5

Telicity expression in the visual modality

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5.1 Introduction

The process of parsing continuous reality into discrete events is an automatic component of human visual perception (Baldwin et al. 2001; Speer et al. 2007; Zacks and Swallow 2007). Research in perceptual psychology has demonstrated that humans rely on velocity and acceleration patterns of an actor's motions to identify event boundaries in visual scenes (Zacks et al. 2009; Zacks and Tversky 2001). Event Segmentation Theory (EST; Zacks et al. 2007) proposes that perceived events are represented in working memory, forming predictions for future parameters of sensory input; when perceived kinematic parameters change drastically (leading to increased error in the predictive power of working memory representation), an event boundary is perceived, the working memory is updated to reflect the new event, and an anchor time-point is relegated to long-term memory.

Virtually identical event segmentation and working memory update phenomena have been observed for perception mediated by linguistic input: readers appear to construct situational models based on linguistic clues to temporal references available within the narrative (Rinck and Bower 2000), and to utilize the same neural substrates to segment and memorize narrated events as the ones observed directly (Speer and Zacks 2005). If event segmentation is indeed a ubiquitous cognitive phenomenon, responsible for modulating working memory and updating long-term memory, then what linguistic means are used to communicate the temporal references required for these processes to take place?

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The structure of events denoted by linguistic predicates has long been of interest to linguistic theory as the source of possible semantic primitives (Vendler 1967; Verkuyl 1972; Dowty 1979; Jackendoff 1991; Pustejovsky 1991; van Hout 2001; Van Valin 2007; Ramchand 2008). One such element, found in the majority of languages, pertains to predicate telicity (also sometimes referred to as event completion, or boundedness). Telic predicates describe events as having a specific temporal endpoint, whereas atelic events do not. The internal makeup of an event is referred to as event structure.

Linguistic means of expressing telicity vary among languages. In English, for example, telicity can be expressed at the lexical level (e.g. fall, break), or at the level of the VP or the entire predicate, by quantifying the internal argument (eat the cake), or otherwise measuring out the event, such as providing it with a bounded path (run a mile, swim to the shore). Either method of quantification provides telic events with an end time-point, which is interpreted at the level of external, or viewpoint aspect.[1] Both internal (event structure) and external (viewpoint) aspect can be realized by lexical or grammatical means. For example, in American Sign Language (ASL), as well as its contact spoken language—English—the event structure is encoded at the lexical or phrasal level, while external aspect is grammaticalized. Slavic languages, on the other hand, frequently conflate the expression of internal and external aspect in a single grammatical morpheme.[2] Croatian Sign Language (HZJ), as well as its contact spoken Croatian, exhibits this phenomenon to a considerable degree. However, even in cases of morpheme conflation, internal and external aspect are conceptually separable (Bertinetto 2001). At the level of external aspect, the speaker makes the distinction between viewing an event from the outside (perfective aspect), or from within (continuous aspect). When a telic event is described in continuous aspect, the information about whether it reaches its endpoint is withheld.

Representation of the event endpoint in various languages has been of particular interest to linguists and psycholinguists, as it both affects the syntactic structure of the sentence, and is used by comprehenders during online sentence processing (O'Bryan 2003; Malaia et al. 2009). Sign languages (SLs), as interfaces of linguistic and visual motor behaviors, provide unique insights into the underpinnings of linguistic representation of real-world events, since the visual modality of signing matches the perceptual interface tied to event segmentation, and SLs are able to recruit physical properties of visual space and motion to convey linguistic information. Is it possible that the sensory features utilized in event perception can be overtly represented in sign languages? And if so, are the same physical features used in different SLs to convey the meaning of telic, change-of-state event?

[1] External, of viewpoint, aspect presents a view of the event (sometimes termed "the situation") from the outside, without regard to its internal structure (Smith 1991).

[2] The same conflation phenomenon can be observed in nouns, where a single morpheme, e.g. -a in Russian, can denote both singular and feminine grammatical features.

5.1.1 *Structure of sign languages*

Sign languages utilize finite inventories of handshapes, signing locations, and movement patterns as a phonological base, and superimpose fluctuations in signing rate and amplitude of motion as suprasegmental features. For example, both sign and spoken languages are amenable to the process of Phrase-Final Lengthening, whereby the last word in an intonation phrase is articulated at a slower rate, as compared to the rest of the production.

Sign languages differ with respect to their phonemic inventories (e.g. the types and combinations of handshapes, signing location, and motions allowed in a particular sign language), and with respect to lexical signs themselves. The latter means that sign languages are not "iconic" in the lay sense of the word, nor are they mutually intelligible. However, despite mutual unintelligibility, from the point of view of a non-signer SLs appear to be more similar to each other than spoken languages are (Newport and Supalla 2000). Wilbur (2003, 2005, 2008) has suggested that such similarities are due to the fact that sign components, especially for predicate signs, 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) has made a further linguistic observation that ASL lexical verbs could be analyzed as telic or atelic based on their movement parameters: telic verbs appear to have a sharper ending movement to a stop, reflecting the semantic end state of the affected argument. The observation that semantic verb classes are characterized by certain movement profiles in SLs was formulated as the Event Visibility Hypothesis (EVH), which predicts that the phonological makeup of signed predicates will correlate with the physics of motion in the real world. More specifically, it predicts that semantics of telicity will be reflected in the kinematic features at the end of predicate signs.

The experiment reported here investigated kinematic correlates of telicity in two unrelated sign languages—American Sign Language (ASL), and Croatian Sign Language (Hrvatski Znakovi Jezik, or HZJ). In ASL, event structure ((a)telicity) can be expressed at the lexical level by different verb roots. Further morphological changes can be applied to verb signs to express grammatical aspect (such as reduplication for several progressive aspects; Klima and Bellugi 1979; Wilbur 2005, 2009b). The event structure of ASL verbs affects their morphosyntactic behavior (Brentari 1998); for example the morphological process "delayed completion" only applies to telic signs (related to the fact that telic verbs, but not atelics, have an event endpoint which can be "delayed").

HZJ presents an interesting contrastive case for investigation of event structure expression in sign kinematics. HZJ is unrelated to ASL (on the basis of which the EVH was formulated), and it has spoken Croatian—a member of the Slavic

language family—as its contact spoken language. Slavic languages frequently conflate event structure and viewpoint aspect semantics into the same morpheme, creating pairs of verbs (atelic and imperfective versus telic and perfective) from the same verbal root[3] (Bertinetto 2001; Filip 1999; Malaia 2004; Borik 2006). In HZJ, the majority of verb signs, including those used in the study, form such aspectual pairs (Milkovi č and Malaia 2010). The HZJ verbs of this type listed in Appendix II differ in both event structure and grammatical aspect. The rest of HZJ verbs fall into two categories. Some do not form event structure pairs at all; the root of these predicates can refer to only one event type, closely related to the semantics of the verb class. For example, verbs denoting transfer of possession are inherently telic, for example DATI (to give), DOBITI (to get); the addition of multiple movement cycles form iterative and/or distributive aspectual meanings. Other verbs are inherently atelic, for example BOLJETI (hurt), IMATI (have), KIŠITI (rain), NADATI-SE (hope), PLANIRATI (plan), and do not have telic counterparts. There is also a category of atelic verbs which form telic predicates by various means of coercion, including a combination with a secondary predicate, quantization of the Patient argument, or specification of the path endpoint.

In this chapter, we describe an experiment which investigated kinematic correlates of event structure in two sign languages: ASL and HZJ, attempting to answer the following questions: (1) Do signers mark event structure kinematically in predicate signs? (2) What are the kinematic features associated with telicity in predicate signs? (3) If kinematic markers of telicity are present in either language, how do they interact with known kinematics of signed prosody? (4) What are the similarities and differences in the kinematic makeup of predicate signs in a sign language with lexical event encoding (ASL) versus grammatical event encoding (HZJ)? The results in two experiments demonstrated that both ASL and HZJ signers reliably mark predicate telicity using higher peak signing velocity, and rapid deceleration following peak velocity. In both languages, Phrase-Final Lengthening affected sign kinematics such that phrase-final predicates were signed slower that those in phrase-medial position; however, in telic signs, only the portion of the sign preceding the peak velocity was amenable to this prosodic effect. In addition to demonstrating that the event structure of signed predicates is reflected in the kinematic features of hand motion during signing, the experiments offer a new, scientifically rigorous approach to the study of phonology and its interfaces in sign languages.

[3] The event structure (internal aspect) and external aspect are still distinguishable in Slavic languages, if only by the few perfectivizing morphemes which do not affect event structure (e.g. perfectivizing prefix po- in Russian).

5.2 Methodology: linguistic and kinematic assessment of telicity in verb signs

In order to investigate the kinematics correlates of event structure, we selected signed predicates (telic and atelic) using linguistic tests, and conducted motion capture recording of chosen predicates produced by native signers. We manipulated the environment in which the predicates were produced in order to assess the possible prosodic effect of Phrase-Final Lengthening on the kinematic variables: each verb was produced in isolation, in a carrier phase, sentence-medially, and sentence finally. For the kinematic analysis of the produced signs, we automatically extracted five kinematic features from the predicates produced in each prosodic condition. The features were then subjected to multivariate analysis of variance (MANOVA) in order to determine which of the features most robustly discriminated between telic and atelic predicates in both phrase-medial and phrase-final prosodic conditions in each sign language.

Various linguistic tests have been used in the literature to demonstrate that telicity is a semantic notion reflected in the grammatical system. The most widely used tests for spoken languages include the temporal adverbial modification test (Verkuyl 1972; Dowty 1979), and the conjunction test (Verkuyl 1972). Telic predicates can be modified by so-called "frame" adverbials, which overtly specify the duration of the event before its endpoint (e.g. "in an hour"). Atelic predicates, on the other hand, can only be modified by "for an hour" type adverbials, limiting the temporal extent of the durative portion of the event without any implications for a natural endpoint. The conjunction test is also based on the semantics of temporal modification: when telic events are combined with a modifier consisting of two adjoining time periods (e.g. "on Sunday and on Monday"), the resultant interpretation is that of two distinct events ("The car died on Sunday and on Monday"). Atelic verbs modified by such adverbials yield an ambiguous interpretation: they can be understood as denoting a single event spanning both time periods, or two separate eventualities (e.g. "She slept on Sunday and on Monday").

Additionally, "almost" modification has been used as a test in sign language research to identify telic predicates (Smith 2007).[4] Finally, telic predicates can combine with the phase verb concentrating on the endpoint subpart of the event, such as "finish," whereas atelic ones do not (cf. Borik 2006). For this study, we elicited a native signer's assessment for 50 ASL verb signs using the adverbial modification

[4] The "almost" modification test allows differentiating between telic predicates (e.g. in English, telic "I almost read the book" does allow for some part of a reading event to have occurred, but not to its culmination in completing the entire book), and atelic ones (cf. English "I almost ran," which is equivalent to negation of the entire event, "I did not run at all").

test, the conjunction test, the "almost" modification test, and the FINISH combinability test.

In the adverbial modification test, ASL predicate signs were considered telic if they combined with the sign meaning "it took an hour,"[5] and atelic if they combined with the signs meaning "for an hour." For the conjunction test, we tested the predicates' meaning in the sentence "she did V(erb) on Sunday and on Monday" (or other appropriate subsequent temporal units). If the resulting sentence was interpreted as denoting two discrete events, the predicate was considered telic; if the sentence referred to one long event, the predicate was considered atelic. If the predicate combined with the sign meaning "almost" (or the sign movement modification for incompletive) yielding the meaning of "one did not complete doing V(erb)," we interpreted this as the presence of an endpoint (which was not reached) in the event structure of the predicate; these predicates were considered telic. If the predicate combined with "almost" and could have *only* the meaning "one did not start doing V(erb)," the predicate was considered atelic. As expected, some of the telic predicates allowed both interpretations. Finally, the predicates were examined for combinability with event phase signs FINISH and STOP. In cases where the predicate combined with FINISH with the "completive" meaning (Fischer and Gough 1999), we interpreted the verb as having an inherent endpoint (i.e. telic). If the predicate did not combine with the sign FINISH meaning "completed," but only with the sign FINISH meaning "already, in the past," and/or instead could only be combined with STOP,[6] we considered it an atelic predicate.

Results of the linguistic tests were combined in order to classify the predicate as either telic or atelic. When telicity interpretations differed between the four tests for a predicate, signaling the possibility of frame structure alternation (Levin 1993), the predicate was eliminated from the final set of 40 stimuli, resulting in 24 telic and 16 atelic signs (Appendix I).

For the study of predicate production in HZJ, 120 imperfective-atelic Croatian verbs and 120 of their perfective counterparts were translated into HZJ in order to identify the mechanisms of temporal-aspectual category expression (Milkovi č and Malaia 2010). A subset of 30 temporal-aspectual sign pairs was selected for further investigation using motion capture recording (see Appendix II).[7]

[5] The ASL expression best transcribed as "it took an hour" is equivalent to "framing," "in an hour"- type adverbials in spoken English, the temporal modifiers specifying the time elapsed to a referenced time-point.

[6] STOP provides the meaning "terminate" without any implication of completion.

[7] We did not have an expectation that items similar in overall semantics in ASL and HZJ would necessarily have a similar event structure; on the contrary, some cross-linguistic differences were expected. As noted above, telicity-perfectivity marking is a widespread feature in the HZJ (but not ASL) verbal system. This allowed us to find a larger number of HZJ predicates with event structure clearly determined by linguistic tests, as was necessary for quantitative analysis.

For the ASL motion capture portion of the study, the 24 telic and 16 atelic signs were randomized, and elicited from six participants in the following linguistic conditions: in isolation, in the carrier phrase "SIGN X AGAIN," sentence-medially "SHE X TODAY," and in sentence-final position "TODAY SHE X." The conditions were the same for all participants: after completing a practice trial, they saw the stimuli in the same order, and signed to the camera while standing. One production per condition was collected for each signer (thus, we recorded 160 productions per signer for six signers). For the HZJ motion capture portion of the study, one native HZJ signer followed the same protocol on five separate days of recording.

The positional data from the marker on the right wrist, tracking the movement of the dominant signing hand, was used for the analysis. A simultaneous video recording at 30 frames per second was made with a NTSC video camera on a tripod outside the motion capture recording field. Both the video and the 3-D positional data were imported into ELAN[8] annotation software, and aligned using the audio marker and T-pose (the signer standing with hands extended to the sides at shoulder level) at the beginning and end of each recording. The video was annotated in ELAN by a native ASL signer, who marked the beginning and end of each target sign following procedures established by Green (1984), assuming the first frame of recognition of the sign-initial handshape as the beginning of each predicate, and either the point of contact, or maximal distance traveled by the hand, as the end of the sign. Thus, the onset and the ending of each sign were defined linguistically based solely on the video cues, without access to kinematic variables. The time points for the beginning and end of each sign were extracted from ELAN annotation of the video data, and processed in MATLAB to extract speed and acceleration profiles for each predicate from the recorded kinematic files.

Selection of kinematic features for investigation was based on previous research in linguistics and psychology. Prior research in event perception has suggested that movement speed and acceleration/deceleration are the markers which enable humans to segment meaningful events from continuous reality (Zacks et al. 2009). The Event Visibility Hypothesis (Wilbur 2003) proposed that sign languages denote telicity by perceptual "end-marking," as potentially measured by the slope of deceleration from peak velocity to the end of the sign, which leads to concomitant changes in other kinematic properties of the sign—namely, sign duration, peak velocity itself, and the timing of peak velocity within the predicate.

[8] Max Planck Institute for Psycholinguistics, <http://www.lat-mpi.eu/tools/elan/> accessed September 30, 2011.

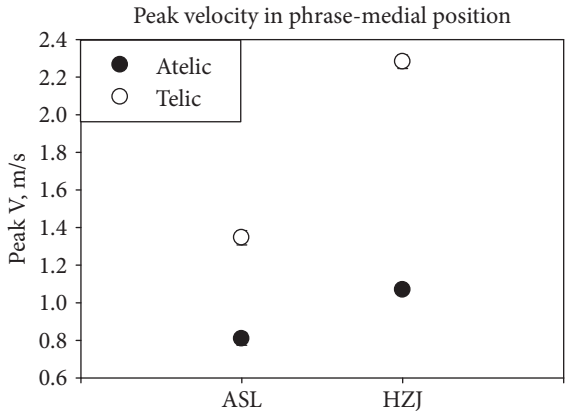

FIGURE 5.1 Production differences in velocity between telic and atelic predicates in HZJ and ASL in medial position.

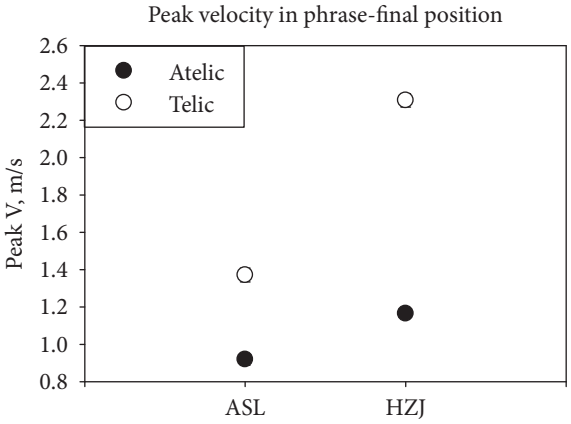

FIGURE 5.2 Production differences in velocity between telic and atelic predicates in HZJ and ASL in final position.

Based on these proposals, the following metrics were calculated for each verb sign:

(a) the duration of the sign in milliseconds (duration);
(b) peak instantaneous speed[9] achieved within each sign (maxV) (figures 5.1 and 5.2);
(c) the percent of sign movement elapsed to the moment where peak speed occurred (% elapsed), which is also the point at which deceleration starts (figures 5.3 and 5.4);

[9] As calculated from displacement between two motion capture recording points, i.e. 0.016 of a second.

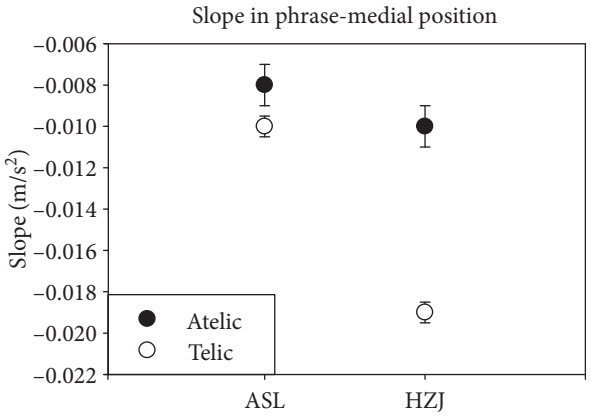

FIGURE 5.3 Production differences in slope between telic and atelic predicates in HZJ and ASL in medial position.

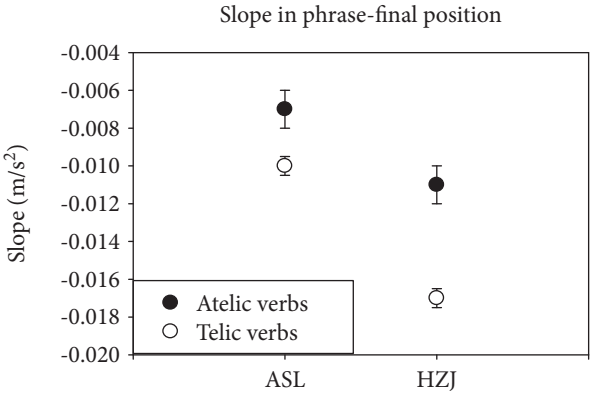

FIGURE 5.4 Production differences in slope between telic and atelic predicates in HZJ and ASL in final position.

(d) maximum instantaneous deceleration within each sign (maxD) (figures 5.5 and 5.6);
(e) the slope of deceleration, calculated as the difference between maxV and the following local minimum, divided by the number of milliseconds over which it occurred. The slope measured the average steepness of the deceleration from maxV to the following minimum velocity, whereas maxD measured the maximum instantaneous deceleration.

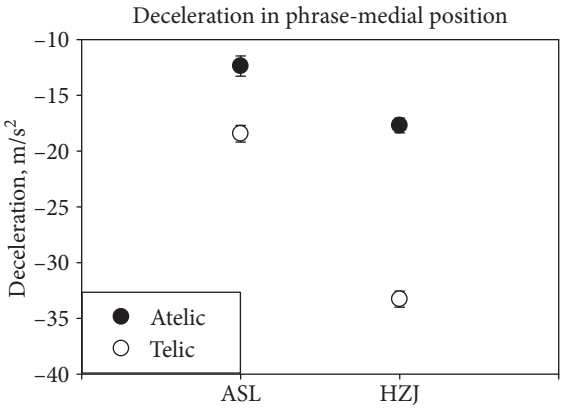

FIGURE 5.5 Production differences in deceleration between telic and atelic predicates in ASL and HZJ in medial position (deceleration is reported as a negative value, as compared to the positive value—acceleration).

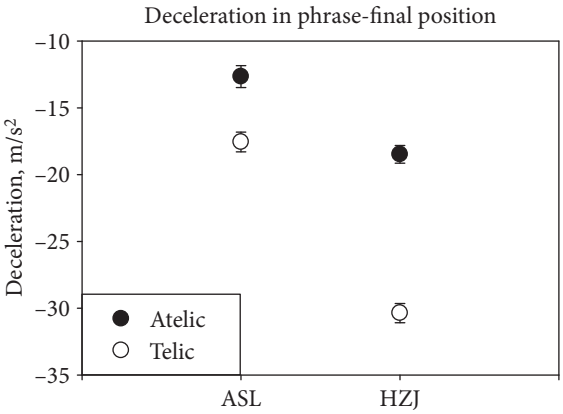

FIGURE 5.6 Production differences in deceleration between telic and atelic predicates in ASL and HZJ in final position (deceleration is reported as a negative value, as compared to the positive value—acceleration).

5.3 Kinematic features representing telicity in ASL and HZJ

Multivariate analysis of variance was conducted to determine the effect of each independent factor (Predicate Type, Position) and their interaction (Predicate Type × Position) on each of the dependent kinematic variables; the overall results for ASL and HZJ are presented in Tables 5.1 and 5.2, respectively. All significant ($p < 0.05$) effects are reported for ASL (Table 5.1) and HZJ (Table 5.2), along with

Table 5.1. Significant effects of Predicate Type and Position on ASL signs

Kinematic variable	Predicate type			Position			Predicate type × Position		
	F (1,916)	$p<$	η_p^2	F (1,916)	$p<$	η_p^2	F (1,916)	$p<$	η_p^2
duration	11.036	.001	.012	29.573	.001	.031			
maxV	78.301	.001	.079	13.092	.001	.014			
% elapsed	4.393	.036	.005	4.323	.038	.005	4.099	.043	.004
maxD	52.614	.001	.054						
slope	29.645	.001	.031						

Table 5.2. Significant effects of Predicate Type and Position on HZJ signs

Kinematic variable	Predicate type			Position			Predicate type × Position		
	F (1,1170)	$p<$	η_p^2	F (1,1170)	$p<$	η_p^2	F (1,1170)	$p<$	η_p^2
duration	68.375	.001	.055	31.292	.001	.026			
maxV	641.448	.001	.354						
% elapsed	28.925	.001	.024	22.288	.001	.019			
maxD	356.863	.001	.234	6.522	.011	.006			
slope	306.200	.001	.207	8.886	.003	.008	4.58	.033	.004

the ratio of variance in the data for predicate type and position explained by each of the kinematic features (F), and the effect size, or the proportion of total variance attributable to each kinematic feature, excluding other factors from the total non-error variation (η_p^2).[10]

As expected, both languages exhibited robust effects of Phrase-Final Lengthening: verb signs in sentence-final position were significantly longer, as compared to the same verbs in sentence-medial position (Liddell 1978; Wilbur and Nolen 1986). Statistical analysis also demonstrated regular kinematic distinctions between telic and atelic verbs in both languages. Of special interest for investigating telicity expression were the features which proved resilient to the prosodic effect in

[10] For those readers who may be less familiar with experiment reporting tradition, results that are not significant are left as blank cells in the tables, allowing readers to focus on those effects that do meet the statistical criterion ($p < .05$) for significance.

Phrase-Final position: maxD and slope in ASL, and peak velocity within the sign in HZJ.

Sentence-finally, the maximum deceleration, and the overall slope of deceleration in ASL were unaffected by the prosody. As there is virtually no vision research on human ability to assess deceleration (Schmerler 1976), it is not clear whether one of these measures might be more indicative of the kinematic cues used by the native signers. Telic signs were characterized by higher peak velocity in both ASL and HZJ sentence-medially, but the difference remained significant in the sentence-final position only in HZJ (Figures 5.1 and 5.2).

The findings show that manual languages express telicity by different kinematic features. It is possible that the more regular expression of telicity (as, for example, in HZJ) leads to regularization of its kinematic representation by, perhaps, a more easily accessible kinematic marker, such as velocity. Both deceleration and velocity had been shown to contribute to event parsing in psychological research (Zacks et al. 2009), but this area of research is still novel to both psychology and linguistics, and more kinematic studies are needed to assess how different motion features are perceived and processed.

In HZJ, the more widespread manner of telicity marking allows the formation of temporal-aspectual verb classes from the same sign root, such that rapid deceleration following peak velocity constitutes a morphemic affix denoting both telicity and perfectivity, similar to affixes observed in ASL for various aspectual purposes, for example different types of reduplication (Wilbur 2005, 2009b).

5.4 Event structure: from real world to manual languages

The data on sign production in ASL and HZJ demonstrates that the final part of telic signs is marked by a rapid deceleration at the end of the sign, or higher peak velocity within the sign, as compared to verb signs denoting atelic events. Overall, the findings confirm the Event Visibility Hypothesis for sign languages (Wilbur 2003, 2008), by demonstrating that physical properties of event endpoints (such as velocity and deceleration of movement) are recruited in sign languages to represent subatomic event structure, and are evident in sign production across sign languages.

The two sign languages, however, differ in how frequently they present telic events as entailing a resultant state. While ASL encodes the telic event structure in the lexical entry of the verb (i.e. verbal lexemes are either telic or atelic), HZJ allows minimal pairs of telic–atelic signs with the same root, which differ only in the kinematic profile. A higher incidence of overt event structure marking in HZJ might be due to the similar phenomenon in its contact spoken language—Croatian, a member of the Slavic language family (Bertinetto 2001).

It needs to be mentioned that the Event Visibility Hypothesis is not intended to be exceptionless. It does not propose that core event semantics should be the same

across languages—merely that the telicity feature, which can be ascertained by semantico-syntactic tests, can be manifested in sign language phonology (Wilbur 2010). Furthermore, it should be expected that phonological manifestations of telicity reflecting the physics of motion might differ among sign languages. Event Visibility can be conceived of as a domain-specific instantiation of a more general hypothesis: that the perceptual skills and neural substrate utilized for real-world event segmentation might also underlie linguistic processing of event structure in sign languages. The latter hypothesis will require extensive cross-linguistic analysis of perception and neural processing of both real-world and linguistic events. However, the present work presents a rigorous quantitative approach to addressing this question for languages in the visual domain, and for developing and testing further hypotheses based on empirical data.

The findings demonstrating that complex event structure is expressed by kinematics of hand motion in signed predicates raise further questions about the psychology of event parsing and representation, both in the human mind and in human languages. Further research is necessary to determine how the perceptual cues provided by the kinematics of the predicate are interpreted by the recipient of signed discourse. Also of interest is an investigation of the relationship between event parsing in perception and linguistic events, especially the sensory and conceptual features which might impact the correspondence between the two. If, as our findings suggest, such features exist in at least two sign languages, are they used by infants during language acquisition? Previous studies have shown that infants parse dynamic scenes using low-level visual features, such as identification of continuity versus change in overall body trajectory (Baldwin et al. 2001), but further studies are needed to investigate whether changes in object speed and acceleration might be of similar value to infant perception.

From the perceptual standpoint, is there a threshold of deceleration which would cause one to interpret an event as telic in ASL or other sign languages? Our results did not suggest a categorical distinction between telic and atelic signs based on absolute values of assessed kinematic features. However, given that perception of deceleration is better than that of acceleration (Schmerler 1976), and that kinematic variables like duration are significantly affected by signing rate (Wilbur 2009a), there is not likely to be a specific value to answer this question, but rather a relative value such as angular velocity,[11] or ratio of deceleration to some other variable. The reported studies of ASL and HZJ are the first ones to provide motion capture measures for such observations. However, there is some evidence that Austrian Sign Language linguistically manifests such differences in the type of non-manual markers (specific mouth gestures,) accompanying predicate signs, such as a change in jaw position for

[11] We thank Martha Tyrone for this suggestion.

telic predicates (see Schalber 2006). So, would the finding of event visibility in ASL and HZJ generalize to other sign languages, both established ones, and those emerging from homesign systems? The evolutionary significance of non-linguistic perceptual skills (such as that of event segmentation) to the development of linguistic communication remains one of the most elusive questions in cognitive science. The studies presented, however, illustrate an intriguing correlation between kinematic features used in event segmentation, and those evident in the production of visual linguistic events.

Appendix I

The following ASL predicates, which were identified as belonging to telic or atelic classes based on the results of all four linguistic tests, were selected for investigation:

- Telic predicates ($N = 24$): *sting, throw, hit, plug-in, appear, catch-up, open-door, ruin, eat-up, check, take-from, zip, close-door, seize, disappear, arrest, become, look-at, arrive, die, relax, steal, suggest, shut-down-computer.*
- Atelic predicates ($N = 16$): *travel, ride-in, collect, live, proceed, shave, follow, write, stay, interrupt, draw, sew-with-machine, send, have, investigate, swim.*

Appendix II

Table 5.3. HZJ signs elicited, and their English translations

Atelic and imperfective form	English translation	Telic and perfective form	English translation
BUDITI	to be waking up	PROBUDITI	to wake up
PUTOVATI	to be traveling	OTPUTOVATI	to take off
PUTOVATI	to be traveling	DOPUTOVATI	to arrive
GLEDATI	to be looking at	UGLEDATI	to spot, to notice
GURATI	to be pushing	GURNUTI	to give a push
BRISATI	to be wiping	OBRISATI	to wipe off
CRTATI	to be drawing	NACRTATI	to draw up
ČEŠLJATI	to be combing	POČEŠLJATI	to comb through
ČISTITI	to be cleaning	OČISTITI	to clean up
ČITATI	to be reading	PROČITATI	to read through
DIJELITI	to be dividing	PODIJELITI	to split
BRIJATI	to be shaving	OBRIJATI	to shave

(*continued*)

Table 5.3. Continued

Atelic and imperfective form	English translation	Telic and perfective form	English translation
BJEŽATI	to be fleeing	POBJEČI	to run away
DISATI	to be breathing	UDAHNUTI	to breathe in
DIZATI	to be lifting	DIGNUTI	to pick up
DOLAZITI	to be coming	DOČI	to show up
DONOSITI	to be carrying	DONIJETI	to bring
DOPUŠTATI	to tolerate	DOPUSTITI	to permit (once)
DOVODITI	to be bringing (someone)	DOVESTI	to bring (to someplace)
DOVOZITI	to be driving	DOVESTI	to drive up
GOVORITI	to be speaking	REČI	to tell
GRISTI	to be biting	UGRISTI	to bite (someone)
GUBITI	to be losing	IZGUBITI	to have lost
ISKORIŠTATI	to be exploiting	ISKORISTITI	to take advantage of
OBLAČITI-SE	to be dressing	OBUČI-SE	to put clothes on
ODGOVARATI	to be responding	ODGOVORITI	to answer
PRODAVATI	to be selling	PRODATI	to sell
PROPADATI	to be decaying	PROPASTI	to fail
BIRATI	to be choosing	IZABRATI	to pick
GRMJETI	to be thundering	ZAGRMJETI	to thunder