Productive reduplication in a fundamentally monosyllabic language

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Abstract

The question to be addressed in this paper is how a language which is fundamentally monosyllabic in structure can have about a dozen different reduplication types with at least eight different linguistic functions. The language under discussion, American Sign Language (ASL), is one representative of a class of languages that makes widespread use of reduplication for lexical and morphological purposes. The goal here is to present the set of phonological features that permit the productive construction of these forms and a first approximation to the feature geometry in which they participate. Reduplication forms are dependent on the event structure of the predicate and the associated aspectual modifications.

Keywords

Aspect; Event structure; Feature geometry; Phonology; Reduplication; Sign language

1. Introduction

When talking about reduplication in spoken languages, the phonological pieces that can be repeated generally include consonants (and clusters), vowels, and syllables (whole/total reduplication may consist of a morpheme/word consisting of multiple syllables; Wilbur, 1973). Copying of sub-segmental features (one or more distinctive features that do not constitute an entire segment, e.g., place or manner specifications) may also be possible. In an essentially monosyllabic language, then, one might expect reduplication of syllables to create two-syllable forms, and rarely triplication to create a three-syllable form, but not beyond. Another expectation might be partial reduplication and modified forms along the lines of *shm*-reduplication, shown in (1) for English and in (2) for Hindi (Grohmann and Nevins, 2004):

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(1)     Money, shmoney, who needs it anyway?
(2)     mãi   paan-vaan     nahiin    khaataa     huuN
        I     paan-ECHO     NEG       eat-IMPF    AUX.1.PRES
        'I don't eat paan or other such things.' [Hindi]
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Looking at reduplication in sign languages reveals a number of creative options that permit a wider range of possible forms, each of which is distinct enough to be assigned a morphemic function. To begin with, the vast majority of lexical signs in ASL and other sign languages

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(SLs) studied to date are monosyllabic. A well-formed syllable in a sign language must have *movement* (Brentari, 1998), that is, a change of something: hand-shape configuration (HS), orientation (O), place of articulation (POA), or location (LOC). Reduplication then is the repetition of that change, e.g., that syllable. One interesting observation is that ASL uses both two-syllable and three-syllable reduplications, but makes no further distinction with respect to number of repetitions. Thus frequently occurring four or five repetitions do NOT mean anything distinct from three.[1]

It is not clear that it makes sense to talk about partial vs. full reduplication in SLs. Partial reduplication requires the ability to copy (a) a single syllable of a multisyllabic word or (b) a portion of a syllable but not the whole syllable. Regarding possibility (a), in SLs, the majority of lexical items are monosyllabic, thus copying is repeating the whole word. Those signs that are lexically disyllabic repeat both syllables when reduplicated, so copying of them is full reduplication as well. Under option (b), copying only a part of the sign configuration, for example only the handshape or location or orientation, for partial reduplication is impossible, because none of these can occur without the others and the movement as well. Furthermore, the 'money–shmoney' type partial reduplication cannot occur because substitutions of handshapes, locations or orientations (consonant equivalents; Brentari, 1998) are very often phonemic. As a result, only full reduplication seems to be productive in SLs. Having said this, it is quite remarkable then that such a large variety of options remain available.

2. History of research on reduplication in ASL and other SLs

The earliest work on ASL reduplication Fischer (1973) identified 'fast' and 'slow' reduplication and categories of verbs [+/−stative] and [+/−durative] (for non-stative verbs). She correlated [slow] reduplication with 'continuation of some kind' and noted that a rocking movement contributed the meaning 'excessive'. Similarly, she found a correlation between [fast] reduplication and habitual (i.e., iterations over time). Finally, Fischer was the first to identify the collective plural morpheme, phonologically [arc] movement; in her system, it fell out naturally as [+ horizontal movement, − reduplication] and could not be disrupted by iterations that would destroy the collectivity of its meaning. Hence, it stands in opposition to the 'distributive', which requires the movement to stop at distinct points in space along the arc.

Klima and Bellugi (1979) further identified formational features that could be combined to create different modulation templates that apply to both adjectival predicates and verbal predicates. In their analysis, they refer to formational terms such as Planar locus (whether the form is horizontal or vertical), Cyclicity (whether the form is repeated or not), Direction (whether the movement is e.g., upward or downward), Geometric array (whether the movement is a straight line, arc, circle or other arrangement), Quality (whether the movement is small or large), and Manner (whether the movement is continuous, hold or restrained). Thus, in their system, each morphological function (e.g., Iterative, Durative) involves a template composed of some of the available relevant formational features (Fig. 1). However, the choices of feature combinations in each template are not explained.

Anderson (1982) reanalyzed these treatments, starting with a different verb categorization: punctual vs. durative/stative, which led him to observe a similarity with reduplication in Micronesian. In particular, in Micronesian, the Continuous form has open syllables (CV-), whereas Iterative and Perseverative have closed syllables (CVC-). In ASL, the durative/stative (Continuous) has no clear division between one stroke and the next, whereas the equivalents

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[1]If additional DPs (QP with numeral quantifiers or pronouns using the non-dominant hand fingers for listing up to five referents) are present, it might be possible to construct meaningful four or five repetition forms, but then the repetition comes from the quantification inside the argument and not from aspectual specification.

of Micronesian Iterative and Perseverative Punctual have a clear stop before returning to repeat. Klima and Bellugi refer to this stop as 'end-marked'.

Wilbur et al. (1983) explored the interaction of different types of reduplication. One important distinction they observed was the separation of modifications for verbal aspect and for argument characteristics. Modifications that affect the temporal (rhythmic, dynamic) formation of the sign reflect aspect, whereas spatial modifications (layout, geometrical shape, horizontal vs. vertical plane) reflect argument information. They also observed that 'embeddings' were possible, for example, distributive (multiple points in space) could embed in iterative (slow rhythmic repetition) to give a meaning such as 'give X to each Y iteratively over time'. However, such embeddings were constrained by semantics and by morphophonology in such a way that the integrity of the form of one could not be disrupted by another (that is, a FAITHFULNESS constraint). Thus, for example, an end-marked form could not embed in the durative or continuative because these forms are smooth and they would be obscured by interruptions from end-marking.

In Wilbur (2003, 2005, 2008c), I argued that the source of end-marking is the presence of the final State in telic events. In fact, the structure of both base and reduplicated forms can be seen to reflect the semantic components of which they are composed, in particular, the event structure. In predicates there is a motivated mapping between meaning components and their phonological forms, such that single-sign predicates are compositionally multimorphemic. Furthermore, the meaning of the constructed reduplicated form is a direct result of the contributions of each of the semantic components. This is the Event Visibility Hypothesis for ASL (and presumably other SLs):

(3) Event Visibility Hypothesis (EVH): In the predicate system, the semantics of the event structure is visible in the phonological form of the predicate sign.

I turn now to a brief overview of the relevant event structure and its mapping to phonological form using the Prosodic Model of ASL (Brentari, 1998). Once the phonological options are clear for the base, we can turn to the options for reduplication.

3. Event structure

For our purposes, I will use a simplified event structure model, extended slightly from Pustejovsky (1991, 1995, 2000).[2] In his system, events are composed of sub-events of two types: static (S) and dynamic process (P) (Table 1). Atelic events are composed of a single basic sub-event, either P or S. Telic events are collectively referred to as Transitions and are composed of a transition between two non-identical sub-events. Achievements, as changes of state, are composed of the transition between two non-identical S elements ($\neg S \rightarrow S$), the two being related semantically by the fact that one is necessarily the negative of the other. For example, 'die' is an Achievement event with the initial state 'not dead, alive' and the final state 'dead, not alive'. Accomplishments are composed of a dynamic P element transitioning to a final S ($P \rightarrow S$). With this system it is possible to capture the basic distinction [+/−homogeneous]: S and P are [+homogeneous] and all T events are [−homogeneous] (Bertinetto, 2001).

As already mentioned, the final State of Transitions (telic events) is visible in ASL predicate signs in the form of end-marking. In fact, motion capture data confirms that this perceived end-marking is the result of one and a half to two times steeper deceleration at the end of telic signs as compared to atelic signs (Wilbur and Malaia, 2008a,b). One extension to Pustejovsky's model is to recognize that for each State in an event, there must be a holder of that state; thus there are final State arguments (Resultees/Beneficiaries/Goals, Ramchand, 2008; Grose,

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[2]For a more complete event structure model in a feature geometry framework, see Grose (2008).

2008) associated with each point in space where the telic sign stops. Other arguments may include the Holder of the initial State, the Initiator and Undergoer of the Process, and the Causer/Force of an event. For now, the presence of end-marking is both an indicator of telicity and a reference to an argument.

4. Phonological form of the base of lexical predicate signs in ASL

In Brentari's (1998) Prosodic Model, she posits a Prosodic Features (PF) branch for features that change during the formation of a sign, as opposed to the Inherent Features [IF] branch for those features that persist throughout the sign. These PFs represent the movement in ASL signs and require specification of at least two phonological timing slots (*x*-slots).

4.1. Telic events

Starting with the simplest case of change of state Achievements, predicate signs are made with a change of handshape, orientation, or setting such that the final configuration is the opposite of the initial configuration. This means that the configuration on the first *x*-slot is different from that of the second *x*-slot, a requirement for all telic event predicates.

To illustrate, consider the case of orientation change. Its features are expressed in the PF branch: [supination], [pronation], [flexion], [extension], and [abduction]. [supination] is rotation from palm down to its opposite – palm up. [pronation] is rotation from palm up to its opposite – palm down. [flexion] is rotation from wrist straight to its opposite – wrist bent. [extension] is rotation from wrist bent to its opposite – wrist straight. [abduction] is side-to-side rotation, which does not involve opposition and to my knowledge does not occur in any telic predicate signs. In Fig. 2 are three examples of Achievement predicate signs, showing [extension] in GIVE-UP, [pronation] in HAPPEN, and [supination] in START. Each has a starting position and an ending position and no path movement in between. Using the prosodic features, Brentari is able to capture repetition of the entire movement with one feature [repeat]. Thus, 'to give up repeatedly' would consist of the IF specifications for handshape and place of articulation (POA) and the PF features [extension] and [repeat]. Below we will consider other options and constraints on such repetition.

Handshape change works similarly; in Brentari's model, it is change of aperture, owing to the observation that what changes is only whether the shape is open or closed. Like orientation change, IF specifies the initial handshape, and the PF feature [open] or [closed] specifies the aperture change. Fig. 3 shows the ASL sign SEND.

The next possibility for simple Achievement structure is change of setting, which Brentari (1998, p. 151) defines as movement between two values within a plane in which the articulator can move. There are three pairs of features relevant to the setting value: [top]–[bottom], [distal]–[proximal], and [contra(lateral)]–[ipsi(lateral)]. The frontal (front–back) plane has the relevant features [contra]–[ipsi] and [top]–[bottom]. The horizontal (top–bottom) plane has the relevant features [distal]–[proximal] and [contra]-[ipsi]. The midsaggital (left–right) plane has the relevant features [top]–[bottom] and [distal]–[proximal]. One observation about the lexicon of ASL is that these features are only contrastive when they convey semantic oppositions, such as up–down and left–right (Wilbur et al., 1983). Fig. 4 shows POSTPONE, which moves from [proximal] to [distal] (that is, two settings in the horizontal plane).

When we look at Accomplishments (P → S), an additional phonological option becomes available, namely change of location, or what is generally referred to as "path" movement. In such cases, the path movement is associated with the Process sub-event, and if the lexical meaning of the sign is *spatial*, then the path represents a path in space; otherwise it is interpreted only as the *temporal* unfolding of the Process event (Wilbur, 2005, 2008c). Grose (2008) refers

to the temporal option as [Extent] and the spatial option as [Path]. [Path] is lexically specified. [Extent] may be lexically specified or morphologically contributed, and may occur with or without [Path]. To avoid terminological confusion, I use Brentari's phonological features [direction] and [tracing]. The feature [direction] is a PF specification that indicates that the hand(s) move along a path and with contact at a body part or reference plane *perpendicular to the direction of movement*; when the contact is at the end of the movement, the feature is written [direction>|]. Morphologically this is P → S, the deceleration and contact being the same transition to final State as in the Achievement Transitions described above. Fig. 5 shows ARRIVE, the process of going along a path in a direction toward a goal/final State/location and then reaching that final State.

The same final State *x*-slots provide the basis for specification of points for *agreement* with verb arguments (*x*). Thus, the final *x*-slot of SEND (above Fig. 3) can be syntactically co-indexed with an antecedent individual. Given the absence of path movement in this sign, the hand is *oriented* toward the point denoting the co-indexed antecedent. With ARRIVE, the non-dominant hand may be co-indexed with an antecedent location (*l*) indicating where the arrival did/will/might take place; if so, it will be located at the point denoting that antecedent, and the dominant (moving) hand will move toward it (and make contact if it is a completed event). Given the lexical meaning of 'arrive' (necessarily involving change of location), the movement is interpreted as spatial [Path] as well as [Extent]. In contrast, POSTPONE (above Fig. 4) only takes events (*e*) as its internal argument, thus the phonological *x*-slots can only be mapped semantically to the time (*t*) of the event.

4.2. Atelic events

The next category involves the feature [tracing], which is PF path movement that does not involve contact with a body part or reference plane or any other phonological marking that could be interpreted as the End-State of the event. In this category, when the Process stops, the movement simply ceases (gradual deceleration to a stop rather than steep deceleration as for end-marking). An example of [tracing], further specified as having a [straight] shape, is given by RUN in Fig. 6a. The sign PLAY introduces 'repetition' (Fig. 6b); it is specified for [tracing] and short repeated movements, captured phonologically by [TM] 'trilled movement'. In the predicate system in ASL, [TM] is a morpheme referring to the 'passage of time without event change' (Wilbur, 2003). Put another way, PLAY is one homogeneous activity that *continues* over time, not the *repetition* (iteration) of a single event of 'play'.

States are another category of interest. As Klima and Bellugi (1979) observed, only changeable states are able to participate in aspectual modification. These States either have no PF branch, and hence no movement, or they have an empty PF branch, which is then the docking site of [TM] (Brentari, 1998). A morpheme with no PF consists of a representation in which only Inherent Features – a single handshape, POA, and orientation – are assigned to a single timing slot (for example, the sign SICK, Fig. 7). For such a form to appear as an independent sign, there must be physical movement with it, but such movement is 'transition' movement, that is, just getting the hand into position for the lexical morpheme and then moving away from that position (Brentari, 1998). Wilbur et al. (1983) argued that the addition of [TM] (which they called gemination) occurred when these light forms were in a prosodically heavy position and had not already combined with another form to create a compound or had not been aspectually modified by the addition of path movement or reduplication. Thus, unlike PLAY above, in which [TM] is lexically specified and reduces an existing [tracing] movement to short reoccurrences, in signs like SICK, which lack PF features, [TM] is a phonological modification for prosodic purposes. I use the term 'repetition' to refer to occurrences which are lexically or prosodically motivated, and reserve the term 'reduplication' for occurrences that serve derivational or inflectional morphological purposes.

4.3. Summary

To summarize, I have outlined event structure that has overt phonological consequences in the formation of ASL predicate signs. Telic events have clear markings of their end States, using changes of aperture, orientation, settings, and location, each of which involves a distinct feature specification for the final *x*-slot on the Prosodic Features branch of the tree. Atelic Process events have the path feature [tracing] and possibly [TM], and they cannot be marked for end State. States either have no PF branch, and hence no movement, or they have [TM]. Morphology uses these phonological pieces, along with points in space, to build durative, continuative, iterative, habitual, incessant, and other aspectual forms, which also involve reduplication. Given that these options are based on the physics and geometry of the real world and hence potentially universal, sign languages look more similar to each other than spoken languages do (Newport and Supalla, 2000).

5. Reduplication types and features

5.1. [repeat]

In all ASL reduplications, the Copy follows the Base. There are at least two pieces of evidence in support of this claim. One is the fact that it is the first occurrence that is stressed and unreduced, whereas subsequent copies are unstressed and may be progressively reduced compared to the base and possibly to preceding copies (Wilbur and Schick, 1987). The second is the indeterminacy of the actual number of copies. There are specific situations in which there is one copy (e.g., dual, deverbal nominals), but most reduplications have at least two copies (for a total of three occurrences of the base), if not more.

The relationship between Noun/Verb pairs in ASL was initially discussed by Supalla and Newport (1978), and with further elaboration in Brentari (1998). Typically, the V has a single long movement, and the N has a repeated short movement. Fig. 8 shows the verb form of SIT, which has a single movement to contact, and the related noun CHAIR, with repeated short movements to contact. Given that the eligibility for participation in such N/V pairs is highly constrained, it is not clear if the nouns have lexically specified repetition, the PF feature [repeat], or if there is a derivational process which adds [repeat] under as-yet-to-be determined semantic or other conditions. Nonetheless, it is obvious that the feature [repeat] is essential in the construction of reduplicated forms. Up to this point, other than the numerical indeterminacy, reduplication in ASL is exactly what we would expect based on spoken language simple Base-Copy reduplication. From this point on, the options available in ASL diverge sharply from those seen in spoken languages.

5.2. [return]

[return] is the linguistically specified movement of the hands back to the starting point of the base (Brentari, 1998 calls this [repeat: 180°]); note that this is not the transition movement between two signs but a 'within-word' movement (for evidence of within-word movement from backwards signing, see Wilbur and Petersen, 1997). Because the hands are always visible, each movement they make is seen, whether linguistic or not, and learners must learn to identify the difference. Lexical signs which have [return] as part of their specification, such as the sign DYE, are disyllabic (Supalla and Newport, 1978). There are two cues. One is that the [return] movement is the opposite of the initial movement. The other is that there is equal prosodic prominence on both movements, rather than just on the first movement (Wilbur and Schick, 1987). In the case of DYE, a downward movement is made, as if putting cloth into liquid dye, and an upward movement is made, as if removing the cloth from the dye. Making only the downward movement would be interpreted as 'putting something down'. When reduplicated, disyllabic signs end up with at least four movements, two for the base and two for each copy. Thus, for DYE, the sequence is down, up, down, up. All four have similar prosodic prominence.

The vast majority of lexical items in ASL are monosyllabic (Coulter, 1982). In order to reduplicate them, the hand must be moved back to its original position. For example, if the lexical movement is change of hand-shape, e.g., from [closed to open] as in the sign SEND above, then the hand must return to the closed position again before the [closed to open] movement can be repeated. The prominence pattern for such a form is: strong ([closed to open]), weak (return to closed), strong ([closed to open]). This form has one Base, a return, and one Copy – in total, it has three syllables. But this is just the beginning.

5.3. Digression 1: number of repetitions and argument number

Returning to the event structure discussion above, and the observation that each telic event has a final State with an associated argument/holder of that State, and that SEND would orient toward that argument (as previously established in discourse by an antecedent), our three-syllable form can be made in a variety of ways. If we have a situation with two different recipients of whatever is being sent, their locations in space will have been made distinct when they were introduced into the discourse; let us refer to these locations as loc_i and loc_j. If the three-syllable form is made with the Base oriented at loc_i and the Copy oriented at loc_j, the form means 'send to two people/dual', that is, to send something to $person_i$ and something (presumably an identical member from the same set of things being sent, e.g., letters, checks) to $person_j$. We will return to an alternate form to express this meaning in Section 5.4. If only one recipient is intended, so that both the Base and the Copy are oriented toward $person_i$, the interpretation could mean instead 'send something(s) twice to the same person').

The next step in outlining reduplication options is to generalize beyond the 'dual' by considering reduplication with more than one copy. The general formula for non-dual reduplication is $M \text{ T } M \text{ T } M (\text{T } M)^n$, where M is the lexical movement (first one Base, subsequent ones Copy), and T is the [return] transition movement prior to each Copy. One Base and two Copies is the general minimum, and generally, more than two Copies is not distinct from only two Copies. The specific number of repetitions is only relevant when, as in the dual, there is a specified number of referents associated with the final State already established in the discourse. With a specified number and the proper prosodic pattern (continued alternating strong–weak with no progressive reduction of subsequent copies), signs like SEND or GIVE can be repeated to mean V-to-two-recipients, V-to-three, V-to-four and perhaps V-to-five, but this approaches the limit and is rare beyond three. Fig. 9 shows the distributive form of GIVE 'give to each of them', where the number of repetitions is not specified by the number of the argument.[3] Unless otherwise indicated, the remainder of the discussion in this paper is based on the general case where the number of object arguments is not relevant to reduplication.

5.4. Digression 2: the feature [2h]

As discussed above, the sign SEND can be oriented toward two different recipients in sequence to form the dual 'send to two people/dual'. The sign GIVE is similar, but it actually moves to/ward the previously established locations for the referents. These are the two basic patterns for showing agreement – orientation or movement. Both of these signs, and many others like them, are articulated with one hand. Another option for the dual is to use the other hand, referred to as the non-dominant hand, and to articulate both occurrences of the sign simultaneously, with one hand oriented/moving toward $person_i$ and the other toward $person_j$. Phonologically, what is produced is a two-handed one-syllable sign instead of a sequence of three syllables. Furthermore, this option is not restricted only to one-handed signs. Signs made with two hands, for example INFORM (Fig. 10a and b), can indicate dual with the same strategy of moving each hand toward one of the referents. Brentari (1998) has extensively discussed the

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[3]This sign was produced to translate the sentence 'Federal regulations require all bosses to give workers a copy of the safety guidelines every year.' With this handshape, it is glossed as 'to gift, give' – compare with different handshape for GIVE in pictures below.

representation of signs made with two hands, and notes the constraint that a maximum of one distinct non-dominant hand specification is permitted in a single prosodic word. I will use the feature [2h], which may be lexically specified, as for INFORM, or added by agreement with 'dual', or added by other verb modifications (below).

With both hands as articulators, another option becomes available – either the two hands move together simultaneously (just [2h]) or they alternate with each other ([2h] and [alternate]). Some verbs, such as JUDGE and DESCRIBE, are lexically specified for [alternate], and differ only in their specification for plane (vertical vs. horizontal) (Fig. 11). The feature [alternate] entails [2h] and [repeat], but [2h] by itself does not entail [repeat]. For example the sign DECIDE is made with the same IF features as JUDGE, including [2h], but it is made with only one single downward movement to a stop (i.e., it is a telic predicate made with [direction>|]).

In JUDGE and DESCRIBE, the feature [alt] contributes the representation of atelicity in these dynamic activities, with the implication that they are ongoing, or progressive, or imperfective, or unbounded (depending on context and theoretical analysis). This implication can be cancelled with the addition of the sign FINISH (ended, done) or STOP (terminated/interrupted) (Fig. 12). In contrast, DECIDE entails completion (one is tempted to analyze it as 'reach a decision' parallel to 'arrive' – 'reach a destination'). The features [alt] and [hor/vert] also occur in reduplicated forms, that is, in forms that carry aspectual and argument information.

5.5. [alternate]

One-handed signs such as GIVE, SEE, and EAT can be produced with [2h] and [alt] in the context of 'do V a lot; overdo V; V without regards to manners; V generously'. In Fig. 13, the signer describes Homer Simpson eating constantly from a food source in front of him (table). The hands are also moving in small circles, for EAT-durative (about which more below).

5.6. [horizontal/vertical]

Klima and Bellugi (1979) noted that the horizontal and vertical planes were distinctive in what they called Distributional Aspect, in which the argument of the verb is multiple and the action of the verb is distributed ('to each'). Thus, they distinguish Apportionative external 'actions distributed around members of a closed group' (Fig. 14a) and Apportionative internal 'actions distributed all over, within a single whole' (Fig. 14b). An example might be to take measurements of all the houses in the neighborhood (external) vs. taking measurements of all the windows in one room of a house (internal). Note that in addition to the specification of horizontal (external) or vertical (internal) plane, the Apportionative includes [repeat] of telic events (end-marking shown by arrow heads) in a circular path [tracing:circle]. Thus, the features for the Apportionative include: [repeat], [plane:hor/vert], plus the requirement that the Base predicate represent a telic event. Notice finally, that each repetition comes immediately after the preceding one, that is, the Apportionative does not specify [return] as part of its formation, unlike the temporal aspects to which we will now turn.

5.7. Return to [return]

In this section, I discuss how reduplicated forms are composed. To briefly review the event structure discussion in Section 3, I outlined various ways of representing the time of events. These included (1) trilled movement [TM], (2) change of handshape, setting, or orientation; and (3) straight movement for [Extent], to which I now add (4) curved movement for 'extra' Extent (time or distance) (Wilbur, 2005). In the absence of a lexically specified spatial interpretation ([Path]), [Extent] is interpreted temporally (elapsed time). Events with temporal [Extent] are represented by signs made with [direction] or [tracing]; those which are punctual are made with changes in handshape, orientation and setting, referred to collectively as 'internal' or 'local' movements. Combinations of Extent and internal movement are possible.

If the Base and each Copy represent an occurrence of an event, it should not be surprising that [return] can represent the time between such events. That is, [return] can have [Extent].

Consider the three possibilities for aspectual inflection of the telic predicate sign LOOK-AT (Fig. 15a). In the incessant, there is essentially no time between such events. Thus, there is no clear return time between events, and no clear start and end time of each event – a rapid sequence of like movements, shown by a form in which you cannot tell where one discrete event ends and the next begins, as in LOOK-AT [incessant = [repeat] [TM]] (Fig. 15b). In the habitual, there is significant time between such events, hence there is a clear start and end time of each event, and for the time between events. This is LOOK-AT [habitual = [repeat] [return = tracing:straight]] (Fig. 15c). In the iterative, there is extended time between such events. Thus there is a clear start and end time of each event, and the extended time between events is represented by an arc/semicircle movement (Fig. 15d) (Wilbur, 2005,2008c). Thus the [return] between Base and Copies is determined by the *semantics of the aspectual inflection with respect to the time between events*. However, there does not appear to be any attempt to provide a true analogical scale for time; the only distinctions are essentially 'none, some, and more'.

One final feature needs to be noted for this set. Note that the *time between iterated events* (the semi-circular return) is made in a plane that is perpendicular to the plane of the [direction] movement of the sign. The iterative, then, contrasts with the other three forms by adding use of an additional plane to the formation of the reduplicated form, that is, it is [3d]. We will see this same feature in the forms made from atelic predicates, and in other forms where the use of [3d] means 'over time, involving extended time'.

A nearly parallel set of options is available with atelic events. What is missing from the paradigm is the case when the time between events is 'none'. Consider first the atelic stative form of LOOK(-AT) in Fig. 16a. Following Gawron (2005), I assume that there is some marking of the meaning of Extent for stative verbs. However, without initial and final points due to lack of initial and final States, the lexical sign itself is not specified for movement; the movement to put the hand in position and move it away again is purely epenthetic (if held in position protractedly, it is interpreted as 'stare'). Were one to try to put short movements between occurrences of the hand in this position, the result would be essentially indistinguishable from the incessant in Fig. 15b above. But this is not just an accidental feature of this sign. Consider again the atelic predicates JUDGE and DESCRIBE. These signs are lexically specified for [2h] and [alternating]. Thus the Base root already has repeated movement in it and there is no way to add short movements between a Base and a Copy.

The two aspectual inflections for atelic predicates parallel to the habitual and iterative are shown in Fig. 16. When the situation itself is atelic, that is, a State or Process, it has no end point because it lacks an end State (the arrows in Fig. 16 indicate direction of movement, not stopping points). To construct the temporally extended form, [return = tracing:arc] is added to the Base, which ends up forming a circle, because there can be no straight lines with end points or it would be interpreted as telic (Fig. 16b). Thus, the absence of incessant-like forms for atelic events is explained by the present analysis. The circle is then repeated as a result of [repeat] supplied by Durative. This form is interpreted as 'one long event', with multiple even circles and an approximate translation in English of 'keep on/be V-ing' – an act of 'looking (at)' is in progress.

In contrast, the continuative reflects long(er) acts of looking with significant time between these acts: 'extended looking over extended time …'. Again, extended temporal extent is conveyed by *elongation* of the movement, but in this case, both the Base and the return are elongated. To indicate repetitive extended atelic events with significant time between them, a curved return cycle is added to an extended atelic root, which has its own curved path (like the

Durative). To indicate multiple events, there is a change of speed at the bottom (Klima and Bellugi's 'uneven tempo'), rather than a stop because stopping would lead to the erroneous conclusion that there is an end point associated with the end of the event, that is, that it represents a telic event. Thus, the generalization is that atelic predicate signs cannot contain or combine with straight lines that are end-marked. The event-based perspective supports a componential analysis of the reduplicated forms, accounting for those that do occur and explaining why other forms do not.

6. The interface of aspectual reduplication and argument structure

In Digression 1 in Section 5.3, I introduced argument structure in the context of the dual and the distributive in order to make the point that the number of repetitions in aspectual reduplication is generally at least three unless there is cardinal number quantification on the argument. The relevant argument is the holder of the end State, which may be a direct object or an indirect object (e.g., recipient). I have argued elsewhere (Wilbur, 2005, 2008c) that the point in space where a predicate sign stops with end marking refers to an individual x, which may be any of the traditional 'persons, places, or things' as long as they are individuated. Each such x is a member of a *set*, which can display a variety of traditional set properties depending on the desired semantics. These properties include (a) set *organization*: ordered (as in verb agreement) or unordered (randomized); can be two-dimensional (line) or three-dimensional (volume, e.g., over time); (b) set *number*: one, two, or plural (and in specific circumstances, 3 and 4); and (c) *quantification*: collective or individuated; indefinite/ non-specific or definite/ specific. I will use the schematic drawings from Klima and Bellugi (1979) to illustrate them in various combinations. The prototype sign for showing an elaborated paradigm of aspects and arguments is the sign GIVE (Fig. 17).

The forms above in Section 5.7 have [repeat], [return], and [tracing] specified for particular path shapes. To begin this section, we can add the features [2h] for 'dual' and [alt] to the one-handed GIVE to produce the two-handed, alternating form for GIVE-dual-durational sign in Fig. 18. The meaning would be something like 'keep on giving to the two of them'. This form shows both temporal aspect and dual argument structure.

If the referent set is singular (x is the only member), the Base and all Copies will stop at the location established in space when the referent of x was introduced into the discourse. We have seen the options available when there are two members of the set in the discussion of the dual above. We have also seen the distributive above, with multiple x in an ordered set, wherein each individuated x is produced in an essentially linear order, with the meaning 'V to each'.

Klima and Bellugi (1979) identified the Allocative inflection in ASL. In general the Allocative reflects 'acts (e) of V-ing over time (t)'. Repeated actions that are distributed with respect to specified individuals x at distinct points in time are represented in the Allocative Determinate, which requires specification for the variables x (individuated arguments), e (events) and t (time). It is produced with [2h] and [alt], and with an unordered set.

The Allocative Indeterminate is also made with [2h] and [alt], and is also unordered, but it is distinguished from the Allocative Determinate in two ways. First, it requires specification of only e and t, but not x. That is, it is indefinite, whereas the Determinate is specific/definite – the Determinate stops at specific locations to indicate x. Since the Indeterminate cannot stop at points in space, because that indicates a specified x, it is made without the stopping points that figure prominently in the schema for the Determinate in Fig. 19. Second, the Allocative Indeterminate has the meaning of 'randomly distributed events of V-ing over extended time', that is, it has [Extent]. As we have seen in the discussion of the Durative and Continuative above, [Extent] which cannot stop at points in space must be curved. Furthermore, like the Iterative, Durative, and Continuative, the Allocative Indeterminate involves events *over time*,

so it has [3d] (volume in space). In Fig. 20, the signer is describing a scene where Homer Simpson is watching TV and is eating from bags of chips, placed in different locations with respect to him (floor left, floor right, slightly behind his head); the labels of R(ight) and L(eft) are from the signer's perspective and are given in the order Hand-Action-Location. There is alternating of the hands (RH, LH), and a general pattern of alternating different sides of the body when reaching. Klima and Bellugi (1979) schematize the Allocative Indeterminate of GIVE as shown in Fig. 21.

7. But wait, there's more… "Embedding" of reduplication

Reduplication involves two types of phonological modifications: spatial and temporal. Spatial modifications reflect information about the *arguments*, whereas temporal modifications reflect aspectual modifications of the *predicate*. This dichotomy is essential to complex predicate sign formation. It is possible to embed spatial and temporal modifications inside other spatial and temporal modifications, with varying degrees of success (Wilbur et al., 1983). Fig. 22a shows GIVE in the Distributive (Klima and Bellugi's Exhaustive): 'give to each of them'. Fig. 22b shows Iterative of GIVE 'give over and over again', and Fig. 22c shows the Distributive embedded in the Iterative 'give to each of them over and over again'.

The morphological structure is [[GIVE + distrib] + iterative] (Klima and Bellugi, 1979). The semantic structure of the reduplicated forms is [[give to each of them] + 'extra time elapses between such events regularly']. The short path movement of GIVE (compare Fig. 17 above) stops at points sequentially for Distributive, then traverses a curved path in a plane perpendicular to the movement of the giving event to indicate the time between distributed giving events, then the giving event movement is repeated, and so on. Note that the repetition in the Distributive is due to the recipient arguments and not to temporal aspect. The repetition of the Iterative, that is, [repeat], is associated with the regularity of the occurrence of the giving events (e.g., holiday gifts every year), and the path specification [return = tracing:large arc; perpendicular to Base plane] is possibly due to the time between such events being larger than the time between acts of giving inside each giving event.

Now consider GIVE + dur (Fig. 23a) embedded in the Distributive (Fig. 22a above), [[GIVE + dur] + distrib]. The Durative circling occurs at each point of the Distributive, giving a meaning of 'keep on giving to each person, one after another' (Fig. 23b). Finally, this construction can be embedded into the Iterative (Fig. 23c), giving the meaning 'keep on giving to each person, one after another, this event sequence recurring regularly over expanses of time.'

8. A feature geometry for reduplication

It is clear that aspectual reduplication requires repetition [repeat] of the Base [root]. The presence of [repeat] licenses [return]. Return specifications between reduplications of roots are either less than, equal to, or greater than the movement in the root. With handshape/aperture, orientation, and setting changes that do not involve [Extent] movement, [return] can only be the opposite feature arrangement to that of the Base. For example, if the Base is specified [open → close], then the return is equal and opposite [close → open]. The 'less than, equal to, or greater than' relationship might boil down to prosodic prominence: unstressed compared to Base, equal stress to Base, and greater stress than Base (I have no evidence that this latter type exists).

But if a path movement [direction] or [tracing] is involved, then the return can be equal to, smaller than, or larger than, the [Extent] of the Base movement. The geometry is shown in Fig. 24. Aspect specifies whether there will be reduplication, and if so, that there must be a return, which is defined as the opposite of the root PF specifications. Aspect further specifies whether the return will equal the root (Base) in prominence (size, stress) or will be less than or greater

than the root. Return is similar in status to class nodes in Brentari's model, such as path, setting, orientation, and aperture, which each have their own set of allowable prosodic features. We have discussed one example, that of aperture, for which the allowable prosodic features are only [open] and [closed].

When the return is equal to the root, we get the Habitual for telics and the Durative for atelics. When the return is less than the root, we get the Incessant for telics; the form is impossible for atelics as discussed above. When the return is larger than the root, we get the Iterative for telics and the Continuative for atelics. These are the temporal aspect possibilities, and the system itself turns out to be very simple (Table 2).

The remaining features, [2h], [alt], [hor/vert], and geometric layout (e.g., that the Apportionative is made in a circle shape), are determined by the argument structure and quantification over the referent domain. The combinations of aspectual inflections and argument structures with different event structure Bases give the multitude of forms that we have observed. The importance of the simplicity of this system needs to be emphasized. Reduplicated forms are not morphological templates of the type suggested by *binyanim*, which are applied to a Base form. Rather, each piece represents some portion of the event structure, which it reflects relatively transparently. Temporal aspect and argument structure (quantification, distributed/collective) are separate structures that interact with the event structure of the Base to capture the variety of meanings (Table 3).

Layering is the separation of phonological elements so that, when simultaneously performed, the phonological elements and their associated functions can be clearly identified (Wilbur, 2000). We have seen that aspectual inflections modify movement characteristics of the Base and the Return, whereas argument structure focuses on spatial characteristics of the referent set. This split makes it possible for different pieces of information about arguments and predicates to be conveyed in a single sign without obscuring each other or the basic lexical item. The phonological component must cooperate with this information packaging conspiracy or the result would be unintelligibility, the signed equivalent of 'white noise'. By segregating available resources for different grammatical functions, ASL is able to combine a number of different morphemes in a single sign, allowing a large, mostly monosyllabic, lexicon which it can then build upon for aspectual inflections and quantified arguments. With respect to reduplication, phonological resources are combined in systematic ways that not only obey the Identity Constraint between Base and Copy (Wilbur, 1973), but also display manipulated regularities in the identity of the Return with respect to the Base, which is clearly a result of the visual/manual modality of production and perception.

Acknowledgments

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Pairs of modulations	Reduplicated	Even	Tense	End-Marked	Fast	Elongated	
Predispositional 'be characteristically sick'	+	+	-	-	+	+	Transitory State
Susceptative/Frequentative 'easily get sick often'	+	+	-	+	+	+	Change to State
Continuative 'be sick for a long time'	+	-	+	-	-	+	Transitory State
Iterative 'keep on getting sick again and again'	+	-	+	+	-	+	Change to State
Protractive[a] 'be sick uninterruptedly'	-		+			-	Transitory State
Incessant 'seem to get sick incessantly'	+	-	+	+	+	-	Change to State
Intensive 'be very sick'	-	+	+	+	+	+	Transitory State
Resultative 'get (fully) sick'	-	-	+	+	-	+	Change to State

[a] Protractive aspect is made as a long, tense hold in place. Thus some features do not apply.

Fig. 1.
Suggested feature templates for several aspectual inflections. Used by permission from Ursula Bellugi, The Salk Institute for Biological Studies.
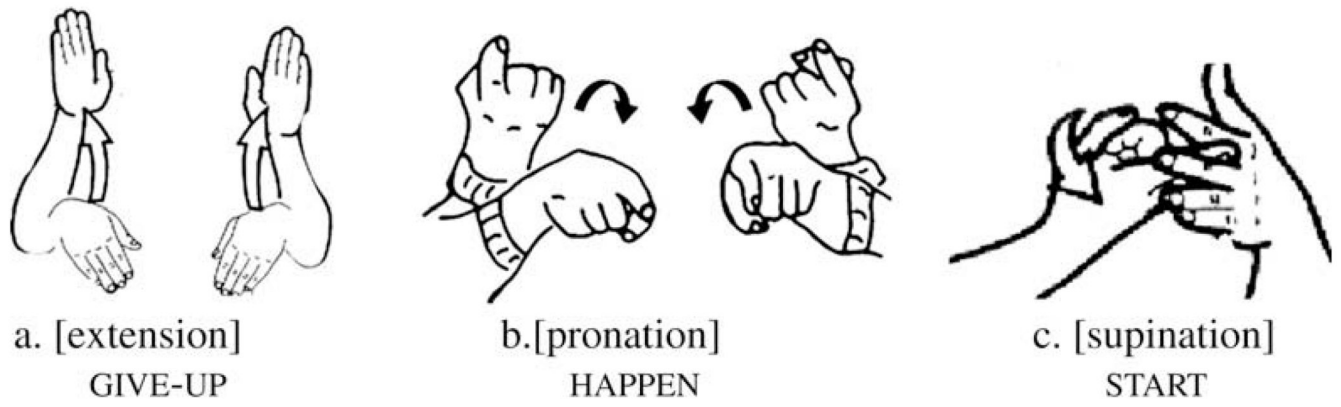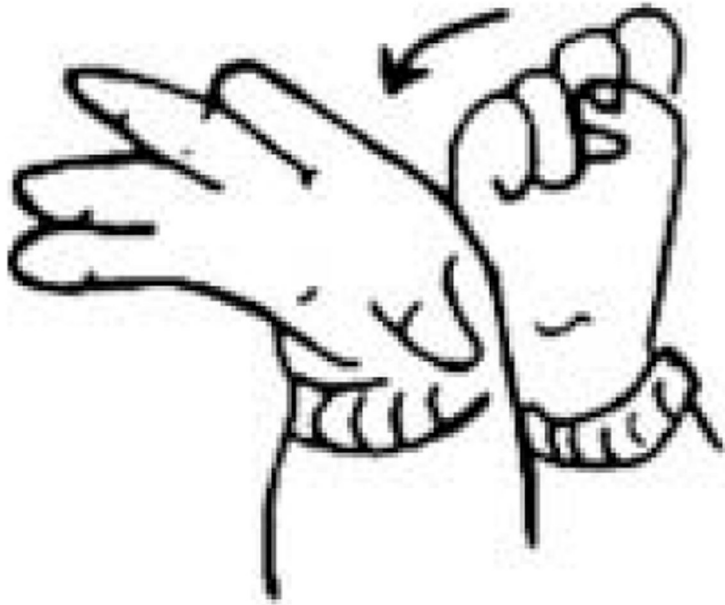
a. [extension]
GIVE-UP

b.[pronation]
HAPPEN

c. [supination]
START

Fig. 2.
Orientation changes used in signs reflecting telic punctual events.

[closed → open]

SEND

Fig. 3.
Change of aperture.

POSTPONE

Fig. 4.
Change of setting.

Fig. 5.
The feature [direction>|] in the sign ARRIVE.

a. RUN
[tracing: straight]

b. PLAY
[tracing + TM]

Fig. 6.
Atelic predicates.

Fig. 7.
The lexical sign 'sick'. Used by permission from Ursula Bellugi, The Salk Institute for
Biological Studies.

a. Verb SIT – one (long) movement   b. Noun CHAIR – two (shorter) movements

Fig. 8.
Verb/Noun pair. Pictures used with permission of Dr. Bill Vicar.
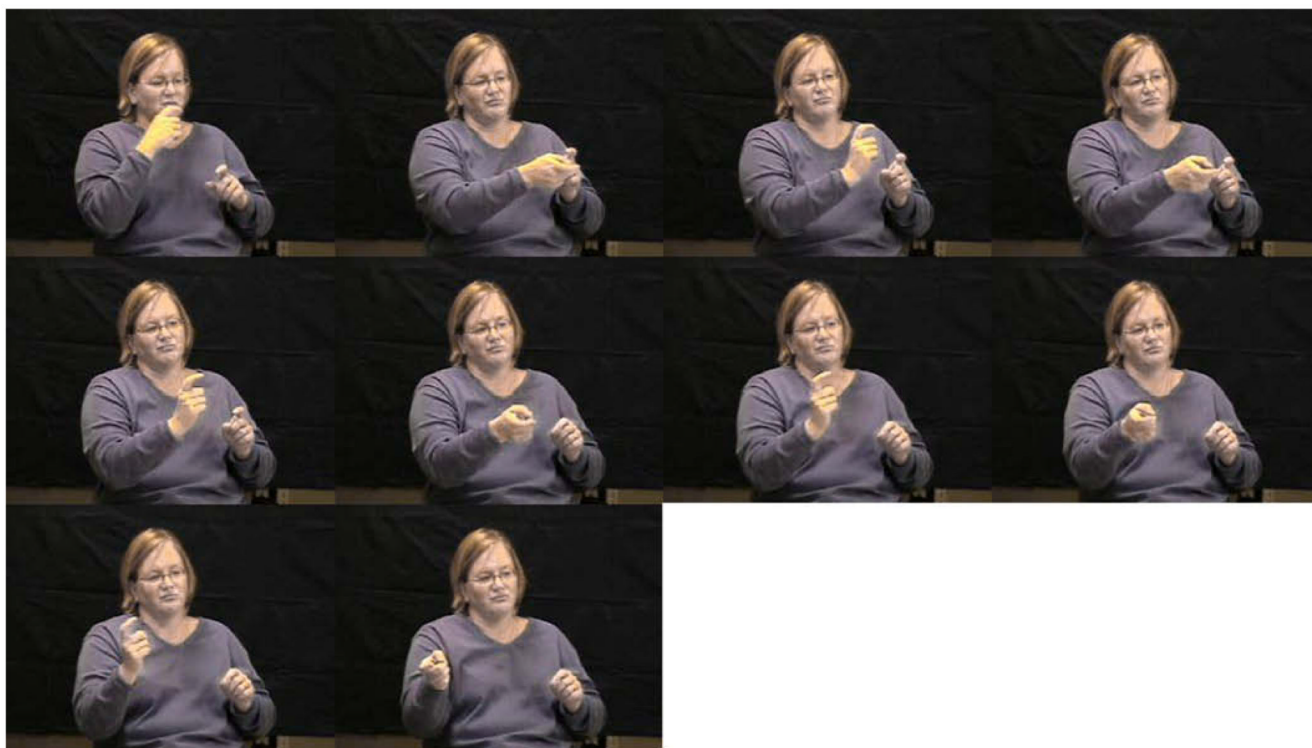
Fig. 9.
GIVE + distrib (5X).

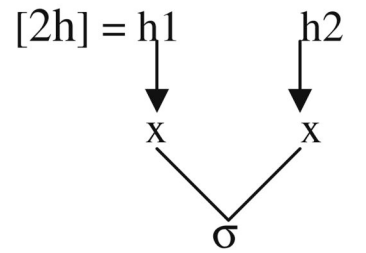(a) INFORM [2h] [repeat] + [dual$_{i\,j}$]   (b) INFORM [2h] + [dual$_{i\,j}$]

Fig. 10.
INFORM (a) two-handed repeated dual, (b) two-handed single movement dual.

JUDGE
[2h], [alt], [vert plane]

DESCRIBE
[2h], [alt], [hor plane]

DECIDE
[2h], [direction], [vert plane: down]

Fig. 11.
JUDGE, DESCRIBE, and DECIDE. Used by permission from Ursula Bellugi, The Salk Institute for Biological Studies.

Fig. 12.
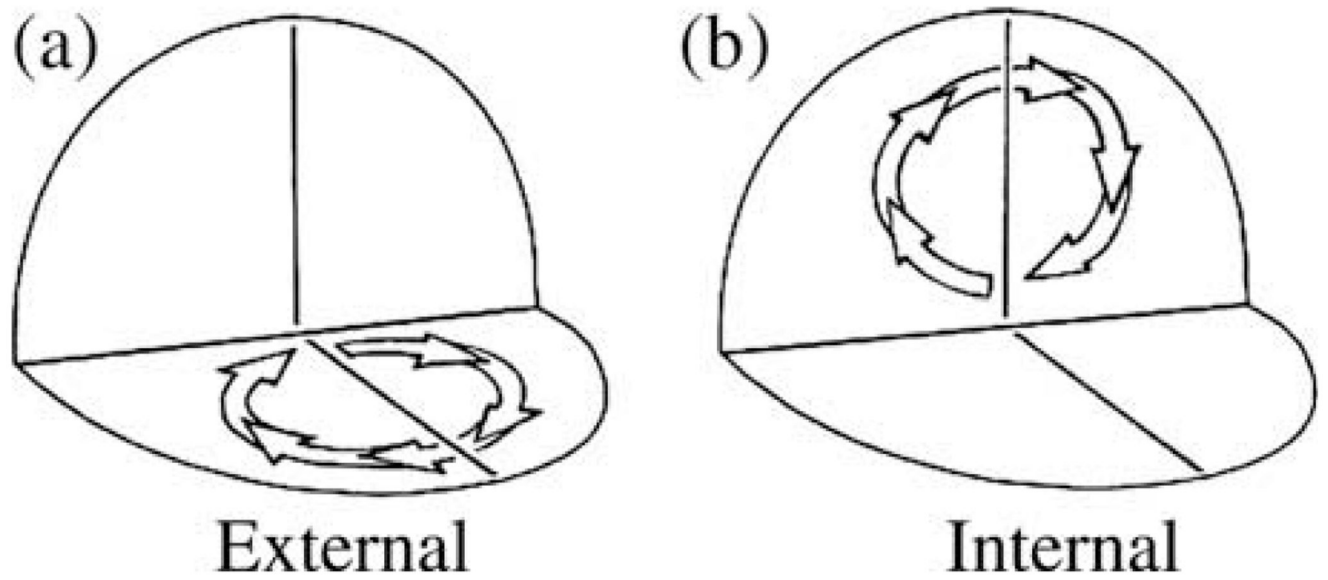FINISH and STOP.

Fig. 13.
EAT-durative, [2h], [alternate].

Fig. 14.
Apportionative External (horizontal) and Internal (vertical). Used by permission from Ursula Bellugi, The Salk Institute for Biological Studies.
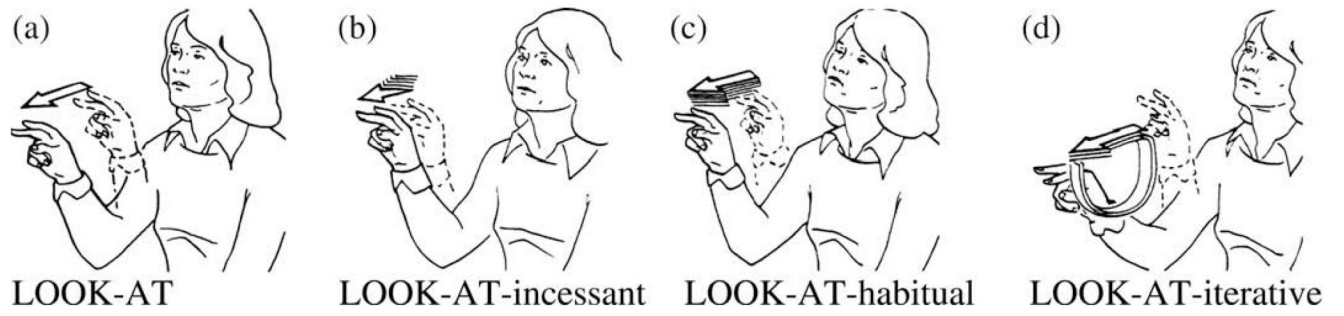
Fig. 15.
The sign LOOK-AT and three aspectual inflections. Used by permission from Ursula Bellugi, The Salk Institute for Biological Studies.

a. LOOK(-AT)   b. LOOK[return=tracing:arc] [dur=[repeat]]   c. LOOK[cont=[repeat][return=tracing:arc]]

Fig. 16.
LOOK-stative and reduplicated aspects Durative and Continuative, which are both [3d]. Used by permission Ursula Bellugi, The Salk Institute for Biological Studies.

Fig. 17.
GIVE. Used by permission from Ursula Bellugi, The Salk Institute for Biological Studies.

Fig. 18.
GIVE-dual-durational. Used by permission from Ursula Bellugi, The Salk Institute for Biological Studies.

Fig. 19.
Allocative Determinate (*x,e,t*) of GIVE, [2h], [alt], [unordered]. Used by permission from Ursula Bellugi, The Salk Institute for Biological Studies.
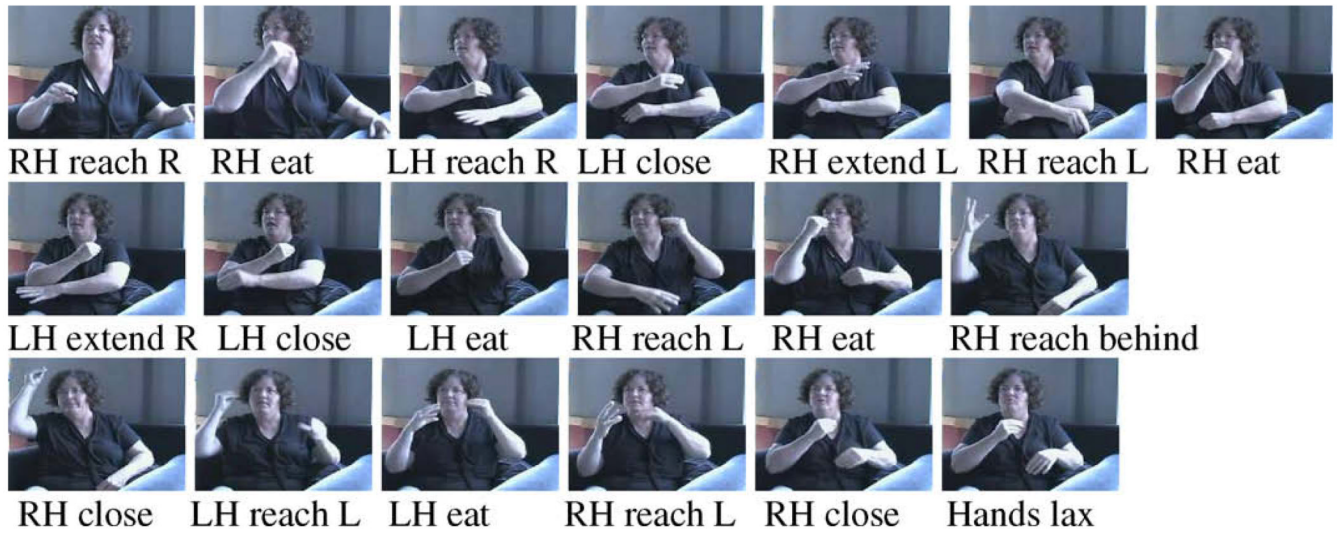
Fig. 20.
EAT-Allocative Indeterminate, [2h], [alt], [unordered], [3d].

Fig. 21.
Allocative Indeterminate (*e,t*) of GIVE, [2h], [alt], [3d]. Used by permission from Ursula
Bellugi, The Salk Institute for Biological Studies.

Fig. 22.
GIVE [distributive in iterative]. Used by permission Ursula Bellugi, The Salk Institute for Biological Studies.

a. GIVE+dur   b. [GIVE + dur] + distrib]   c.[[GIVE+dur]+distrib]+ iterative]
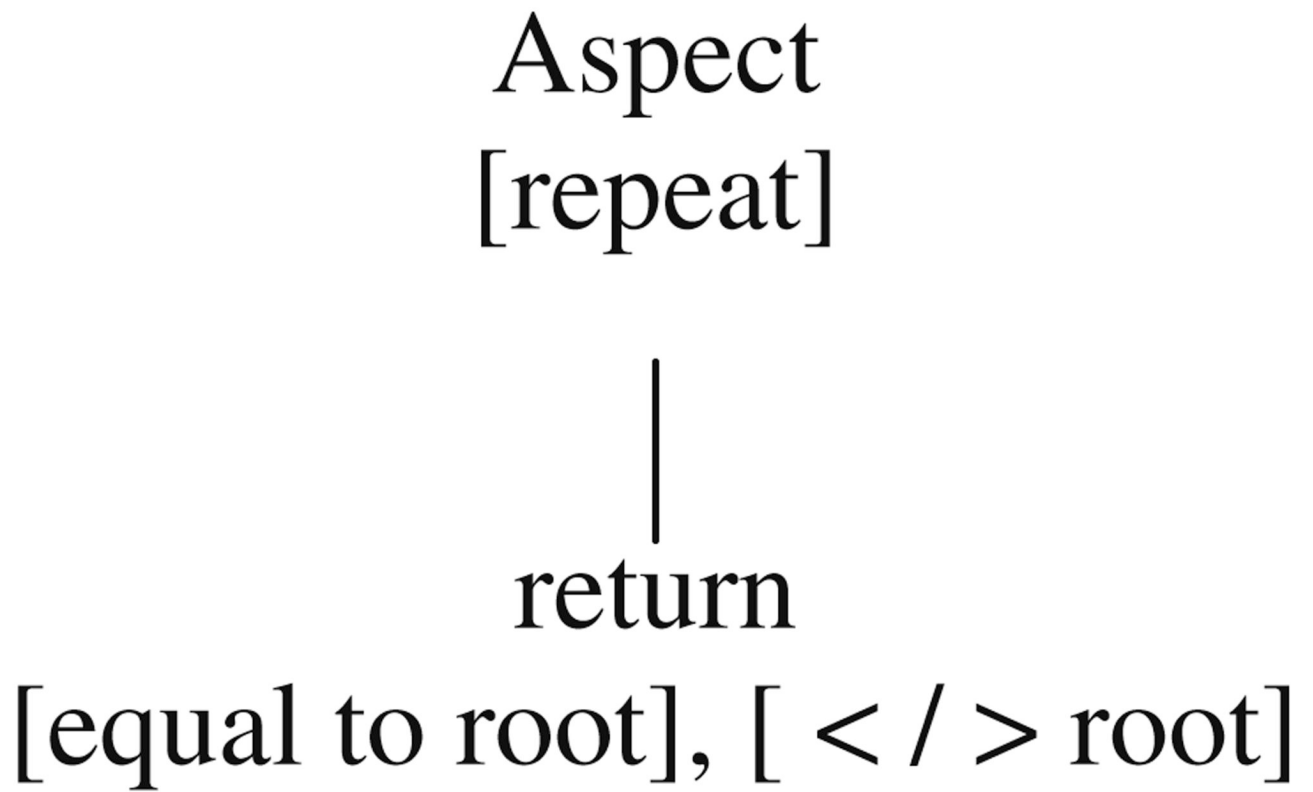
Fig. 23.
GIVE + Durative + Distributive + Iterative.

Aspect
[repeat]

|

return

[equal to root], [< / > root]

Fig. 24.
Feature geometry for ASL aspectual reduplications.

Table 1

Pustejovsky's sub-event types.

Sub-event type	Sub-event notation	Homogeneity type
States	S	Homogeneous
Processes	P	Homogeneous
Transitions: Achievements	S → S	Heterogeneous
Transitions: Accomplishments	P → S	Heterogeneous

Table 2

Combinations of return options and base yield aspectual inflections.

	Telic root	Atelic root
[return = root]	Habitual	Durative
[return < root]	Incessant	*
[return > root]	Iterative	Continuative

Table 3

Components for complex predicate structure movements.

Source	Semantics	Phonological form
Predicate	Event telicity	End marking (marked deceleration)
Predicate	Event duration (punctual; extent)	No path; Path (straight or curved)
Predicate	Event completion	Contact (hand/body or plane)
Predicate	Event initiation	Loss of contact
Return	Time between events	Opposite of Base
Argument structure	Arguments (definiteness; quantification; set organization)	Points in space; Location; Handedness (for dual); Geometric layout; [2d]/[3d]
Aspect	Temporal relationships	[Repeat]; [Return]; Return Size compared to Base