesigner producing a noun-verb pair distinguished by repetition of movement. The verb-target sign, TAKE-PICTURE (left), is produced with a single movement; the movement of the noun-target sign, CAMERA (right), is repeated.

To evaluate the statistical significance of this pattern, we applied nonparametric statistics to each individual's data (data are collapsed across iterability to increase power), but found that the pattern was not reliable for any of the homesigners (all *p*s > 0.05): Fisher's exact test statistic = 0.7605 for homesigner A, 1.00 for homesigner B, 0.2962 for homesigner C, and 0.0844 for homesigner D (marginal effect).

We again compared the four homesigners to the signers who were the earliest members of the Deaf community (NSL cohort 1) by using a logistic mixed-effects regression with random effects for participant (*SD* = 0.2246) and stimulus item (*SD* = 0.8540). Table 11 provides the estimated coefficients, standard errors, and significance levels of the effects. We found a significant effect of iterability (β = −1.9251, $p < 0.001$): both groups were more likely to use movement repetition with iterable events than with noniterable events. We also found a marginal effect of word class (β = −0.7861, $p = 0.0754$; both groups tended to produce more repetition in response to noun-target vignettes) and a marginal effect of language group (β = 0.6618, $p = 0.0548$; cohort 1 signers tended to use more repetition overall than homesigners).

BASE HAND. Finally, we examined use of a base hand in signs produced in response to noun- and verb-target vignettes in the four individual homesigners. All four homesigners were more likely to produce a base hand in response to verb-target vignettes than to noun-target vignettes for iterable events; homesigners rarely produced a base hand for noniterable events (see fourth set of columns in Fig. 10). Figure 13 presents an example of a

	β	*SE*	*z*	*p*	
(intercept)	0.1974	0.3351	0.589	0.5559	
Word class	−0.7861	0.4421	−1.778	0.0754	
Iterable	−1.9251	0.2987	−6.445	1.16e-10	***
Cohort 1	0.6618	0.3446	1.921	0.0548	
Word class * Cohort 1	0.7304	0.4621	1.581	0.1140	

TABLE 11. Results from the logistic mixed-effects regression analysis for production of signs with repetition of movement by adult homesigners and NSL cohort 1 signers.

homesigner producing a base hand in his response to a verb-target vignette (left illustration, CUT-WITH-SCISSORS, describing a man using scissors to cut a piece of paper a single time) but not in his response to the corresponding noun-target vignette (right illustration, SCISSORS, describing a man dropping a pair of scissors into a glass of water).

FIGURE 13. An example of an adult homesigner producing a noun-verb pair distinguished by the use of a base hand. The verb-target sign, CUT-WITH-SCISSORS (left), is produced with a base hand (representing the object of the event, paper); the noun-target sign, SCISSORS (right), does not incorporate a base hand.

To evaluate the reliability of this effect, we applied a nonparametric test to each homesigner's data (data were collapsed over iterability to increase power), but found that the pattern was reliable in none of the homesigners: Fisher's exact test statistic = 0.2329 for homesigner A, 1.00 for homesigner B, 0.6199 for homesigner C, and 1.00 for homesigner D.

Again we compared the four homesigners to the signers who first formed the Deaf community. We used a logistic mixed-effects regression with random effects for participant (*SD* = 1.072) and stimulus item (*SD* = 2.187). Table 12 provides the estimated coefficients, standard errors, and significance levels of the fixed effects. Both groups used a base hand more often for iterable than noniterable events (β = −4.5522, $p = 0.000167$). Moreover, in the model comparing NSL cohort 1 and homesigners, there is a significant effect of word class (β = 2.5844, $p = 0.005417$) but no effect of group (β = −0.2718, $p = 0.746957$) and no interaction between word class and group (β = −0.8788, $p = 0.278567$); both groups tended to use a base hand more often in response to verb-target vignettes.

	β	*SE*	*z*	*p*	
(intercept)	−1.5772	0.8501	−1.855	0.063530	
Word class	2.5844	0.9293	2.781	0.005417	**
Iterable	−4.5522	1.2095	−3.764	0.000167	***
Cohort 1	−0.2718	0.8424	−0.323	0.746957	
Word class * Cohort 1	−0.8788	0.8110	−1.084	0.278567	

TABLE 12. Results from the logistic mixed-effects regression analysis for production of signs with a base hand by adult homesigners and NSL cohort 1 signers.

6. Discussion: emergent lexical category distinctions. We conducted three studies to explore how sign languages, both established and emerging, signal the distinction between signs for objects (nouns) and signs for actions (verbs). We developed a paradigm to elicit forms that share the same stem and thus have the potential to vary systematically in sign form when used as a label for an object (noun target) versus a related action (verb target). In study 1, we used this paradigm to elicit noun-target and verb-target responses from signers of an established language, ASL, and found that they distinguished noun signs from verb signs using utterance position, movement size, and movement repetition, thus replicating previous research (e.g. Supalla & Newport 1978).

In study 2, we used the paradigm to examine the noun-verb distinction in an emerging language, NSL. We found that NSL signers, regardless of their year of entry at the deaf school, used utterance position and movement size to distinguish nouns and verbs. However, we also found evidence that two additional markers of the noun-verb contrast are more systematic in younger signers of NSL (i.e. more recent entrants into the Deaf community): movement repetition (nouns) and base hand (verbs). Both of these findings suggest that intergenerational transmission plays a unique role in language development and that transmitting a system to new generations of learners might be essential in order for certain properties and patterns to conventionalize (see §6.2 for discussion of other evidence in support of this). In addition, we found evidence that iterability plays a significant role in utterance position, repetition, and the presence of a base hand, though it is nondifferential with respect to the noun-verb contrast. The significant effect of iterability in these parameters may be evidence of the prominence of iconicity in an emerging system like NSL.

Finally, in study 3, we used the paradigm to examine the noun-verb contrast in adult Nicaraguan homesigners, whose linguistic experience bears certain similarities to that of NSL cohort 1 signers, who entered the community at its inception, before there was a language to be learned. Homesigners use their idiosyncratic communication with hearing individuals around them, who do not fully share the homesign system (Goldin-Meadow & Mylander 1983, 1998, Flaherty et al. 2016, Carrigan & Coppola 2017); homesigners thus primarily use their system to produce, not receive, information. Nevertheless, the system innovated by each of the homesigners in study 3 distinguishes target signs in response to noun- and verb-target vignettes. All of the homesigners used utterance position, and some used movement size, to distinguish nouns from verbs. Homesigners displayed a tendency to produce more movement repetition on nouns than on verbs, and more base hands on verbs than on nouns, but neither of these patterns was statistically reliable at the level of the individual homesigner (although there was a statistically reliable effect for base hand when homesigners and NSL cohort 1 signers were analyzed together). Together, studies 2 and 3 make it clear that (unsurprisingly) sharing a communication system with others fosters increased conventionalization but also that intergenerational transmission to new learners is an essential component of a language's development. In the sections that follow, we consider the implications of our findings, as well as directions for future research.

6.1. Is the distinction between nouns and verbs a fundamental property of human communication? Homesigners offer a unique opportunity to test hypotheses regarding the innate properties of human communication and the linguistic system. Because homesign is an idiosyncratic system developed in the absence of conventional language input, systematic properties present in homesign reflect the properties with

which humans must come 'preequipped' to incorporate into their eventual communication systems, including language. As discussed earlier, the distinction between lexical categories like nouns and verbs may be a fundamental property of human language (although, as also noted earlier, this fact does not entail that the property resides in the lexicon itself). The homesigners in our studies differentiate labels for objects and actions (as do the other language groups), but is the distinction we have documented really between nouns and verbs? Conceptual distinctions are not sufficient evidence for grammatical categories. Rather, it is the role that a word or sign plays within the linguistic system that determines whether it functions like a noun or verb (e.g. the word *walking* in the utterance 'walking is good for you' functions like a noun even though it refers to an action because it occupies a syntactic slot reserved for nouns). However, this is exactly the nature of our results. Each of the four homesigners in study 3 systematically places their object and action labels in different positions in the utterance and frequently combines these labels with different formational markers. Although homesigners lack conventional linguistic input, they still have the same morphological and syntactic capacity with which all humans are genetically endowed, and the patterns we observe are entirely analogous to the morphosyntactic differences that are the hallmark of grammatical category distinctions.

Research with a single child homesigner in the US confirms that the conceptually grounded differences we observe are mapping onto linguistic differences in grammatical category. Goldin-Meadow and colleagues (1994) classified the child's gestures following Sapir (1921): nouns were considered to be the focus or subject of the discourse, and verbs to be the predicates of the discourse. Thus, if the homesigner used a gesture to focus attention on an entity, it was coded as a noun; if he used the gesture to say something about that entity (i.e. to predicate something of the entity), it was coded as a verb. They found that the child initially distinguished nouns from verbs through the use of nonoverlapping gesture inventories for these two concepts; that is, one set of gestures functioned as nouns, another as verbs. As the homesigner aged (after 3.25 years), he began to use similar gestures in both grammatical roles and, as in conventionalized languages, distinguished nouns from verbs in both distribution and form: gestures functionally categorized as nouns tended to be abbreviated, while those functionally categorized as verbs tended to make use of meaningful spatial location and movement. When produced in a multigesture utterance with a separate pointing gesture referring to the same object, gestures categorized as nouns tended to precede the point (i.e. the point functioned akin to a determiner), while those categorized as verbs tended to follow the point (i.e. the point functioned akin to an argument).

In a more recent analysis, Hunsicker and Goldin-Meadow (2012) found that predicate nominal gestures ('drum' in *that's a drum*) also tended to follow pointing gestures (like other predicates; 'beat' in *that beat*, used to describe beating a drum) but that complex multigesture nominal constituents ([*drum that*] *beat*) do NOT exhibit within-constituent ordering preferences ('drum that' and 'that drum' were comparably common in this type of utterance), similar to the word-order flexibility attested in nominal constituents of established sign languages (and in many spoken languages). Finally, gestures categorized as nouns playing a patient role tended to precede those categorized as verbs playing an act role when gestures of both types cooccurred in an utterance (*drum beat*), as would be expected given that patient-act order predominates in homesign (Goldin-Meadow & Mylander 1984b, 1998).

To determine whether these functionally, formationally, and distributionally distinguished categories were truly nouns and verbs (as opposed to labels for objects and ac-

tions), Goldin-Meadow and colleagues (1994; see also Goldin-Meadow 2004) further explored the contextual conditions in which the homesigners' gestures were produced and found that, when gestures were coded as nouns, they 'looked like' other nouns in terms of form; when they were coded as verbs, they looked like other verbs. Conceptual information alone (e.g. contextual presence of an action or object) did not predict these form properties (or gesture behavior); classification as noun or verb did. Thus, it is the grammatical notion of noun versus verb that better explains patterns in the homesigner's gesture.

An alternative approach to the question of whether the conceptually grounded differences we observe are mapping onto linguistic differences in grammatical category is to follow a suggestion made by Goldin-Meadow and colleagues (2015) that silent gestures—the gestures produced by hearing individuals when asked on the spot to describe events without speech—reflect heuristics for communicating information in a structured manner but, because they are developed on the fly, do not reflect a linguistic system. Silent gesture is not isomorphic to an individual's spoken linguistic system (Gershkoff-Stowe & Goldin-Meadow 2002), nor do the gestures themselves constitute an independent linguistic system, though certain language-like properties have been found in silent gesture (see Goldin-Meadow et al. 1996, Gershkoff-Stowe & Goldin-Meadow 2002, Goldin-Meadow et al. 2008, Meir, Lifshitz, et al. 2010, Hall et al. 2013, Futrell et al. 2015, Özçalışkan et al. 2016, among others). However, silent gesture does NOT exhibit all of the properties of natural language, or even all of the properties displayed by homesigners (see, for example, Brentari et al. 2012; for discussion, see Goldin-Meadow 2015). Future work could determine whether (and how) silent gesturers distinguish between nouns and verbs. If silent gesturers make this distinction, then the differences we have found need not reflect a linguistic system (although they still could be embedded within a linguistic system in homesigners and signers). In contrast, if silent gesturers fail to distinguish nouns and verbs, we would have suggestive evidence that the distinctions reflect grammatical (as opposed to merely conceptual) distinctions.

6.2. THE CONTRIBUTION OF TRANSMITTING AND SHARING A COMMUNICATION SYSTEM. As highlighted earlier, the distinction between nouns and verbs may be a fundamental property of human language. Indeed, our studies show that this distinction (qua objects and actions) is so integral to human communication that it can emerge in systems developed without the benefit of conventional linguistic input (homesigners, early users of NSL), even when those systems are idiosyncratic, one-way means of expressing (but not receiving) information (homesigners). However, the participants in our studies also include individuals whose backgrounds and experiences reflect more 'typical' language acquisition and usage scenarios. Both ASL signers and users of NSL who entered the community in more recent years have the familiar linguistic profile of users of an established language: their linguistic system is shared with a community and was acquired as a consequence of early childhood exposure (even if that exposure came from older students, not family members). Thus, comparison across the language groups in our studies offers insight into how fundamental properties like the noun-verb contrast become further entrenched and grammaticalized within the linguistic system, and how factors like transmission influence this process.

We found that all signers, including homesigners and signers who entered the Deaf community in its early years, used utterance position and movement size to distinguish between nouns and verbs. However, only ASL signers and NSL signers who entered the Deaf community more recently (when there was a language model to learn from) used movement repetition (ASL, NSL); moreover, NSL signers who entered the community

later made more systematic use of the base hand as a marker of this distinction, although the distinction was present in homesigners and NSL cohort 1 signers (see Table 12). As noted earlier, these findings suggest that transmitting a communication system to a new set of learners may be essential for these devices to systematize as a marker of the noun-verb distinction. Intergenerational language transmission has been observed to play a key role in other areas of the grammar. For example, Senghas and colleagues (1997) found that NSL cohort 1 signers, like adult homesigners (Coppola & So 2005), do not display stability as a group in certain linguistic uses of space, but that across-subject consistency is present in NSL cohort 2 signers. Thus, the grammatical system does not 'come on-line' all at once but instead continues to develop as the language is transmitted across generations. Indeed, the rich discipline of historical linguistics shows that even 'established' languages continue to develop (and change) as they are transmitted to new generations of learners.

Note that homesigners and NSL signers who entered the community early did not differ in their uses of any of the devices studied here; that is, there were no significant effects of language group in Tables 9–12. Our findings thus make two points: (i) grammatical patterns such as the marking of the noun-verb distinction can emerge in an isolated communication system (homesigners), and (ii) sharing a communication system with others may not significantly affect all grammatical devices; rather, intergenerational transmission may play an essential role in certain areas of grammaticalization.

6.3. Iconicity and grammaticalization. Using sign form to distinguish nouns from verbs is common across sign languages. Moreover, many of the devices used to mark the distinction are similar across sign languages (see Table S1 in the supplementary materials), including several of those studied here. How do we explain these crosslinguistic similarities? Aronoff and colleagues (2005) suggest that the morphology of emergent sign languages has iconic origins. Indeed, given that sign languages emerge from homesign, it would be difficult to imagine a situation in which the initial stages of an emerging sign language were not grounded in iconicity. For example, verbs may tend to be produced with large movements of the proximal joints because they grow out of large enacted and embodied action signs (Kimmelman 2009). Our data provide ample evidence that iconicity of this type is present even at the earliest stages of language emergence, as both homesigners and early users of NSL produce verb signs with large proximal movements. Thus, our results also offer further insight into the role of iconicity in the development of a linguistic system.

For example, although not previously documented as a formational marker of the noun-verb distinction in sign languages, the differential role of the base hand may have roots in iconicity. Verbs, as discussed earlier, may be more likely than nouns to use a base hand because the base hand iconically represents an argument of the event denoted by the verb (though the morphosyntactic status of this base hand 'argument' is beyond the scope of the present research). Recall that the base hand was not reliably used to distinguish nouns and verbs in individual homesigners and that NSL signers who entered the community at its inception did not use this marker as reliably as those who entered the community later (although the distinction was present when homesigners and NSL cohort 1 signers were analyzed together; Table 12). Thus, despite its potential grounding in iconicity, the base hand as a verbal marker is robustly systematic primarily in later stages of a language's development. This finding confirms what sign language researchers have long intuited: iconicity is not at odds with the linguistic status of sign languages. Rather, it is part of the linguistic system and, as such, is subject to the multifaceted forces of conventionalization.

Conventionalization of the linguistic system includes not only 'picking' which distinctions are grammatically relevant, but also determining how these distinctions are grammatically marked. If the noun-verb contrast is indeed universal, languages may not have the option of not 'picking' this distinction as part of the grammar, but how the distinction is manifested will still be a matter of variation and conventionalization. The differential use of the base hand conventionalizes over time in NSL and may not be conventionalized at all in ASL (ASL made little use of the base-hand function of the nondominant hand in general). This is further evidence for another long-standing observation about iconicity: it is not deterministic, and the presence of iconicity does not entail similarity. Although modern linguistics has at its foundation the observation that human languages are remarkably similar to one another, languages do vary. Language variation is not a modality-specific phenomenon; sign languages vary not only from spoken languages, but also from one another. Using the base hand as a formational means of distinguishing verbs from nouns may be one such locus of crosslinguistic variation. When Supalla and Newport (1978) identified the systematic differences between nouns and verbs in ASL, they were countering earlier claims that these categories are not formally different in the language (Stokoe et al. 1965). Researchers, confronted with the task of linguistic analysis in a new modality, had overlooked the differences between nouns and verbs because they were not yet aware of the relevant grammatical parameters of sign languages. Decades of research have significantly improved our understanding of sign languages, but it is almost certain that our analyses are still limited by ignorance (as is true in the analysis of spoken languages as well). Uncovering the grammatical role of the base hand in NSL 'puts it on the table' as a pattern to look for in other sign languages, and future work may reveal that NSL is not alone in using the base hand to signal grammatical category.

Future research should also investigate another possible source for this crosslinguistic variation: the gestural 'substrate' of sign languages. The relative absence of the base-hand function in ASL may stem from differences in the co-speech gestures used by hearing individuals in the United States (and France, given ASL's historical relation to French Sign Language, LSF) versus Nicaragua. Ambient co-speech gesture is accessible to deaf individuals and may be incorporated into and grammaticalized in their sign system (Frishberg 1975, Zeshan 2000, Janzen & Shaffer 2002, Coppola & Senghas 2010, Franklin et al. 2011). Studying co-speech gestures of hearing individuals in the United States and Nicaragua would shed light on this possibility and would complement the study of silent gesture proposed in §6.1.

Another parameter that reveals the interaction of iconicity and language development is the use of repetition to mark nouns, a phenomenon that parallels nominalizing usages of reduplication. Although reduplication is also often used iconically (e.g. intensification, pluralization), we follow Kouwenberg and LaCharité (2003) in classifying the use of reduplication to mark or change lexical category as a noniconic function, as it goes beyond using 'more of the same form [to stand] for more of the same content' (Kouwenberg & LaCharité 2003:8). The use of movement repetition to mark nouns appears, on the surface, to run counter to the principle of iconic emergent morphology. Although the use of movement repetition to mark nouns may not itself be iconic, this device may still have its origins in iconicity. Power issues prevented us from statistically assessing the potential role of iterability in ASL. However, in both NSL and homesign, there was a significant main effect of iterability in three of the four parameters studied (utterance position, movement repetition, base hand). Thus, iterability of the associated action is a salient

property for users of these systems. Moreover, iterability may play a role in the use of repetition as a noun marker. Here too our data are insufficient for statistical analysis (models including an interaction between iterability and word class in NSL did not converge), but NSL cohort 1 signers (Fig. 6, third columns) did use more repetition on nouns than verbs if the associated action was iterable; they showed no discernible difference for noniterable events. Furthermore, although the pattern was not statistically reliable, three of the four homesigners used more repetition on nouns than verbs for iterable events (Fig. 10, third columns); homesigners rarely used repetition at all for noniterable events. Thus, the use of repetition to label objects (nouns) may be iconically linked to the iterability of the actions associated with those objects. Putting together the present findings with previous research may finally explain the mysterious and pervasive pairing of this device (repetition) with this function (lexical category marking) in (sign) language (in addition to the observation that nominalization is a crosslinguistically common 'noniconic' function of reduplication). What is important to keep in mind, however, is that while the raw material for this distinction may be iconic, it is reorganized and used in arbitrary ways. If repetition remained anchored to iconicity, we might expect it to appear only on verbs as an expression of iterability or actual iteration (as it also does; Fischer 1973). Instead, the repetition also seems to serve this more arbitrary function of signaling grammatical category. Interestingly, exactly this developmental pattern is arguably at play in the genesis of pidgin and creole languages (see contributions to Kouwenberg 2003). Reduplication is robustly attested in creole languages but not in earlier pidgin stages, where it may be unattested or limited to frozen forms or select, adverbial meanings. Moreover, research on creole languages also suggests that noniconic uses of reduplication, including to mark or change category, may be later developments in language genesis. Finally, the trajectory away from iconicity (and toward system-internal consistency) mirrors patterns of historical change documented elsewhere in sign languages (Frishberg 1975, Kegl & Schley 1986).

At this juncture, it is worth noting that repetition for grammatical purposes (reduplication) appears to be a property of language writ large, an observation that Kouwenberg (2003) dates back to at least Pott 1862. All documented languages make some use of reduplication in their grammatical systems (Inkelas & Zoll 2005), and the use of meaningful repetition is a preferred feature of language design (Berent et al. 2016). Given the pervasiveness of reduplication in the grammars of human language, it is not surprising that repetition exhibits some of the earliest evidence of grammaticalization in NSL. However, there is an even more significant conclusion to be drawn from the development of repetition as a nominal marker: it is an example of emergent sign systems developing exactly the linguistic properties that we see in language after language. That is, what is emerging in Nicaragua is not just systematic; it is familiar. It is language.

7. Conclusion. We have found that making a distinction between nouns (labels for objects) and verbs (labels for actions) is so fundamental to human language that it emerges in communication systems innovated without the benefit of a conventional language model. Neither homesigners nor NSL signers who entered the Deaf community at its inception experienced language input, nor do the homesigners share their communication system with other users. Nevertheless, this distinction is present and marked in both groups. Moreover, although there is variation in the particular devices that sign languages around the globe use to mark the noun-verb distinction, there is also remarkable crosslinguistic similarity. Here, too, we found some of the same devices in all of the lan-

guage groups we studied—sign distribution (utterance position) and movement size marked the noun-verb distinction in ASL (an established sign language), successive stages of NSL (an emerging sign language), and homesign (the precursor to NSL).

However, there were also patterns of variation across these language groups. This variability informs our typological understanding of (sign) language and offers unique insight into how the noun-verb distinction emerges and develops. Although a noun-verb contrast can emerge in the absence of language input and a community of users, these factors affect how that contrast is grammatically encoded. Movement repetition and base hand were used by homesigners and NSL cohort 1 signers primarily when describing iterable events. In later developmental stages (NSL cohorts 2 and 3), these properties are reliably used to distinguish nouns from verbs and there is no evidence of iterability playing a differential role. In addition to being general evidence for conventionalization and grammatical development, these findings suggest that transmitting a communication system to a new generation of learners may be essential for a device to go beyond its iconic roots. Our results thus bear not only on how grammatical distinctions emerge and continue to develop in a new (sign) language, but also on the origins of certain patterns of similarities and differences across languages, more broadly construed.

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Abner
Linguistics Department
440 Lorch Hall, University of Michigan
611 Tappan Ave.
Ann Arbor, MI 48109
[nabner@umich.edu] (Abner)
[mflaher1@swarthmore.edu] (Flaherty)
[kmstangl@gmail.com] (Stangl)
[marie.coppola@uconn.edu] (Coppola)
[dbrentari@uchicago.edu] (Brentari)
[sgm@uchicago.edu] (Goldin-Meadow)

[Received 9 December 2017;
revision invited 2 March 2018;
revision received 1 July 2018;
revision invited 12 August 2018;
revision received 30 October 2018;
accepted 26 November 2018]