

## COMPLEX PREDICATES INVOLVING EVENTS, TIME AND ASPECT: IS THIS WHY SIGN LANGUAGES LOOK SO SIMILAR?

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### Abstract

This paper presents a novel perspective on the complex structure of predicate signs, addressing the mapping between semantic components of events and their overt morphophonological representations in ASL (the Event Visibility Hypothesis), and suggests that fundamental similarities across SLs may be related to these structural pieces. Predicate sign structure is compositional in ways that have not been previously identified, and their components are grammaticalized from universally available physics of motion and geometry of space. The semantic concepts involved here are *individual*, *event (states and processes)*, *location*, *duration*, *termination*, and *completion*. The relevant characteristics from geometry are *point*, *line*, *plane* and from physics *distance*, *duration*, *velocity*, and *acceleration/deceleration*. With the principled exception of classifier predicates (CLP) and spatial 'tracing' movements, phonological path movement of predicate signs maps to semantic Extent (duration) of an event and movement which stops at points in space maps semantically to the final State of telic events and its individual argument. Thus, like CLP, agreeing verbs are multimorphemic. These resources provide an explanation for the apparent visual similarity of SLs to each other, even while they remain mutually unintelligible.

### 1 Introduction

This paper presents a novel perspective on the complex structure of predicate signs in sign languages, and suggests that fundamental similarities across sign languages may be related in part to these structural pieces. I address the mapping between the semantic components of events and their overt morphophonological representations in ASL. I use complex predicates to show that (1) predicate sign structure is compositional in ways that have not been previously identified (Wilbur 2003, 2005, Grose, Wilbur & Schalber, 2007); and that (2) predicate sign components are grammaticalized from universally available physics of motion and geometry of space, which are therefore fundamentals on which more advanced meanings can be constructed (Wilbur 2003, 2005). These resources provide an explanation for the apparent visual similarity of languages to each other, even while they remain mutually unintelligible. The fact that they are grammaticalized units of meaning which have to be learned as part of the linguistic system distinguishes them from conventional gestures or mime.

My claim in this paper is that in the *predicate* domain, with the principled exception of classifier predicates (CLP) and spatial 'tracing' movements, the path movement of predicate signs indicates the temporal extent of an event (e), that path movement between sign repetitions reflects time between events (e), and that phonological end-marking of the movement reflects the final state of telic events ( $e_n$ ). Furthermore, movement that stops at



points (p) in space also indicates individual argument semantic variables ( $x$ ). This mapping of semantic components and phonological forms represents a systematic recruitment of characteristics of the physical world for conceptual, hence morphological, semantic, and syntactic purposes. The semantic concepts involved here are *individual*, *event*, *location*, *extent*, *termination*, and *completion*. The relevant characteristics are from geometry (*point*, *line*, *plane*) and from physics (*space/distance*, *duration*, *velocity*, and *acceleration/deceleration*).

It is important to understand why these spatial and temporal notions are relevant to the *linguistic* analysis. In speech, the acoustic signal derives from, but is different from, the motion of the articulators (visible information on the lips is extremely limited with respect to the whole phonological inventory). In signing, the visual signal – the hands moving – *is* the motion of the articulators, that is, what is seen is the temporal dynamics and spatial location of hand movement. The linguistic system depends on the visual perceptual system to process the necessary distinctions.

Motivated mappings have, of course, been discussed extensively in the context of iconicity (Boyes-Braem 1981; Shepard-Kegl 1985; Taub 2001) and metaphors (Wilbur 1990; Wilcox 1993), as well as in the long discussion of the status of classifiers in sign languages (cf. Emmorey 2003 for an overview and papers debating various options). With a few notable exceptions, these discussions have avoided or rejected analysis within a formal generative framework, either because iconicity was considered irrelevant to linguistic analysis, or because formal linguistic analyses were rejected as irrelevant to iconicity. This literature has identified images and concepts that are mapped to phonological forms, which then may undergo further conventionalization or grammaticalization into standard lexical signs.

The exceptions to the above generalization have generally tried to identify those meaning-form mappings that are sufficiently conventionalized to be considered morphemes (cf. Schick 1987; Supalla 1982, 1985; Supalla & Newport 1978). Only Shepard-Kegl (1985) has attempted to systematically relate iconically-motivated morphemes to the construction of productive predicates and the syntax they appear in. This paper seeks to contribute further to the formal discussion by using an event structure based analysis to identify additional morphemes, which can be derived from universally available resources in physics and geometry. Because these resources are universally available, they may be used in hearing culture gestures and in mime. However, to be morphemes in a sign language, they must be conventionalized and grammaticalized beyond their gestural or mimetic uses. In order for such forms to undergo grammaticalization, there must be a language-specific grammar to assert pressure to cause these items to change.<sup>1</sup> Formal

1 Modifications brought about by ease of articulation, perception, or processing should not be language-specific (beyond modality differences) because they are language-external by definition.



generative approaches attempt to provide a characterization of the linguistic system into which modified items must fit. Thus, the morphemes presented in this paper are part of a linguistic *system*, carry meanings that are grammaticalized as compared to their gestural and mimetic counterparts, and must be explicitly learned as part of learning a sign language.<sup>2</sup> Given the data available on these morphemes so far (ASL, Austrian Sign Language, Croatian Sign Language, among others), I put forth the hypothesis that they will be found in all sign languages<sup>3</sup>.

‘Complex predicates’ here means any non-nominal predicate that consists of at least a Verb (including change-of-state adjectives, such as ‘sick’; Klima & Bellugi 1979). Other potential components of a complex predicate include: its telic/atelic event structure; the duration or the location of an event; completion of an event; resultative state; elapsed time between repeated events; temporal aspects of events (e.g. habitual, iterative); participant arguments and their collectivity/distributivity; and nominal predicate modifiers.

The morphemes discussed in this paper are given in Table 1; the morphemes and their descriptions supersede those in Wilbur (2003, 2005). Section 2 discusses the Event Structure model of Pustejovsky (1991, 1992, 1995, 2000), which allows the generalizations regarding the semantic components to be stated. Section 3 discusses the morphological mapping of these semantic primitives and the specific phonological pieces that are seen in complex predicates. Section 4 addresses the recruitment of the underlying physics and geometry. Section 5 considers more complex predicates. Section 6 concludes the paper.

- 2 Furthermore, they participate in the projection of syntax, just like their spoken language counterparts do (cf. Ramchand 2004). More specifically, they participate in the projection of first phase syntax, that is, the light vP and its contents (Grose, Wilbur & Schalber 2007).

An anonymous reviewer raises the question of why, if these morphemes are universal to all sign languages, they must be learned. The claim that some feature will be found in all sign languages or is universal (found in all languages) does not necessarily entail that it must be innate. Instead whatever is biologically based with respect to human language, that is, Universal Grammar, must at minimum ensure both that language is learnable and that language is learned. It could be that what is innate is related to notions of syntax or syntactic categories, or specific learning mechanisms or paradigms. For example, DiScuillo (2005) argues that it is ‘asymmetry’ that is biologically wired, and that from this, phonology, morphology, and syntax follow.

- 3 Although they may be used in different lexical items in different languages. I thank Katharina Schalber and other colleagues for raising this question. For example, ASL and Italian SL differ in their signs for ‘to love’. The ASL sign is body-anchored and has no movement; it is probably based on the language-specific choice of ‘hugging or holding a loved one’. The LIS sign has path movement away from the signer’s chest toward a referent (present or set up in conversation), probably based on the language-specific choice of ‘transfer of love from heart of one person to another’. Thus, the LIS sign uses a *transfer* metaphor, and represents it lexically as a telic event with the morphemes identified here as Path and EndState. A language can use both in the same way that English has the stative ‘I love you’ and the transfer metaphor ‘I give you my love’ (e.g. ‘Give my love to your mother when you see her.’)

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Morpheme Class	Function	Sub-event type	Phonological form
EndState <sup>4</sup>	Marker of telic events	State	Rapid deceleration to a stop
InitialState <sup>5</sup>	Marker of initial state	State	Rapid acceleration from a stop
Extent	Duration of events	Process	Path, [tracing]
Path	Distance of spatial events	Process	Path, [tracing]
Extra	Adverbial modifier		[Arc]
USET	Adverbial temporal modifier		Trilled movement [TM]

Table 1: Proposed morphemes

## 2 Event structure

The term ‘event structure’ is used here in a broad sense including analyses of Aktionarten, Aspectology, and Situation Aspect. Event structures are analyzed as conceptual structures that correspond to morphemes in the Lexicon (Grose, Wilbur & Schalber 2007). As such, event structures may not correspond one-to-one with lexical verbs and may not be transparently represented on the surface in a given language. For example, event structures are relatively opaque in English, although their structure is recoverable through syntactic tests. In contrast event structures are relatively transparent in ASL (discussed further below).

### 2.1 Event types

Generally, analyses of event structure group events into four basic types: States, Activities, and Achievements and Accomplishments (Table 2).<sup>6</sup> In States, nothing happens

4 Acceleration and deceleration can be thought of as changes in speed: acceleration increases the speed, and deceleration decreases the speed. ‘Rapid’ is a relative term: for our purposes, ‘regular’ is comparable to starting forward or stopping with a car at a light, whereas ‘rapid’ is comparable to an unusually fast start (think of teen drivers ‘flooring it’ or ‘leaving rubber’ from the tires), and to an usually fast stop (‘jam on the brakes’).

An anonymous reviewer raises the question of how such ‘rapid’ acceleration and deceleration can be determined. We are able to measure these changes in speed using a motion capture suit and pair of gloves (Wilbur & Malaia 2008, in press)

5 All movements have an onset, that is, they accelerate from not moving (zero velocity) to moving (at a certain speed, whatever that is). But not all movement has a linguistically meaningful InitialState. InitialState must have a rapid acceleration from a stop. The same is true for deceleration and EndState.

6 C.S. Smith (1997) identifies a fifth: Semelfactives. Because they have heterogeneous internal structures and pattern like telic events, they are not distinguished separately here. These are punctual events which may occur in a series that has duration, including verbs like *blink*, *cough*, and *bark*. Rothstein (2004) argues against C.S. Smith’s analysis. I will not address these forms separately; they may occur in the incessant (‘bark, bark, bark’) and with TEND for habitual meaning (Wilbur 1998). Grose (2008) provides a treatment for them.

(‘stative’). In Activities, there is something going on (‘dynamic’), but whatever is going on does not have a goal or endpoint at which the activity will be complete. Instead, Activities are terminated due to external factors (like friction, gravity, human decision, exhaustion, strong vibration waking someone up, running out of chocolate, etc). Achievements are simple changes of state: ‘not broken’ → ‘broken’, ‘not sick’ → ‘sick’. Accomplishments are composed of an incremental activity, such as painting, that leads to a final result, in which something is created or completed, as in “She painted a picture” and “He painted a house”.

States	Activities	Achievements & Accomplishments
The plant is green.	Sam is running.	Da Vinci painted the Mona Lisa.
The book is on the table.	The baby slept.	The window broke.
Lions have manes.	Ronnie eats chocolate.	Bill got sick.

*Table 2: Examples of States, Activities, Achievements and Accomplishments in English*

Typically, the first distinction is to separate stative from dynamic events (Activities, Achievements and Accomplishments). Rothstein (2004) offers some general linguistic tests for such States:

- They cannot occur with the progressive;
- Their default reading in the present tense is non-frequentative and non-habitual;
- They cannot be the complement of ‘force’/‘persuade’ type verbs;
- They cannot occur in the imperative;
- They do not occur with agentive adverbs (e.g. ‘deliberately’);
- They cannot be focused in the pseudocleft (wh-cleft);<sup>7</sup> and
- They can occur with ‘for *x* time’ (e.g. ‘for an hour’).

Dynamic events can be modified by temporal adverbs and can occur as the complements of the verbs ‘finish’ and ‘stop’. Rothstein includes these additional tests to separate the behavior of different dynamic events, as well as the inception and termination of dynamic events, as appropriate:

a. Adverbial Time Tests

- ‘for *x* time’ duration
- ‘at *x* time’ punctual time; in Activity, refers to Onset
- ‘in *x* time’ and ‘take *x* time’ locate end of (telic) events

b. ‘Finish’ vs. ‘Stop’

- ‘Finish’ occurs with dynamic and telic events; Accomplishments
- ‘Stop’ occurs with atelic States and Activities
- ‘Stop’ with an Accomplishment is interpreted as ‘interrupted’
- Achievements are punctual (have no extent) and therefore cannot occur with either ‘finish’ or ‘stop’.

<sup>7</sup> For discussion of pseudoclefts in ASL, see Wilbur (1996).

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Rathmann (2004, 2005) provides the following list of sign examples for ASL:

States:	KNOW, LIKE
Activities:	STUDY, EXPLAIN
Semelfactives:	COUGH, KNOCK
Achievements:	ARRIVE, PASS-TEST
Accomplishments:	FILL-OUT FORM, BUILD HOUSE

Here I will use Pustejovsky's (1992) terminology for event structure, with his notions of States, Processes, and Transitions, and their corresponding argument structure (described in more detail in section 2.4). I will frame my arguments in these terms so as not to unnecessarily complicate the presentation.<sup>8</sup> The primary implication of this decision is that Achievements and Accomplishments are both Transitions, with different sub-event structure. Also, here I will deal only with the temporal components of events, and not with causation, agentivity, or linking. Spatial predicates containing Path are included here because, by virtue of the physics associated with them, they imply temporal extent.

## 2.2 Pustejovsky's model of event predicate structure

I use a model of event structure that has developed from the sub-event analysis of Pustejovsky (1991, 1992, 1995, 2000). In his system, events are composed of sub-events of two types: static (S) and dynamic process (P) (Table 3). Atelic events are composed of a single basic sub-event, either P or S, thus capturing the basic distinction [+/-dynamic] found in feature-based systems (P is [+dynamic] and S is [-dynamic]). 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 [+/- homogenous] (Bertinetto 2001) used in feature-based approaches to telicity (S and P are [+homogeneous] and all T events are [-homogeneous]). It is also possible to distinguish the two telic event types, Achievement and Accomplishment, without using the subjective notion of [+/-durative], wherein Achievement is considered [-durative] (that is, punctual) and Accomplishment is considered [+durative] (Vendler 1967; C.S. Smith 1997; inter alia).

Subevent type	Subevent notation
States	S
Processes	P
Transitions: Achievements	$S \rightarrow S$
Transitions: Accomplishments	$P \rightarrow S$

Table 3: Pustejovsky's sub-event types

<sup>8</sup> In practice, we now make only the distinction between stative (S) and Dynamic (D) events. Transition events thus are compositional and contain a final S:  $S \rightarrow S$  is Achievement, whereas  $D \rightarrow S$  is Accomplishment.

Following Pustejovsky (1992:56), a *State* (S) is “a single ongoing event (e) that is evaluated relative to no other event”. *Process* (P) is “a sequence of events identifying the same semantic expression”, which can be divided at any point into an event “that is just like the undivided event” (e.g. run, sleep):  $P \rightarrow e, e, e$ .<sup>9</sup> In contrast, a *Transition* (T) is “an event identifying a semantic expression, which is evaluated relative to its opposition”, and therefore has a final state  $e_n$ . Prior to the final state, there is either another State (the opposite of the final state) or a Process (Figure 1). This approach views the construction of meaning as a *compositional* process, with the temporal event subcomponents “involving the concepts of initial, internal, and final temporal subperiods” (p. 48).

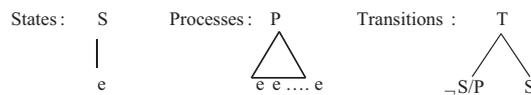


Figure 1: Representations of three event types from Pustejovsky (1992)

I turn now to the separation of telic and atelic events, a fundamental distinction that has been much discussed in the spoken language literature. ASL (and other sign languages) provide an excellent opportunity for exploring these notions further because the distinction is visible in the formation of the predicate signs themselves. That is, as I argued in Wilbur (2003), Transition predicates, which are telic, have a phonologically overt ‘EndState’ in their form, whereas States and Processes, which are atelic, do not. The phonological marking of ‘End-State’ can be seen in those examples with [+End-marking] in Klima & Bellugi (1979, Table 11.2).

### 2.3 Working definitions of Telic/Atelic

The telic/atelic distinction is most clearly analyzed in terms of the internal structures of events. Within the context of event structure, ‘telic’ is understood as the property of events

9 Note that this representation ‘e,e,e’ does not mean that ‘e’ is repeated, but rather that dividing up an ‘e’ yields a proper portion that is also the same ‘e’. That is, dividing up the homogeneous activity ‘sleep’ into smaller time units yields an event ‘sleep’. In contrast, dividing up the heterogeneous Achievement ‘arrive’ into smaller time units will yield one unit with the final end-State of ‘arrived’ and multiple other sub-states of ‘not arrived’. For an elegant account of this issue in a feature-geometry model of event structure, see Grose (2008)

containing a natural conceptual/semantic endpoint.<sup>10</sup> In contrast, atelic events do not contain such a point and have the potential to continue indefinitely, without any change in their internal structure.<sup>11</sup>

Atelic events, once they have been initiated, have a *homogenous* structure, in that they may be divided into identical intervals, each of which is an instance of the event itself, i.e. ‘walking’ as an instance of ‘walking’. Since telic events contain an endpoint, they are understood to have a *heterogeneous* internal structure and cannot be divided into identical intervals because the last/final interval will always be different from the others (i.e. ‘dying’ is not an instance of ‘die’).

#### 2.4 Argument structure for event predicates

In this system, each sub-event has a relationship with some entity, or argument role. S sub-events may have two types of argument roles, distinguished by their relationship to other sub-events in the event structure: (1) the ‘Resultee’, which is the holder of the Resultant final State ( $S_R$ ), or (2) the role ‘Holder’ of any other State ( $S_H$ ).<sup>12</sup> The role associated with initial dynamic P sub-events is Initiator ( $P_I$ ); all other P sub-events are associated with an Undergoer ( $P_U$ ). This system of labeling is used in the syntax built up from this sub-event analysis (see Grose, Wilbur & Schalber 2007; Basu 2005) and is modeled after Ramchand’s (2004) work.

10 Discussion has raised the question of the term ‘natural’ with respect to the notion of endpoint for telic events. I use the term ‘natural’ as a shorthand for those cases in which it is possible to know *in advance* when an event will end if nothing external interferes, that is, its natural end. Thus, the event of ‘die’ is ended when the individual is dead; the event of ‘go to the store’ is ended when the store is reached; the event of ‘eat an apple’ is done when the apple is gone. In contrast, the event of ‘eat apples’ has no natural endpoint from which it can be predicted when the event will end. The presence of a quantifier, such as ‘eat three apples’, provides the endpoint, namely when the three apples are gone.

To determine the telicity of an event, it is necessary to assess the semantics of the event, which may be represented linguistically in numerous ways: single verb; verb plus particle or prefix or suffix; verb plus DP with QP; and in highly agglutinating languages, a single word composed of many morphemes. It is an anomaly of English that a single verb like ‘eat’ or ‘walk’ can appear in both telic and atelic structures. In numerous other languages, there is a clear morphological distinction between the word(s) representing an atelic event and the word(s) representing a telic event.

11 Although not always clear in the literature, telicity is independent from the status of an event as ‘open’ or ‘closed’ (Bertinetto 2001), concepts which are understood in terms of the relationship between an event and a reference time; ‘open/closed’ status does not alter the internal structure of the event. Both telic and atelic events may be either closed or open (Grose, Wilbur & Schalber, 2007 for further application to ASL). If the initiation of an event is thought of as the ‘left edge’, and the end of the event as the ‘right edge’, then the status of an event as open or closed at a reference time R is determined by whether the right edge exists at time R (event is closed) or not (event is [still] open). ‘Ate apples for an hour’ is closed, but not telic.

12 When the movement of a predicate sign is end-marked by rapid deceleration to a stop at point  $p$ , the individual semantic variable  $x$  referred to by this definite description (‘ $x$  is located at  $p$ ’) is the *holder* of the final State. Predicate signs which lack this end-marking do not have a final State (are atelic) and therefore do not project a Resultant Phrase with holder ( $S_R$ ). A recent extensive model is given in Grose (2008).

In the event structure tree ('first phase syntax') Ramchand labels the argument of the light *vP* the Initiator, which is the argument of the causing sub-event (when it exists); the argument of the process sub-event is the Undergoer; and the argument of the result state (when it exists) is the Resultee. She notes that arguments of stative verbs can be treated this way (there are no sub-events), and she labels them Rhematic Objects (Rhemes), noting that they can be DPs, PPs, and APs. The purpose of this label is to indicate that these are not related to sub-events but are rather part of the description of the predicate itself (others have called this the 'predicate modifier'). In section 2.6, this distinction will be illustrated as part of the difference between examples (3a) and (3b).

## 2.5 Why use this approach?

Butt and Ramchand (2002) successfully apply this framework to (spoken) Hindi/Urdu. Basu (2005) provides an application of this framework to the compound verbs and serial verb constructions of (spoken) Bengali/Bangla. Our prior work on sign languages has found this framework useful, and it is consistent with the Event Visibility Hypothesis argued for here. In Figure 2, the trees for the various sub-event options are given; it has been shown that each of these is below Tense (Grose 2003, 2008), that there are functional phrases that interact with these projections (Benedicto & Brentari 2004), and that they are appropriate for representing sign languages, including ASL and Austrian SL (Grose, Wilbur & Schalber 2007; Schalber 2004).

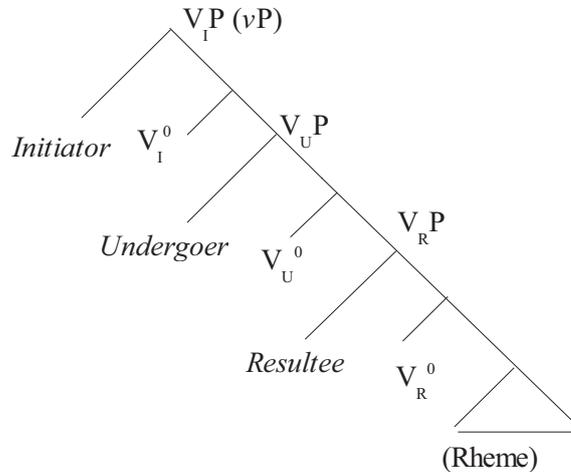


Figure 2: Syntactic structure corresponding to telic event structure below TP.

As the analysis below will reflect, using our event-based analysis, Brentari's Prosodic Model, and the Event Visibility Hypothesis, we have been able to provide explanations for a number of otherwise inexplicable facts (Grose et al. 2007; Schalber 2004; Wilbur 2003, 2005).

1. Klima and Bellugi (1979) describe ‘end marking’ as a contributing factor to the phonological forms of aspectual modulations. We provide a straightforward explanation of the meaning of ‘end marking’ as EndState, and, from that, can predict its presence or absence in the different aspectual forms;
2. We correlate Brentari’s phonological movement inventory with the event structure of categories of predicate signs: atelic States and Processes, telic punctual Transitions, and telic non-punctual Transitions. We provide an explanation for the use of [tracing] and [direction] path movements;
3. The argument structure associated with the predicates falls out naturally from our event-based analysis, including each type of argument (individual, location, event, other). Furthermore, the phonological forms of ASL and Austrian Sign Language (ÖGS) predicate signs show these arguments clearly;
4. Our analysis accounts for the patterns of verb agreement in ASL (discussed further below);
5. Our analysis provides a consistent explanation of the phonological forms of predicates with [delayed completive], [unrealized inceptive], and ‘almost’ modifications (C.R. Smith 2007);
6. Our analysis of simple event structures extends to explanations of the more complex reduplicated structures without any further assumptions (Wilbur 2005);
7. Our analysis is applicable to core lexical items and to classifier predicate constructions; and
8. Our analysis makes claims about grammaticalization and sign language evolution.

## 2.6 Understanding Telic/Atelic in the context of sub-event structure

The notion of *telicity* used here is associated with the presence of a final EndState  $S_R$  in the sub-event structure. A Process without a defined EndState is atelic (‘walked’ in 1a). If the event is goal-oriented, that is, occurs with a final state ‘the store’, it is telic (1b).

(1)

- a. Mary walked.
- b. Mary walked to the store.
- c. Mary walked for an hour.

The temporal duration in (1c) indicates how long the activity of walking lasted, but not why the walking ceased. The event of walking is bounded by the temporal frame, and the event of walking has ended, so the event is ‘closed’ (see fn. 11). There is no clear EndState and the event is *atelic* despite being terminated. Similarly, the event of ‘reading’ in (2a) is atelic.

(2)

- a. Damir (tried to) read.
- b. Damir (tried to) read the dictionary.

The reading event (2b) is ‘potentially’ telic or atelic because ‘the dictionary’ can be interpreted in two different ways. Van Hout (2000) provides a clear discussion of the differ-

ence. In one case, the dictionary is an *affected object* whereas in the other case it is a *modifier* of the reading event (cf. “to engage in dictionary reading”; Ramchand 2004 calls this ‘Rheme’). The strong object reading is seen in (3a) and the modifier reading in (3b).

(3)

- a. Lorenzo ate a sandwich for lunch. → The sandwich is gone.  
 b. Lorenzo ate seaweed for lunch. → Seaweed still exists.

In (3a), the sandwich is eaten and, being totally affected, does not persist beyond the end of the eating event (cf. Pustejovsky 2000). In (3b) there is no entailment that there is no more seaweed after Lorenzo finishes engaging in seaweed-eating events. That is, seaweed is an eating-event modifier; I will follow Ramchand (2004) and refer to this as the ‘Rheme’ (not an argument of the verb).

This distinction can now be clarified for “reading the dictionary”. In (4a), the dictionary is an affected object and provides a boundary for the telic “reading the dictionary” event, namely reading the last word listed under the letter “Z”. (4a) also illustrates that such an event can perhaps never reach this EndState, terminating instead in the words listed under “E” (This is the role of ‘try to’). Note then that “telic”, with its EndState, does not imply *completion*, it merely makes it possible for there to be a state at which the event is considered complete. In (4a) then, the telic event has *terminated* but it is not completed.

(4)

- a. Lorenzo tried to read the dictionary, but he only got to the E’s.  
 b. Lorenzo tried to read the dictionary, but the print was too small.  
 c. Lorenzo tried to read the dictionary all the way through, but the print was too small (so he had to stop).

In contrast, in (4b) ‘dictionary’ modifies the type of reading event that Lorenzo tried to engage in, but the event was terminated because of reading difficulties resulting from small print. There is no state at which such a reading event would be considered complete because (4b) does not entail that Lorenzo intended to read the dictionary from beginning to end, only that he intended to engage in the activity of reading something in the dictionary; the event in (4b) is atelic and like (4a) has been *terminated*. The event ‘read the dictionary’ is telic when an EndState ‘all the way through’ is overtly indicated as in (4c), but the event remains incomplete, that is, not reaching its EndState because of external factors (termination).<sup>13</sup>

To sum then, first it is the *event* that is telic or atelic – the predicate describes the event, reflects the event, conveys the essence of the event. Telic events have an EndState which may be reached (completed) or may not be (terminated before completion, incomplete). Atelic events have no EndState, thus cannot be completed, only terminated. Note that in examples (4a-c), the event structure of ‘Lorenzo tried to read the dictionary’ by itself is

13 The function of ‘try to’ in each of these sentences is to indicate that the intention was not successfully realized; the opposite meaning is provided by ‘manage to’. Both verbs focus on the completion of the event and, like ‘start/begin to’, do not provide a separate event (Pustejovsky 1995; ter Meulen 1995). They are combined with the following event to create a complex event predicate, not two completely independent events.

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indeterminate with respect to telicity. The additional text is necessary to indicate whether the intended event is telic or atelic. In many languages, such ambiguity would *never* occur because the telicity status is marked (commonly using affixes; e.g. in Croatian, the atelic verb ‘to wipe’ is *brisati*, and the telic verb ‘to wipe up/clean’ is *obrisati*). Van Hout (2000) observes that in English and Dutch, telicity is visible with a verbal particle, such as ‘eat-up’ or ‘op-essen’. However, in English, such differentiation is not always overt (as in example 4), and telicity status must be recovered through syntactic/semantic tests.

There are a number of standard tests for determining telicity in languages in which the surface representation of telicity is opaque (Dowty 1979:60). One commonly used test is co-occurrence with the temporal expression ‘in *x* time’ (telic) contrasted with ‘for *x* time’ (atelic). However, this test is controversial and does not translate well into ASL.

(5)

- a. Quino ate the sandwich in 10 minutes/ \*for 10 minutes. (telic)
- b. Quino ate seaweed for 10 minutes /\*in 10 minutes. (atelic)

(6)

- a. Roberto walked around the park for 10 minutes. (atelic)
- b. Roberto walked around the park in 10 minutes. (telic)

A more useful test for examining event structure in English and ASL is the adverb ‘almost’. In English, ‘almost’ produces a single ‘unrealized inceptive’ reading over atelic events, indicating that an event was almost, but not in fact, initiated (7).<sup>14</sup>

(7)

- Alexandra almost slept (during the long trip but never fell asleep).

With telic events, the same ‘unrealized inceptive’ reading is available (8a), but there is a second ‘incompletive’ reading also available, in which case the event was initiated but did not reach its endpoint (8b).

(8)

- a. Michelle almost read two books. (but never started the first one)
- b. Michelle almost read two books. (but never finished the second one)

In (7) and (8a), ‘almost’ has wide scope over the event initiation, regardless of internal sub-event structure, that is, it is located above the top verbal projection (typically light *vP*). In the incompletive reading (8b), ‘almost’ has narrow scope over only the endpoint of the event, and therefore must be located lower in the tree (below inception and above the EndState). These two readings of ‘almost’ in English are straightforwardly accounted for with a sub-event analysis, which predicts that there are two syntactic positions in telic events for ‘almost’ to take scope, but only one such position in atelic events. Without a sub-event analysis, it is difficult to see how English ‘almost’ could “see inside” telic events in order to modify only the endpoints, but could not do so with atelic events.

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<sup>14</sup> See Rathmann (2005) for discussion of the various incomplete forms, including the conative.

In ASL, the equivalents of the wide and narrow scope readings of ‘almost’ occur in different syntactic positions and are morphologically distinct (C.R. Smith 2007). In the unrealized inceptive, the phonological movement of the sign is halted immediately after it is initiated (in the case of SIT-DOWN, the path movement downward is not articulated; in general, the rapid acceleration for the initiation of the event is immediately followed by terminating the movement), indicating that the event does not take place (Liddell 1984; C.R. Smith 2007).

(9)

I SIT-DOWN+(unreal-incept)  
Isg sit-down.unrealized inceptive  
‘I almost started to sit down.’

In the incomplete (10), the phonological movement of SIT is halted before the sign is completed (its path movement downward ends before the moving hand makes contact with the non-dominant hand; Liddell 1984), corresponding to the narrow scope of ‘almost’ in English.

(10)

I SIT-DOWN.incomplete  
Isg sit-down.incomplete  
‘I almost sat down (but stopped myself before contacting the seat).’

C.R. Smith (2007) demonstrates the use of ALMOST and the incomplete modification in ASL. With this general background, I turn now to the mapping between sub-event structure and phonological form.

### 3 Morphological mapping of sign formation and event structure

Recent and ongoing work provides support for the following hypothesis (Wilbur 2003, 2005 on ASL; Schalber 2004 on Austrian Sign Language [ÖGS]):

(11)

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

That is, predicate signs contain morphemes that reflect the event structure they represent. These morphemes have regular phonological forms by which they are recognized. For the phonological portion of the mapping, I assume the Prosodic Model of ASL (Brentari 1998) because it already has in place the needed phonological structure (Wilbur 2003).

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 that persist throughout the sign. Brentari (1998:22) defines *prosodic features* as “those properties of signs in the core lexicon that can change or are realized as dynamic properties of the signal (e.g. aperture, setting).” These PFs represent the move-

ment in ASL signs and require specification of at least two phonological timing slots (x-slots).

### 3.1 Extent and Path morphemes

Two of the morphemes supporting the EVH are Extent (phonologically a path) and Path.<sup>15,16</sup> For non-spatial predicates, movement indicates Extent, that is, elapsed time (*t*) of an event (*e*).<sup>17</sup> The absence of Extent means that an event is punctual (Wilbur 2003, 2005). For spatial predicates, such as CL predicates, path reflects movement in space or the morpheme Path. Spatial verbs have been indentified as a separate verb category at least since Padden (1983), and confirmed by Janis (1995). I claim that the default interpretation is temporal (non-spatial predicates); a *spatial* interpretation must be *lexically specified*.

(12)

Extent morpheme: an event has extent (is not punctual). In reduplicated forms, this morpheme also represents the time between recurring similar events indicated by the lexical portion, which is reduplicated. Its phonological form is 'path specification in PF'; in Brentari's model, this is [tracing].

(13)

Path morpheme: an event has extent and its interpretation is spatial in nature (must be lexically specified). Its phonological form is 'path specification in PF'. Again, in Brentari's model, this is [tracing].

Both of these morphemes require the hands to move a distance in space. The difference between them is semantic. In terms of grammaticalization, Duration (time) is further along the grammaticalization cline 'person > object > process > space > time > quality' identified by Heine, Claudi and Hünne Meyer (1991, inter alia). Distance (space) repre-

15 Extent and/or Path reflect the fact that the event semantics either refer to change over time (Extent) or change over location (Path) but of course change over location requires temporal extent (the passage of time). Those that do not refer to change over time or location refer to States that *hold* over time or over location without changing. Either way, given the physics of the world, change occurs either with respect to time (*t*) or with respect to both time and 3-d location (*x,y,z*).

16 Rathmann (2004) argues for a morpheme *xMOV<sub>y</sub>*, which contains not only the path movement but also the specifications for argument agreement (really *xMOV<sub>y</sub>* is at least three morphemes); it occurs in telic predicates with verb agreement. In our event-based model, it is not necessary for the arguments to be specified in this way, because they are determined by the sub-events (cf. Figure 2). Rathmann also posits MOV for those atelic (activity) predicates. Neither morpheme can handle the semantic difference between duration and distance that can be expressed by path; instead, in Rathmann's analysis, both are Duration, and Rathmann posits CL-MOV for spatial predicates, implying that all spatial predicates must have classifiers (but see Brentari & Padden 2001).

17 It is also the case that path movement *between* repetitions/iterations of the same event reflects Extent, that is, elapsed time between such events (Wilbur 2005). This shows up with various aspectual modifications in reduplications of the main predicate sign. Furthermore, when spatial predicates participate in reduplication constructions, the phonological path movement between each occurrence of the event in the reduplicated form is still Extent, that is, time between events.



sents a prior step, and both of them are to the right of ‘process’ (activity, motion). To learn a sign language, one must learn that in predicates phonological path (in space) is most often interpreted as Extent (time), that is, the metaphor TIME IS SPACE has been grammaticalized. Those items (e.g., DRIVE-TO) that retain space as Path (space) are exceptions to this generalization and presumably have to be learned separately (hence the notion of ‘lexically specified’, that is, ‘different’ from the others).

### 3.2 States

In Brentari's model, States are represented phonologically with empty PF nodes, that is, no phonological movement. Such a morpheme consists of a representation in which only Inherent Feature nodes - a single handshape, location, and orientation - are assigned to a single timing slot (for example, the sign SICK). For such a form to appear as an independent sign, there must be physical movement with it, but part of the claim of the Event Visibility Hypothesis is that such movement is just getting the hand into position and then moving away from that position, and is not meaningful, that is, not a separate morpheme (Brentari 1998). This type of movement has been referred to as ‘transition’ movement (Wilbur 1987, *inter alia*); it contrasts with morphemic movement by which the hand gets to the position of the State, such as that seen in the resultative of ‘sick’, discussed in section 4.2.3.

#### 3.2.1 Telic/atelic representation in the Prosodic Model: EndState

For homogenous atelic events, the phonological specifications of the first and second/last timing slots are identical. For example, if the sign is RIDE-BICYCLE, the first timing slot has IF specifications for handshape for both hands (fist), movement (path movement in a circle [tracing], [circle], in vertical plane), orientation (away from body) and POA (neutral space in front of signer, about chest high); these features spread to the second timing slot. Higher in Brentari's tree is the feature [alternate], which indicates that the movement of the two hands with respect to each other will be out of phase (i.e. when one is at peak height of its circle, the other is at bottom of its circle). The specifications for handshape, movement, orientation and POA do not change between the first slot and the second.

In contrast, for heterogeneous telic events, the specifications for the two PF timing slots are phonologically contrastive. These two distinct x-slots are available to provide an initial specification for semantic interpretation as ‘not the endState’ and a second specification that can be interpreted as ‘the endState’. In this respect, the phonology mirrors the semantic opposition discussed by Pustejovsky. Telic events contain one more morpheme

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than atelic States or Processes. I have dubbed this morpheme ‘EndState’ because of its primary function as marking the end of telic events.<sup>18</sup>

(14)

EndState: an affix morpheme which means that an event has a final state and is telic. Its phonological form is ‘a rapid deceleration of the movement to a complete stop’.

### 3.2.2 Telic events: movement with EndState

In the Prosodic Model, the phonological movements that are combined with the EndState morpheme are change of aperture (handshape change, SEND in Figure 3a), orientation change (HAPPEN in 3b), setting change (POSTPONE in 3c), change of location (HIT in 3d).

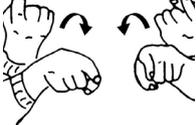
			
a. change of aperture handshape change SEND	b. orientation change HAPPEN	c. setting change proximal / distal POSTPONE	d. change of location with contact HIT

Figure 3: Examples of movements in signs denoting telic events

The three signs without phonological path movement, SEND, HAPPEN, and POSTPONE, are punctual telic Transition events. Phonologically, the handshape change, orientation change, and setting change involve an initial specification for handshape, orientation, or setting on the first x-slot and a different specification for one of them on the final x-slot.

18 Rathmann (2004) has a morpheme HOLD “which abruptly stops the movement of the hand at some point along the path”. For him, HOLD is an “abstract morpheme, meaning that it does not contain overt (lexical) phonological content”; its location along the path is determined by “spatio-temporal conceptual structure which determines the point at which the movement of the articulators is interrupted.” That is, HOLD is seen as an interrupter of the path movement. At the same time, he says that “HOLD is applied to MOV and contributes telicity to the activity that is conveyed by MOV.”

My conception differs. EndState is present only when it is licensed by a telic event, which by definition has an end state. If the path is to be interrupted before it reaches the expected end state, the morpheme ‘incomplete’ must be present and the non-dominant hand is put where the expected end state would have been, and the dominant hand stops path movement where the actual EndState is. Thus, the difference between ARRIVE and ARRIVE –incomplete is that in ARRIVE, the dominant hand makes contact with the non-dominant hand, that is, it reaches the expected end state, whereas with ARRIVE-incomplete, the dominant hand stops short of contact with the non-dominant hand. In Rathmann’s approach, we would have to say that where the hand stops moving adds telicity to the activity, rather than saying that the event is telic and must be represented with an expected end state, which is where the non-dominant hand is located.



No phonological path ([tracing] or [direction]) is present, and therefore these signs do not contain Extent, that is, they are punctual.

In contrast, the sign HIT contains a phonological path (change of location of the fist) and a final specification for EndState ([contact] between two hands, which each represent a participant/argument in a transitive event/predicate); together the phonological specifications of path and final contact are represented in Brentari's model as [direction>]. HIT is a sign that fits Brentari's Direction-of-Transfer Principle, that is, HIT is a transfer verb (something is transferred from source to goal). HIT has a spatial Path meaning, in addition to a temporal meaning. When adverbs modify predicates with specified spatial/Path meaning, only the spatial interpretation of the adverb is possible. So, for example, it is not possible to add Extra [arc] to mean 'it took a long time for him to hit her' (temporal), but it is possible to add it with the meaning 'he wound his arm extra far back to hit her' (spatial). This spatial meaning can be attributed to HIT's origin as a classifier predicate (the fist on the dominant hand is an agentive classifier, the index finger on the non-dominant hand is a whole entity/person classifier; cf. Kegl 1985; Benedicto & Brentari 2004).

### 3.2.3 States and arguments

Because States always have one argument, the point at which the predicate sign movement stops, wherever that is, represents the argument of the EndState. That is, EndState entails an argument ( $x$ ) at a point ( $p$ ) in space where the movement has stopped, but EndState is not the point itself. EndState as a State ( $S$ ) *holds* of the argument entailed at that point, which I will represent as  $S_x$ .

These same phonological x-slot specifications provide the basis for specification of points in space ( $p$ ) for agreement with verb arguments ( $x$ ) (discussed further in section 4.1.2). For example, the final x-slot of SEND can be co-indexed with an antecedent individual (the recipient). Given the absence of path movement in SEND, the hand is instead *oriented* toward the point ( $p$ ) denoting the co-indexed antecedent ( $x$ ). This is further evidence that the EndState is not at the point in space, but merely indicates it – it is the argument reference that is referred to by the point in space (again, discussed further in 4.1.2). With HIT, the nondominant hand may be placed at a point in space ( $p$ ) to show that it is co-indexed with an antecedent argument ( $x$ ) indicating the undergoer, and the dominant (moving) hand (agent, cf. Kegl 1985) will move toward it and make contact (assuming a *completed* event). HAPPEN, with its orientation change, introduces the existence of an event ( $e$ ) into the discourse. POSTPONE only takes events ( $e$ ) as internal arguments, thus the Initial State and the EndState can only be mapped semantically to the time ( $t$ ) of the events. The initial point in space at which the sign starts indicates the 'old' scheduled/expected time of the event, and the final point in space, shown by where the movement stops, indicates the 'new' time of the event with respect to the 'old' time. Thus, if the 'new' point is further away from the 'old' time and the signer, the sign means 'postpone, put off until a later time'. However, it is also possible for the 'new' point to be closer to the signer's body than the 'old' point, providing the mean 'pre-poner, to move to an earlier time.' It is also possible for the time of the event to be meaningfully manipulated in appropriate contexts (15). In (15b), the final occurrence of the sign POSTPONE can be made with two forward movements, one stopping at a point ( $p_y$ ) for one week, and the



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second at a more distal point for two weeks ( $p_z$ ). The discourse context determines how these time points are interpreted (weeks, minutes, etc.).

(15)

- a. WEDDING MUST  $_x$ POSTPONE $_y$   
'The wedding had to be postponed.'
- b. ONE-WEEK TWO-WEEK WANT  $_x$ POSTPONE $_y$ , WHICH  $_x$ POSTPONE $_y$ , $_z^{++}$   
'Do you want to postpone it for one week or two?'

### 3.2.4 Telic non-punctual events: Extent/Path + EndState

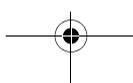
Brentari posits a feature [direction], which is a PF path specification that indicates that the path has contact at a body part or reference plane perpendicular to the direction of movement; when the contact is at the end of the movement, the feature is written [direction >]. Within the EVH approach, this feature is the phonological representation of the combination of the morphemes Extent or Path with EndState.

### 3.2.5 Atelic events: Path in PF, no EndState

In contrast to the above representations of telic events in sign formation, the phonological specifications for the second phonological x-slot in Process signs cannot be distinctive from the first x-slot specification. In fact, they *must* be identical; hence the phonological specification on the second x-slot can be treated as phonological spreading from the initial x-slot. Thus, Processes have phonological path movement, that is, Extent.<sup>19</sup> Brentari uses the feature [tracing] for 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 EndState of the event. In fact, [tracing] is the representation of path movement in atelic events with Extent or Path, whereas [direction] only occurs with telic events. Also, when the Process stops, the movement simply ceases. From a morphemic perspective, the movement of Process events is monomorphemic (there may of course be other morphemes associated with the IF specifications of the lexical item or CL predicate).

An example of [tracing], further specified as having a [straight] shape, is given by RUN in Figure 4a. That PLAY (Figure 4b) has path movement [tracing] was established by Supalla and Newport (1978:101), who identify it as "continuous unidirectional repeated". Here, the repetition is captured by [TM] 'trilled movement'. Finally, the sign READ (Figure 4c) is similar in PF features to PLAY, but obviously the IF features are different.

19 Supalla (1990) notes that Process events like 'limping' do not co-occur in the same sign with spatial path ([tracing]) and must be a serial verb construction in ASL. However, the Indiana dialect of ASL does allow 'limping in a circle', and similar manner and path forms, to be a single complex sign rather than requiring a sequential construction.



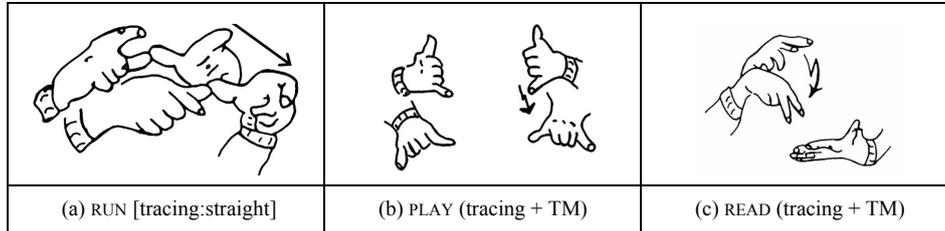


Figure 4: Atelic predicates (phonological descriptions from Brentari 1998)

### 3.3 Adverbial modifiers

I have identified 4 event morphemes of the EVH: EndState, InitialState, Extent, and Path. Two of these are State subevents (End and Initial) and two are Process subevents (Extent and Path). I have also discussed the combination of States and Processes to give an expanded collection of possible types, as well as the relationship between States and their arguments. I will return to this discussion in section 4.

Each of the identified event morphemes and their combinations can be modified by adverbial morphemes. Here I illustrate such morphemes and leave discussion of how best to characterize adverbs in the syntactic trees for a separate investigation.<sup>20</sup>

#### 3.3.1 Extra

The first adverbial is Extra. It modifies predicates containing the morphemes Extent or Path. It must be located in the tree above the projection containing the phonological path specification, since this is what it modifies.

(16)

Extra: an adverbial morpheme meaning ‘extra, more (of)’. Its phonological form is a simultaneous affix consisting of Brentari’s shape feature [arc]. It modifies event predicates containing the morphemes Extent or Path.

#### 3.3.2 USET ‘Unchanging State in Elapsing Time’

The second adverb is USET. It indicates that a State goes on unchanged over time. Its phonological form is Brentari’s PF feature [TM] ‘trilled movement’, providing rapid vibrating, oscillating or tremoring movement. Note that USET only has a temporal interpretation, never a spatial interpretation. I formally define this morpheme as (Wilbur 2003):

<sup>20</sup> The reader is referred to Alexiadou (2004) for an overview of the issues and to Smith (2007) for application to ASL.

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(17)

The affix USET: a morpheme which means ‘Unchanging State in Elapsing Time.’ Its phonological form is the PF feature [TM].

The USET morpheme can be lexicalized as part of lexical items, such as WAIT. It can also serve as an event modifying adverb, a pause filler meaning ‘um’, and as a derivational prefix morpheme, such as the marker of the delayed completive. In my analysis, only the use of [TM] in the sign FINGERSPELL is purely phonological (but not unmotivated, as the finger wiggling indicates the sequence of letters being formed by the hand); that is, FINGERSPELL does not contain USET, only [TM]. All of the other uses retain at least some aspect of the USET morpheme’s meaning. In this sense, [TM] is like [s] in English. It can be the non-morphemic last sound in the lexical item ‘glass’, or it can be a phonological form of any of the morphemes 3<sup>rd</sup>-sg-present ‘walks’, possessive ‘Sarah’s, theirs’, or noun plural ‘cats’.

Brentari (1998:165, 196-205) provides an extensive discussion on the *delayed completive* aspect and the role that [TM] plays in it as a prefix. She observes that the delayed completive can only attach to punctual telic forms (by definition, only telic events have the potential to be complete), and that the attachment is to the first x-slot. My claim is that this prefix is (or is derived from) the morpheme USET, which is represented phonologically by [TM], and that morphologically, USET modifies InitialState, adding the meaning ‘to stay in the initial state without change over elapsed time’. This implies that the event stays in the InitialState ‘for a while’, the interpretation of the extent of ‘a while’ being contextually determined.

My analysis also implies that the predicate sign WAIT contains USET, giving the semantics (roughly) of ‘being in a state of waiting’, that is, indicating passage of time when nothing happens while waiting for an expected event. Both of these uses, delayed completive and WAIT, suggest that USET must occur with potentially durative changeable states.<sup>21</sup> It is important to understand that WAIT is not modified by USET – WAIT contains/ is lexicalized from USET. WAIT is an atelic Process. The lexical meaning of WAIT is ‘wait for e’, but the event structure is V<sub>U</sub>P with undergoer U surfacing as the subject of the sentence (cf. Figure 2). If e is overt, it is a predicate modifier (Rheme), not an argument; that is, WAIT is intransitive.

Another use of USET is as part of another adverb, meaning ‘infrequently, rarely’. In the sign INFREQUENTLY, there is initial contact between the two hands (‘an event occurs’) followed by an Extent+Extra (=curved path) cycle indicating ‘significant time between recurrent similar events’. This movement may then occur with the infix USET ([TM]-wiggling fingers at the top of its arc), to indicate even more time passing with nothing happening between event occurrences, after which the hand returns to contact the other hand again. Without the infix, the form roughly means ‘a long time passes between occurrences of the event of interest’; with the infix, it means roughly ‘a really long time passes between occurrences of the event of interest’, where the event of interest is the event that

21 Rathmann (2004) and Rothstein (2004) allow for ‘derived’ event types, such as ‘derived stative’ or ‘derived accomplishment’, either by combination of two morphemes such as Activity and HOLD (see fn. 13) or semantic type-shifting. Grose (2008) provides an alternative analysis.

‘infrequently’ modifies. The longer the time between such events, the fewer the number of occurrences of the event can be, hence ‘infrequently, rarely’.<sup>22</sup>

### 3.4 Summary of sub-event morphology

In summary, predicate signs representing telic events (Figure 2) all contain the affix morpheme EndState, which is phonologically marked in association with the second timing slot in the Prosodic Features branch of the sign. The resultant movements include the punctual events represented by non-path movement (such as change of aperture, orientation change, setting change).<sup>23</sup> If there is phonological path, the morphemes Extent or Path are present, the interpretation is atelic, and the default phonological form is Brentari’s [tracing], that is, movement over a line (regardless of geometric shape). When Extent or Path and EndState are combined, the interpretation is telic, and the resulting phonological form is Brentari’s [direction], a feature that entails movement to a plane perpendicular to the direction of movement of the hand (e.g. real or abstract contact). The morpheme Extra provides adverbial modification indicating the interpretation of contextually significant ‘long time’ or ‘long distance’, and its phonological form is [arc]. The morpheme USET is also an adverbial modifier which can be affixed to InitialStates to indicate duration.

### 3.5 Support from Austrian Sign Language (ÖGS)

Schalber (2004) investigated the relationship between event structure and phonological form in ÖGS. Her analysis of the ÖGS data confirmed that in predicate signs:

- Telic events are found with the morpheme EndState, with and without Extent/Path;
- Extra extent or distance can be conveyed with the morpheme Extra [arc]; and
- Predicates with atelic event structure contain [tracing], [TM], no PF (no movement), or exhibit reduplication (‘derived atelics’).

She found that, like ASL, predicate signs denoting a State or Process lack the morpheme EndState. Also similar to the ASL data, she found that the phonological features in atelic predicates are [tracing] (18), [TM] (19), and no PF (20).

(18)

MANN	BODEN	WISCHEN: [tracing], [circle]
man	floor	wipe
‘A man is wiping the floor.’		

<sup>22</sup> This infix was originally identified by Judy Kegl in the mid-1970s.

<sup>23</sup> Brentari (1998:151) defines setting change as “the movement between two values in a plane in which the articulator can move.” She notes that there are two ways to disambiguate setting change from path movement. One is metathesis: if the specifications on the first and second x-slots can be reversed (for example, changing ‘top to bottom’ to ‘bottom to top’), then the form has settings, not path. Secondly, if there is a shape specification (for example, arc, circle, outline a triangle, etc.), then the form has path, not setting.



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(19)

BUB	TÄGLICH	ABEND	COMPUTER	TIPPEN: [TM]
boy	daily	evening	computer	type

‘A boy types every evening on his computer.’

(20)

MANN	TELEPHONIEREN: [no lexically specified PF]
man	talk-on-phone

‘A man is talking on the phone.’

#### 4 Relevant Geometry and Physics

The spatial geometry for linguistic recruitment includes: point (1-dimension), line (2-d), and plane (3-d) (see Brentari 1998 for an extensive discussion of how these contribute to the phonological component). With the addition of temporal physics (dynamic motion), we can also recruit distance ( $d$ ) from point<sub>a</sub> to point<sub>b</sub>, where  $a \neq b$ ; elapsed time ( $t$ ), how long it takes to traverse the distance; velocity ( $v$ ) =  $d/t$ ; and acceleration/deceleration (change in velocity over time).

##### 4.1 Geometric point ( $p$ )

There is a substantial literature on the role of points in space and pointing in sign languages. Points ( $p$ ) have been argued to be all or partially linguistic, gestural, spatial, cognitive, among others (Alibašić 2003; Berenz 2002; Liddell 2003). The discussion in the literature has focused on the question of the nature of the mapping between the point and its potentially meaningful function. By itself, the indication of a point ( $p$ ) within a linguistic context signals nothing other than that there is something associated with that particular location.<sup>24</sup> Certain points are reserved for specific meanings, that is, at/to self is ‘I’, along the line between signer and addressee is ‘you’, and points off that line are ‘other(s)’ (Alibašić 2003; Berenz 2002). These three possibilities form the foundation for both personal and spatial agreement in SLs.

##### 4.1.1 Pointing and points

My claim is that the point ( $p$ ) as a *form* is morphologically mapped with the set-theoretic semantic *meaning* ‘individual ( $x$ )’. From a set-theoretic perspective,  $x$  is any entity that can be a member of a set. Semantically, an entity or event that can be a member of a set must be sortal/countable (or what Moltmann 1997 calls ‘integrated whole’). At this formal level of definition, it is irrelevant whether the individual ( $x$ ) has already been introduced into discourse, or even exists. Semantic individuals need not be a person, an object or a concept; they may also be spatial locations ( $l$ ). Because of the metaphorical linguistic rela-

24 As Kegl (1976) has shown, there may be body projections at these points such that the movement is to a height that would be appropriate for the head of a person located roughly at  $p$  (see Liddell 2003 for similar arguments).



relationship between space and time (cf. Clark 1973), it is not surprising that they also function as temporal start ( $t_0$ ) and end ( $t_n$ ) times.

The status of these items as morphemes is in direct contradiction to claims made by Liddell (2003) *inter alia*. For example, Liddell claims that since there are an infinite number of possible points in space, there cannot possibly be any meaning-form mapping because the form is always changing. While I agree that there are in fact an infinite number of possible points in space (and an infinite number of possible members of the referent set), I disagree with Liddell's conclusion that there is therefore no possible form-meaning mapping constancy worthy of being called a morpheme.<sup>25</sup> This is because I am identifying two morphemes, one which represents the State and its holder, and the other which represents the particular individual in the referent set. The first morpheme is the rapid deceleration to a stop, which indicates a point in space ('a point in space refers to  $x$ ') while asserting that a State holds of something in association with that point in space (the holder of the State  $S_x$ ); this meaning-form mapping does not change at all. The second morpheme is 'point in space', which may be co-indexed with a referent if already introduced into discourse, and if not, the point is unbound, leaving the referent to be further specified by discourse. That is, the morpheme is not 'this particular point in space where the sign movement or indicator pointing just stopped'; rather it is the geometric point in space ( $p$ ), which indicates an individual ( $x$ ), no matter where it is made in space. In Klima and Bellugi's (1979) 'exhaustive' and 'allocative determinate' modulations, the movement of the hand comes to a stop at (potentially random) locations somewhere in the relevant discourse context. If the signer wishes to provide an explicit referent for any point, an overt noun must be associated with that point at some time in the discourse. There are an infinite number of possible referents for any *point* in space, just as there are an infinite number of possible referents for 'he', 'she', 'it', 'this', and 'that'. The *referents* are discourse determined, as Liddell suggests, but the form is invariant: a geometric point in space. What Liddell takes to be an 'deictic indicator' to the point I take as an instance of State( $x$ ) (meaning at minimum the *existential*, 'there is an  $x$  about which a property/state will be predicated'). The fact that there are both a State and a holder of the State and that they are represented by specific phonological forms is not discourse determined; rather they are morphemes that must be learned.

25 I know of no reports providing data of more than 5 points in space being used simultaneously in actual sign discourse. The availability of the fingers on the non-dominant hand, especially in ASL where numbers are one-handed, for keeping track of multiple referents is one way that signers can avoid requiring the need to make such multiple distinctions in space. Changing topics, and sometimes the overt sign indicating 'wiping the space clean' to start a new topic, are ways to prevent the unnecessary accumulation of distinct points in space. Under topic change circumstances, the same points can be re-used for other referents, and if a signer does want to refer back to someone discussed in a previous topic, the referent is usually reintroduced. Finally Miller's (1956) magic number for processing 'seven plus or minus two' may be involved as an external constraint.

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Additionally, the point itself is a *definite description* hence quantified, and in the context of appropriate predicates, an internal argument (see Kegl 1976).<sup>26</sup> Again, the point in space is parallel to the English forms *this* and *that*, which are definite and can only have their referents identified by context (e.g. “I want that”) (cf. Larson & Segal 1995 for introduction to the formal semantics of definites). Finally, Neidle et al. (2000) argue that ASL definite determiners do not allow form variations in contrast to adverbials, and that definite determiners are specific to a *point*, whereas locatives may indicate a small *area*.<sup>27</sup> Thus, the point in space has the phonological form ‘point’, and the meaning associated with it is ‘reference to a definite individual who is a member of a set’.

#### 4.1.2 Verb agreement

The function of points as the phonological representation of syntactic arguments can be seen in the verb agreement system in ASL (and other sign languages). ASL has three types of agreement: (1) verb does not agree at all; (2) verb agrees with object; and (3) verb agrees with subject and object (Padden 1983; separated into personal agreement and spatial agreement, Janis 1995; see further discussion in Brentari 1998). Subject-only agreement does not occur, even though it is the most frequent type of agreement in spoken languages. Verbs that do not allow person or spatial agreement have no path movement and do not have the option of using changes in orientation and facing to show agreement in the absence of path movement. Verbs that allow object agreement have path movement (or orientation and facing specifications) with EndState, allowing the final phonological x-slot to be available to indicate a specific (*p*) (thus, they must be telic). If the referent has already been established in space, the specification must be the corresponding location; if the referent has not yet been, or will not be, established, then any point not already used for another referent may be chosen. Because the forms that allow object agreement also have an initial x-slot which must be different from the final x-slot, the initial slot may be used for subject agreement if not already assigned a specific location in the lexical item (e.g., TELL moves away from the mouth and can show object agreement, but cannot show subject agreement because the starting point, mouth, is lexically specified).

Because the phonological specification of both x-slots must be the same for atelic event verbs, they lack distinctive final x-slots, hence no object agreement. Furthermore, the initial x-slot is also unavailable for subject agreement because it must be specified lexically. For example, no subject can be indicated by the hands without spoiling the cyclic formation of RIDE-BICYCLE. Instead, this is a context for a serial verb construction

26 Josep Quer asks if the strong version of this, namely to definitely exclude indefinite descriptions from being associated to points, was intended. He suggests the example: IX<sub>1</sub> <sub>1</sub>GIVE<sub>3</sub> MAN (IX<sub>3</sub>) ‘I gave it to a man’. At least for ASL, there can be third person verb agreement on GIVE for indefinites if and only if the form of GIVE is made essentially with a wrist rotation (pivot) from orientation toward ‘I’ to orientation toward Loc<sub>3</sub>, but not if GIVE actually moves (changes location) between I and Loc<sub>3</sub> in any way that might indicate the presence of a stopping point in space (Brentari 1998:150). As soon as Loc<sub>3</sub> is indicated in any way that implies the presence of a ‘point in space’, the only possible interpretation is definite. An actual indexing movement directed to a point in space eliminates any possible indefinite reading.

27 Rathmann (2005) rejects this claim but does not provide detailed evidence to refute it.



(Supalla 1990). Similarly EAT-GLUTTONOUSLY (2h, alternating) has a form similar to RIDE-BICYCLE, in which the hands circle at mouth height with movement and orientation towards the mouth. No subject can be indicated by the hands; instead body/perspective shift, point of view predicate, or overt pronouns are available to separately indicate subject. Thus the absence of subject-only agreement falls out naturally from the proposed analysis.

Space prevents me from dealing with additional implications of the treatment of points in space as members of a set. These include: (a) *set organization*: whether the set is ordered (as in verb agreement) or unordered (randomized, seen in the Klima & Bellugi's allocative indeterminate); whether the set is two-dimensional (line) or three-dimensional (volume, e.g. over time, also seen in the allocative); (b) *set number*: one, two, or plural (and in specific circumstances, 3 and 4 without overt numerical quantification); and (c) *quantification*: collective or individuated; indefinite/non-specific or definite/specific. The various complex aspects, such as the allocative, and the randomized plural in German Sign Language discussed by Pfau and Steinbach (2005) instantiate these additional set characteristics.

## 4.2 Geometric line

### 4.2.1 Path meaning

With the *principled exception* of spatial predicates (such as DRIVE-BY-VEHICLE), where space represents space, and 'tracing' movements which outline a shape or describe a spatial path, movement of the hands along a line represents 'elapsed time'. However, there does not appear to be any attempt to provide a true analogical scale of 'distance for time'; the only possible distinctions are essentially 'none' (punctual, no path) or 'Extent' (non-punctual, path) and with the adverb Extra 'more' (addition of [arc] to increase path).

Why don't classifier predicates and those with [tracing] movement participate in this predicate geometry-meaning mapping system? The answer is that their path movements are already lexically specified as meaning *spatial* path, extent, or shape outline. That is, classifier predicates contain Path. Hence, these paths are not available to be interpreted temporally; length of the path movement does not correlate with temporal duration of the *event*. For example, the descriptive classifier predicate that shows the length of a pipe or board involves two hands moving away from each other; these can stop at a variety of distances apart, indicating a different length with each different stopping point, e.g. a short one, a slightly longer one, a substantially longer one, and so on. Here, the movement stops at different points to show the *boundary* of the extent denoted by the descriptive classifier predicate. However, the translation from *spatial* extent to the *temporal* domain of elaps-

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ing time is not possible: the representation of a longer extent of an object described by a descriptive classifier predicate does not imply anything about time.<sup>28</sup>

#### 4.2.2 Path modifications: adding Extra and Extent

Curved ([arc]) lines provide the phonological ability to show semantically *elongated* time or distance. The sign ARRIVE has a path movement from ‘non-contact to contact’ of the two hands. Adding Extra [arc] gives the meaning of ‘more, extra’, resulting in the meaning ‘it took a long time to arrive’.

In the case of punctual events that are essentially change of state ( $S \rightarrow \neg S$ , e.g. ‘die’ = ‘alive’  $\rightarrow$  ‘not alive’), to extend the time of the event (give it duration, e.g. ‘dying’), Extent is added to the stem, yielding an event structure  $P \Rightarrow S$ . The initial specification for Inherent Features (handshape, etc.) spreads along this path (see related discussion in Crasborn 2004).

With the addition of Extent, it is now possible to interrupt/terminate the movement before the final S specification is reached, indicating the meaning “almost die” (i.e. the event terminates but does not reach the final state). Extent may also be combined with Extra to indicate extra duration of the event after InitialState and before EndState, meaning ‘it took a long time for someone to die.’

#### 4.2.3 Path modifications: change of speed for ‘resultative’

It is important to see that the mapping described above is not simply an iconic recruitment of physical characteristics into gestures, but rather part of the grammatical component. Phonologically, to create the Resultative in ASL, a PF branch with path movement is added to the root containing the IF features of the resulting adjectival State; this path provides the two needed x-slots, the second of which can be interpreted as the resultant end-State.

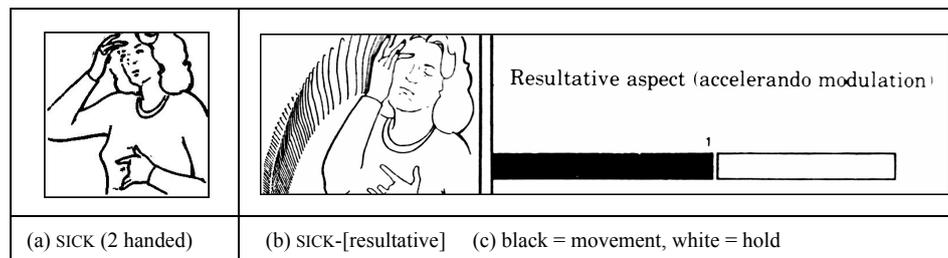


Figure 5: The lexical sign ‘sick’ and its resultative form. Used by permission from Ursula Bellugi, The Salk Institute for Biological Studies.

28 Reviewers suggest that this might not be universal because some classifiers (e.g. whole entity/semantic classifiers, among others) permit repetition with temporal/aspectual interpretation. However, repetition of the movement is not the same as lengthening of the movement. Lengthening of a spatially interpreted path can mean ‘greater distance’. Repetition of the exact same path can mean ‘iterative, happens again and again’, but that form represents repetition/multiple occurrences of an event, not increased time of an event itself (as in ‘took a long time’). Note also that here I am discussing descriptive classifiers, those that indicate extent/shape of an object. Semantic classifiers, at least those in ASL, are in a different class – Brentari calls them ‘whole entity (w/e)’, whereas these she calls ‘descriptive classifiers (DCL)’.

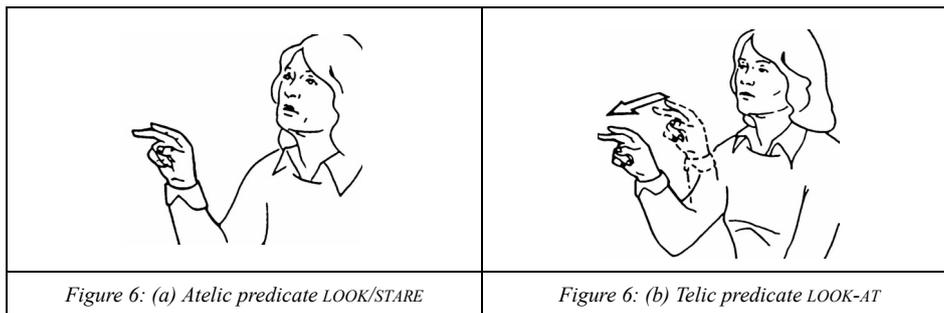
Figure (5a) illustrates the State ‘sick’, phonologically represented as contact of the middle finger with the forehead, that is, IF specifications only. This articulation will become the specification of the final x-slot, hence the EndState, in the resultative form. As can be seen in (b), a path movement has been added before the contact of the finger to the forehead. In terms of sub-event structure, this form is a complex of two sub-events. The added path (Extent) indicates the passage of significant time during the first (atelic Process) event, the “coming” to be sick. The second event is the change of sick status ‘get sick’, from ‘not sick’ to ‘sick’. I claim that the phonological specification of the resultative – change of speed from slow to fast – marks the boundary between the two events and represents another recruitment from the domain of physics into sign language. The rapid deceleration to a stop needed for the contact between the finger and the forehead (even if actual contact does not occur) supplies the morpheme marking End-State of the telic event ‘get sick’. Finally, ‘sick’ is the resultant state, and its stative extent is represented by the *held* contact at the end of the movement (Figure 5c).

Syntactically, SICK has one argument  $S_H$ . In the resultative form, there is still only one argument, which is simultaneously the Holder of the initial not-sick State  $S_H$ , the Undergoer of the Process of ‘getting sick’  $P_U$  and the Holder of the Resultant State ‘sick’  $S_R$ . By subscripting  $S_H$ ,  $P_U$ , and  $S_R$ , we can keep track of the projections in which the sick person is being represented. At the same time, in this example,  $H=U=R$ , that is, there is only one argument in the event, despite three sub-events.

## 5 Applications to more complex structures: Reduplicated structures

### 5.1 Temporal aspect and reduplication

Temporal aspect is constructed from combinations of Extent, Extra and reduplication (Wilbur 2005). Figure (6a) illustrates the atelic predicate sign meaning ‘to look, stare’ and Figure (6b) illustrates the telic predicate sign meaning ‘to look at something (x)’. These two forms are the foundation of more complex forms, illustrated in Figures 7 and 8.



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When there is essentially no time between events, as in the Incessant (Figure 7a), there is a rapid sequence of like movements in which you cannot tell where one discrete event ends and the next begins.<sup>29</sup> When the time between recurrence of telic events is not focused by the signer, which is the default situation, there is a clear return from final position of one event to initial position of next event, that is, a short *linear* return path, creating the Habitual (Figure 7b).<sup>30</sup> For the Iterative, the time between events is long given the context and the signer's evaluation, and the return path between occurrences of each event has Extent+Extra [arc] while the event itself has only Extent (Figure 7c).<sup>31</sup>

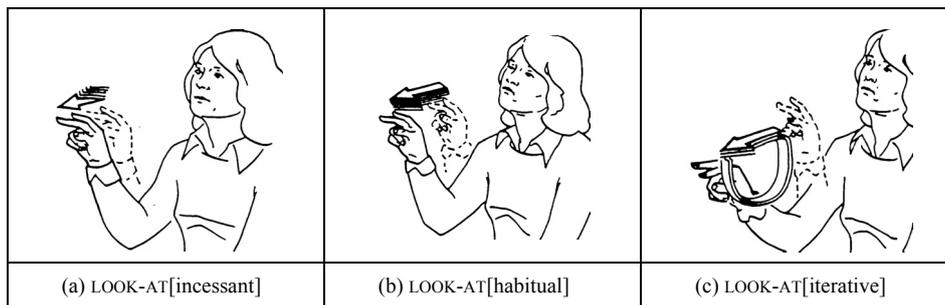


Figure 7: Three temporal aspectual modifications on telic predicates (note stops at arrowheads). Used by permission from Ursula Bellugi, The Salk Institute for Biological Studies, La Jolla, CA.

- 29 The phonological form is [TM]. The Incessant is 'derived from' multiple overlapping telic looking events that have been compressed so that each individual event is obscured and no longer individuated. Note that any aspect that requires reduplication will create an atelic complex predicate.
- 30 I would like to thank Josep Quer for raising the issue regarding the actual default, which I initially and somewhat loosely called 'short'. He notes that when you have habitual interpretation in the past, for instance, the elapsed time can be long: "I used to celebrate Hanukka when I was a child." In this example, there is a year between each occurrence of Hanukka, which is certainly not 'short.' I have reworded the default to 'signer does not focus on the length of time'. The signer can focus on how long the time between events is, adding Extra [arc] for the Iterative, or the signer can focus on how short the time between repetitions of an event is, which is the Incessant.
- 31 The terminology applied to these aspectual modifications is that established in Klima & Bellugi (1979). It is probably time for these to be given a thorough reconsideration to make them conform better with the semantics and aspectual literature, although it is not immediately obvious exactly which literature should be followed (discussion in Wilbur 2005).

In contrast to these reduplications of telic events, recurring atelic events do not have stops in their movement (Figure 8).<sup>32</sup> What Klima and Bellugi (1979) call the ‘durative’ refers to a single long event, whereas their ‘continuative’ refers to long events on different occasions over time. Klima and Bellugi (1979:257) provide an example of the usage of ‘continuative’ aspect with adjectival predicates that best exemplifies the multiple ‘extended event’ reading on ‘different occasions’:

(21)

SUPPOSE[+] TIRED[+], FOR\_SURE SISTER SILLY[M:continuative]  
 ‘If my sister becomes very tired, she will surely act silly for a long time.’

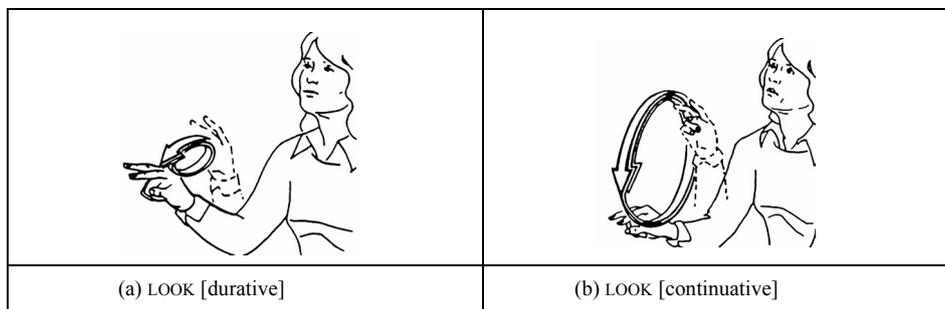


Figure 8: Two temporal aspectual modifications on atelic predicates (arrowheads indicate direction, not stops). Used by permission from Ursula Bellugi, The Salk Institute for Biological Studies, La Jolla, CA.

Note that both the durative and continuative aspects use curved paths; a straight line followed by a curved line 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 with an End-State. Thus, the absence of iterative-like forms for atelic events is explained by the present analysis.

32 Josep Quer notes that “in the semantic literature, sometimes the distinction between habitual/iterative is made in terms of mass-uncountable vs. countable repetitions.” However, there does appear to be some disagreement about this. Moltmann (1997, chapter 7) argues that event verbs, even conjunctions, in general are *mass* in nature; for example, note the singular pronoun ‘it’ despite countable conjoined antecedents: “Mary danced, fell, hit her head and died. *It* happened yesterday.” In another paper, Barner, Wagner & Snedeker (2005) explore the mapping between mass-count syntax and semantics, and how event semantics affect the meaning of derived nouns. They argue that their results “provide evidence against the idea that mass nouns force an unindividuated construal” and that verb iterativity is linked to individuation by mass and count nouns. My conclusion is that further investigation of the relationship between the mass-count distinction and the habitual-iterative distinction is warranted.

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## 5.2 Distributive quantification: Another role of points in space

The relevance of specified ( $p$ ) is seen in distributive quantification ‘verb to each  $x$ ’. That is, each  $x$  ( $x_1, \dots, x_n$ ) is represented by  $p$  ( $p_1, \dots, p_n$ ), each production of the verb stops at each recipient  $x$ , and the result is ‘repeated stops at multiple points in sequence’ (Figure 9a). Normally, at least three productions of the verb movement stopping at the distinct points are made for the general meaning ‘distributed plural, more than two’. Under circumstances with prosodic equality of each movement, these productions can be made to mean ‘exactly three’ or ‘exactly four’. Figure (9b) illustrates distributive quantification inside the scope of an iterative temporal aspect (Wilbur 2005; Wilbur, Klima & Bellugi 1983; Grose, Wilbur & Schalber 2007).

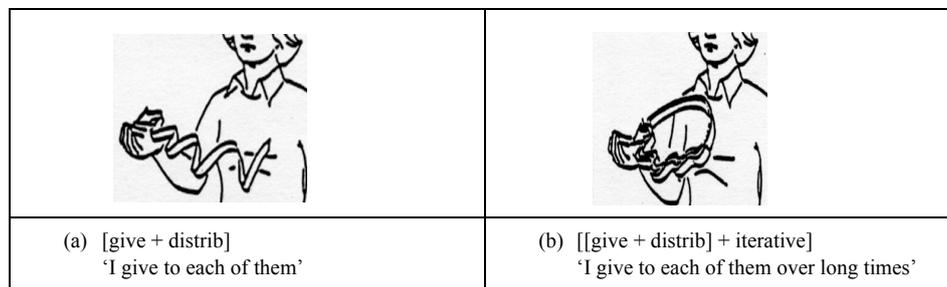


Figure 9: Distributive quantification, and distributive quantification embedded in iterative. Used by permission from Ursula Bellugi, The Salk Institute for Biological Studies, La Jolla, CA.

## 6 Universality and grammaticalization

Given that the physical options discussed in this paper are universal, it is expected that sign languages will recruit these options and assign them various meaningful functions. It is an empirical question whether the functions that they are recruited to perform are similarly universal or vary widely. But this generalization may provide the fundamental similarity that makes sign languages look more similar to each other than spoken languages do (Newport & Supalla 2000).

These resources are grammaticalized into SLs. They are not present in communal gesturing such as that used in Nicaragua among deaf children before Nicaraguan SL emerged, even though the meaning is conceptually available (Kegl, Senghas & Coppola 1999; Senghas & Coppola 2001). That is, there is a disconnect between the basic conceptual nature of the meanings expressed and the forms required to express them, indicating grammaticalization into abstract linguistic systems of SLs (Rathmann & Mathur this volume; Casey 2004). Evidence in favor of this claim is that the default interpretation of Extent is temporal (widest use with verbs), and not spatial (restricted number of verbs, Zwitserlood 2004). It is grammaticalization that requires the learners of each sign language to discover that visible *spatial* path means *temporal duration* most of the time, rather than the more obvious mapping of visible spatial path to ‘spatial path meaning’.

The idea that there is a correlation between the formation of verb signs and their temporal aspect is not a new one. Fischer (1973) noted the relationship between durative

meaning and slow reduplication. Supalla and Newport (1978:103) make the following correlations: “in general single movement in the sign corresponds to single, punctual or perfective action. Repeated movement, in contrast, refers to durative or iterative activity which is made of repeated punctual actions (e.g. SMOKE is composed of iterative actions of bring a cigarette to the mouth).” What I hope to have shown here is both the extent of this relationship and its systematicity, as well as its fundamental role in the grammatical structure of sign languages.

## 7 Acknowledgements

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