ADJECTIVE INTENSIFICATION IN AMERICAN SIGN LANGUAGE*

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Languages have different strategies for intensifying the meaning of a lexical item. In English, for example, adjectives can be intensified by adding a free morpheme *very*, as in *very good* as opposed to *good*. In American Sign Language (ASL), there is a sign VERY, which has the handshape of a manual alphabet V and is thus considered an "initialized" sign, but it is regarded as a borrowing from English and has a highly limited use (Padden 1988, Wilbur et al. 2012, Lapiak n.d.). Instead, intensification of an adjective in ASL is usually achieved by changing the form of the adjective itself, or "modulation" in Klima and Bellugi's terms (1979: 245). A similar process is also observed in Australian Sign Language (Auslan) (Johnston and Schembri 2007). Since intensification and other modulations in ASL involve modification of an adjective itself as opposed to sequential addition of a free morpheme, they have been frequently compared to vowel length in English, as in *looong* as opposed to *long* (Klima and Bellugi 1979, Liddell 2003, Johnston and Schembri 2007, Wilbur et al. 2012).

While recognizing the formational similarity to the phenomenon usually regarded paralinguistic in English, authors treat intensification in ASL, and sign languages in general, as inflection, along with other modulations for expressing aspectual information (Klima and Bellugi 1979, Padden 1988, Johnston and Schembri 2007). One proposed reason for treating intensification as a morphological rather than paralinguistic phenomenon is that there is a correspondence between seemingly systematic formational changes applying to a group of signs and the meaning achieved by this process[1] (Johnston and Schembri 2007). However, to my knowledge, the claims of systematicity in intensification tend to be based on qualitative descriptions of a small set of examples. Although the morphological status of intensification is beyond the scope of this paper, quantitative measurement of previously identified formational changes under intensification may be a useful first step towards addressing this issue. Moreover, previous descriptions of intensification are largely based on signs with a path movement (see below); since individual adjectives vary in their lexical movement properties, it is also important to document possible variations in realization of intensification among lexical items. Therefore, focusing on manual movement, this project aims to provide statistical support for previously identified properties of intensification and to uncover potential sources and degrees of variability across lexical items. These

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[1]Note, however, that while a correspondence between systematic formational changes and meaning is necessary for intensification to be considered morphological, it does not seem sufficient for it to be distinguished from a paralinguistic process such as vowel length in English, which is also systematic.

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descriptions have implications for a number of questions, including whether intensification is indeed a morphological process, and if so, how the process can be formally represented.

1. Background on sign language phonology

This section provides background on phonological representations of signs that is necessary to understand the previous literature of intensification and coding choices in the current project. In sign language phonology, there is a consensus that at least *handshape* (the configuration of the hand(s)), *location* (the location of the hands in signing space), and *movement* (the movement of the hands during the sign) are contrastive, since, much like phonemes in spoken languages, minimal pairs differing in each of these characteristics can be found (e.g., Johnston and Schembri 2007, Sandler 2012, van der Kooij and Crasborn 2016). These contrastive characteristics are often called *parameters*. Of the three parameters, only movement is typically discussed as being affected by intensification.

Previous descriptions of intensification assume the presence of sequential segments called *movements* and *holds*, which originate in Liddell and Johnson's Move-Hold model (e.g., Liddell and Johnson 1989). In this model, movements refer to "periods of time during which some aspect of the articulation is in transition," while holds refer to "periods of time during which all aspects of the articulation bundle are in a steady state" (Liddell and Johnson 1989: 210). Typically, a sign consists of an initial hold, a movement, and then a final hold.

Movements in turn can be classified into *path* and *local* movements. Path movements are articulated by the shoulder or elbow joints, causing a change in the place of articulation. Local movements are articulated by the wrist or finger joints, causing a change in orientation or hand configuration (Brentari 1998). Signs can have a path movement, a local movement, or a combination of both path and local movements. A potentially distinct, third category of movement is trilled movements (TMs), which refer to "small, rapidly repeated" movements whose number of repetitions is often uncountable and does not have phonological or morphological significance even when it is countable (Brentari 1996: 45). TMs can be articulated by a variety of joints. Despite these distinctions, the inventory of types (i.e. shapes) of TMs seem to correspond to that of local movements (see Brentari 1998: 166, Fig. 4.12 for a complete list of types of local movements and TMs).

For path and local movements, following Brentari, I assume that a movement can be articulated by different joints across the categories of path and local joints. For example, a local movement typically articulated by the wrist may, under certain circumstances, be articulated by the elbow joint, and in turn, a path movement which canonically involves the elbow may be articulated by the wrist. These variations in articulatory sites seem to exist within a single signer, and they are argued to be dependent on "physiological factors, social considerations, or interactions between signers and perceivers" (Brentari 1998: 134).

Since movements are known to be articulated by different joints while the distinction between path and local movements depends on the joint involved in articulation of a given movement, it is important that one keeps track of articulatory sites of a movement across productions. This information can be most transparently represented in Brentari's (1998) Prosodic Model. In this model, movement features are represented under a prosodic feature

node, and the shoulder, elbow, wrist, and finger joints correspond to feature nodes that are hierarchically organized by proximity to the torso: the setting, path, orientation, and aperture nodes, respectively (Fig. 1).

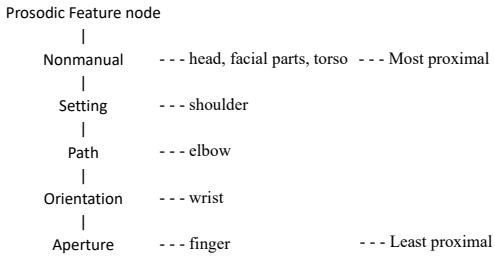

Figure 1: Feature nodes in the Prosodic Model and corresponding joints (adopted with modification from Brentari 1998: 130, Ex. 2))

Articulation of a movement at a non-canonical joint is represented as "[m]igration" of a movement, with an association line drawn from the canonical joint to the target joint. Upward migration (e.g. wrist to elbow) is called "proximalization" or "phonetic enhancement," while downward migration (e.g. elbow to wrist) is called "distalization" or "phonetic reduction" (Brentari 1998: 133-134). Finally, nonmanual movements, which encompass the head, facial parts, and torso, are represented at the nonmanual node, which is considered the most proximal.

2. Background on intensification

In the previous literature, there seems to be a consensus that intensification affects both holds and movements and that nonmanual properties are also involved, but there is a lack of consensus in specific descriptions of these formational changes. Moreover, intensification shares a number of properties with what is referred to as 'stress,' but the relationship between the two phenomena is debated. This section reviews the previously identified formational properties of intensification and stress.

2.1 Properties of intensification

In the literature of intensification, the most frequently and consistently documented characteristic of intensified forms is the presence of a longer initial hold (Klima and Bellugi 1979, Padden 1988, Sandler and Lillo-Martin 2006), which is observed regardless of whether the following movement is path or local (Brentari 1998). While some authors argue that a final hold is also lengthened under intensification (Sandler and Lillo-Martin 2006), others do not mention a final hold at all (Wilbur et al. 2012) or only mention the presence of a final hold with no reference to its length (Klima and Bellugi 1979, Padden 1988).

Descriptions of movement under intensification tend to focus on path movement, with reference to its size, rate and repetition. Some authors describe changes to a path

movement under intensification as *enlargement* or *addition* of a movement path (Wilbur et al. 2012), while others refer to increased *rate* of a movement, as seen in such descriptions as "a very rapid single performance" (Klima and Bellugi 1979: 259) and "a very rapid release to a final hold" (Padden 1988: 100). The latter authors also claim that repetition of movement observed in the non-intensified form of some signs is lost under intensification.

There are a number of unresolved issues with regards to behaviours of movement under intensification, especially when properties of individual lexical items are taken into account. First, to my knowledge, neither the size nor rate of a movement has been quantified, and whether both enlargement and increased rate can be applied simultaneously is unclear. Second, the claim that repetition is lost under intensification is inconsistent with my initial observations of natural signing. Third, since changes to a path movement presume existence of a path movement, whether and how signs with only a local movement are affected is unclear. For example, if addition of a movement path is a property of intensification, do all signs without a path movement obtain a path movement under intensification? The only available description of a sign with a non-path movement under intensification is of the sign DIRTY (Klima and Bellugi 1979), in which a lexical TM is replaced by a single local movement. Investigating a larger set of signs without a path movement may lead to a more comprehensive generalization. Fourth, if it is the case that signs with a path movement have an enlarged movement path and signs without a path movement gain a path movement under intensification, what are the sources of these phenomena? In other words, are path and local movements subject to different formational changes, or can these changes be represented as a unified phonological process?

Other claimed properties of intensification include increased muscular tension and nonmanual components, including tongue wagging, head tilt, and frown (Klima and Bellugi 1979, Padden 1988, Brentari 1998, Wilbur et al. 2012). Descriptions of intensification in this study focus on manual movement since it is, as mentioned above, one of the three major parameters of the signed modality, and its behaviour under intensification has been most extensively documented. However, it is worth mentioning that, like movement properties, there has been no quantitative measurement of muscular tension to my knowledge, and the description remains somewhat impressionistic. It is also not clear how consistently the nonmanual properties are observed.

2.2 Properties of 'stress'

Intensification is phonetically similar to more widely studied phenomena referred to as 'stress,' and the distinction between the two is debated (Klima and Bellugi 1979, Padden 1988). Some of the phenomena described as stress in the literature (e.g., Friedman 1976) may be better described as intensification. As evident in the variability in syntactic categories of target signs as well as structures of carrier phrases in the studies of stress (Friedman 1976, Wilbur and Schick 1987), the term 'stress' has not been explicitly defined with respect to its semantic/pragmatic roles, with the consequence that semantically/pragmatically distinct notions of emphasis, focus, and possibly intensification are treated as a single phenomenon under the phonological notion of stress (c.f. Wilbur and Patschke 1998, who address this issue).

The formational properties shared between intensification and stress include increased muscular tension, changes in duration (Friedman 1976; Wilbur and Nolen 1986), increased rate and/or size of movement (Friedman 1976; Wilbur and Schick 1987; Wilbur and Zelaznik 1997, cited in Wilbur 1999; Wilbur and Martinez 2002), changes in repetition, and nonmanual components (Wilbur and Schick 1987, Wilbur 1994, Wilbur and Patschke 1998, Wilbur 2000). The most prevalent use of nonmanual components in stress is the "mirroring" of a manual movement, i.e., the alignment of the head or torso movements with a manual movement in terms of rhythm or direction (Wilbur and Schick 1987: 320). Cues for stress marking are considerably varied across lexical items, and no single property can be considered a primary marker of stress; however, a distinction emerges between signs with and without a path movement such that the latter involve a larger number of cues, possibly to compensate for perceptual weakness due to the lack of path movement (Wilbur and Schick 1987).

Given the similarities between the two phenomena, the current study draws from both the literatures of intensification and stress for formational properties to investigate while maximizing uniformity among target signs in terms of their syntactic category and environment.

The data provide statistical support for the earlier claims of longer initial and final holds as well as larger size of movement but fail to support increased rate of movement. In addition, the data challenge the claim that repetition is lost under intensification. By dividing the target adjectives into signs with and without a path movement, this project uncovers how the movement modifications apply to the latter. Finally, it will be proposed that considering which joints are involved in articulation of a movement may facilitate a uniform representation of changes to path and local movements as well as some of the behaviours of nonmanual properties under intensification.

3. Methodology

3.1 Elicitation

A total of 98 adjectives were elicited (see Appendix), selected from the ASL-Lex database (Caselli et al. 2017), the literature on intensification (Klima and Bellugi 1979, Padden 1988, Wilbur et al. 2012) and stress (Friedman 1976, Battison 1978), and the author's prior observation of natural signing. For phonological and semantic uniformity among the target signs, compounds, signs produced at the nondominant arm, identity terms (e.g., ethnicity), and signs whose English glosses are close-scale adjectives (e.g., EQUAL) or only compatible with attributive use (e.g., OTHER) were excluded. The adjectives were elicited in a carrier phrase (described below) with a preceding subject, and in order to minimize potential influence from the phonological properties of a preceding subject sign on the target adjective, subject signs were selected so that they were two-handed, produced in the neutral space with no body contact, and ended in one of seven unmarked handshapes (Battison

1978), with the exception of three signs that were chosen for semantic compatibility with some of the target adjectives.[2]

This study involved one consultant, who is a female non-native fluent signer of ASL from British Columbia, Canada. She was informed prior to her participation that the project concerned how the meaning of 'very [adjective]' is expressed by changing the form of the adjective itself. The signer sat facing a video camera, with a green screen in the background. Each adjective was first elicited in a non-intensified context, SUBJECT ADJECTIVE 'The [subject] is [adjective],' which served as a baseline, followed by an intensified context, SUBJECT very ADJECTIVE 'The [subject] is very [adjective].' Target sentences were presented on a slide on a laptop screen in front of the camera. The convention of representing ASL signs with English words in capital letters was adopted, except that the concept of 'very' was in lower-case letters in order to discourage the use of the initialized sign VERY. The author sat behind the camera and manually paced the transitions between sentences, ensuring that the signer's hands returned to the resting position (i.e., on her lap) after each sentence. In order to encourage natural signing, the consultant was asked to sign to the camera as if it were her Deaf friend and to freely add classifiers and additional expressions whenever that would feel more natural. The consultant was asked to inform the author and skip a sign if she would not apply intensification to a particular sign, use another sign to express an intensified meaning, or did not recognize the sign. Occasionally, the consultant explained the usage of particular signs and answered the author's questions during the elicitation. In addition, as a result of encouraging natural signing, the subject was often followed by a third person pronoun, and the target adjective was sometimes followed by additional signs such as WOW and classifiers under intensification. Each item was elicited twice across a total of three elicitation sessions, and one production per item was coded for the current analysis.[3]

3.2 Coding

Intensified and non-intensified forms of each adjective were coded for their formational properties. This section outlines these properties and their respective methods of measurement. For consistency, all of the properties described below were coded based on the dominant hand.

3.2.1 Duration

In order to test the hypothesis that intensification involves a longer hold, the durations of the initial and final holds were measured in terms of number of frames (FPS=59.94). Durations of the movement and the whole sign were also measured for comparison. Cues to boundaries between movements and holds include blurriness of the hands and change in

[2]The subject signs that conformed to these principles were BOOK, BOX, CLASS, OCEAN, ROOM, SHIP, and TEACHER; the exceptional subject signs BABY, ICE CREAM, and NOODLE were also included for semantic compatibility.

[3]Due to technical problems in the first session, most of the coded tokens are the second production of each item, taken from the second and third sessions.

movement direction (Wilbur and Nolen 1986). Additional cues to boundaries between holds and transitional movements in particular include achievement or loss of a lexical contact and change in muscular tension, which is reflected in hand configurations. Since the coding was based on the dominant hand, any periods in which the non-dominant hand was steady while the dominant hand was in transitional movement, whether from a preceding pronoun to the initial hold of the adjective or from the final hold to an additional sign, were excluded from duration of the initial and final holds.

3.2.2 Path and local movements and the joints involved

Based on whether the movement in the non-intensified form was articulated by the shoulder, elbow, wrist, and/or the finger joints, each sign was coded for whether it had a lexical path or local movement, or both. When a seemingly single movement was articulated by multiple joints across the boundary of path and local joints in the non-intensified form, I consulted ASL dictionaries (Lapiak n.d., Bailey and Dolby 2002) to identify a joint that is consistently involved across signers. Movements in the intensified forms were also coded for the joints involved and labelled as path or local movements accordingly. In addition, since TMs share an inventory of movement types with local movements and do not cause a change in place of articulation, for coding purposes, I classified them as a local movement.

In order to investigate the effect of a lack of a path movement, signs were divided into two groups depending on whether or not they had a lexical path movement, regardless of whether they (also) had a local movement. Of the 98 adjectives, 71 signs had a lexical path movement, and 27 signs had only a local movement (Table 1).

Movement type	Number of signs
Path / Path and local	71
Local only	27
Total	98

Table 1. Distribution of lexical movement types

3.2.3 Repetition of movement

If a sign had repetition of movement in either the intensified or non-intensified form, both forms were coded for the number of cycles of movement, even if the movement was a TM. The end of one cycle was identified as the time when the direction of movement changed for the next movement, whether it was for another cycle of movement or a transitional movement. Depending on the contour of movement, at the end of a cycle, the hand can either return to the starting point (e.g., “circle” and “back and forth” movements (Caselli et al. 2017: 791)) or be the furthest from its starting point (e.g., “straight” and “arc” movements).

3.2.4 Rate of movement

As one potential method of quantifying the rate of movement, a measure called Visible Amplitude (Tkachman et al. under review) was employed. For each production of the target adjective, Optical Flow Analysis was conducted on the movement component of the sign, using the FlowAnalyzer software (Barbosa 2013). Visible Amplitude was then calculated from the results of Optical Flow Analysis (see Tkachman et al. under review: Fig. 4 for details). Schematically, Visible Amplitude is the average magnitude of movement across all the frame-steps in question, and a greater Visible Amplitude indicates a faster rate of movement. Since Optical Flow Analysis does not distinguish contributions from multiple movements that are simultaneous, of the 71 signs with a path movement, signs that had both path and local movements in either the non-intensified or intensified forms (N = 28) and one-handed signs in which the nondominant hand from the preceding subject sign was remaining at the onset of lexical movement in either the non-intensified or intensified form (N = 4) were excluded. Similarly, of the 27 signs without a path movement, signs that had a path movement in the intensified form (N = 2) and one-handed signs with the confound of the non-dominant hand from the subject sign remaining in the video frame (N = 6) were excluded. In addition, one sign was excluded from each group due to inconsistent frame sizes, leaving 38 signs for quantifying the rate of path movement and 18 signs for local movement.

3.2.5 Size of movement

Size of the movement was measured by imposing a grid (32×32 pixels) on a video. For each sign, a fixed location in the dominant hand was chosen as a reference point, usually a particular joint or tip of a finger that is visible to the camera throughout the movement. The distance travelled by the reference point during a given movement was manually recorded in terms of the number of squares in the grid it passed through. The size of the local movement, if present, was also measured using the same method. Note that, of the 71 signs with a path movement, two signs were excluded since the movement was on the midsagittal plane (i.e., towards and away from the signer and camera) and therefore could not be measured with the current method. Similarly, of the 27 signs with only a local movement, 11 signs were excluded, either because the size of the local movement was unmeasurable due to its direction or extremely small size (N = 4) or because the hand(s) did not travel in space at all (N = 7).

3.2.6 Nonmanual movement

In order to investigate whether mirroring of manual movement by nonmanual components documented in the literature of stress is also observed in intensification, movements of the head and torso were coded if they aligned with a manual movement in rhythm or direction. Although this coding overlooks other possible nonmanual movements and facial expressions, it provides a systematic documentation of nonmanual movements in relation to manual movements under intensification.

4. Results

4.1 Duration

The data provide statistical support for lengthening of holds. Paired t-tests comparing the duration of the initial hold in the intensified vs. non-intensified forms show that duration of the initial hold was significantly longer under intensification in both signs with a path movement [$t(70)=5.27$; $p=1.456\times10^{-6}$] and those with only a local movement [$t(26)=4.55$; $p=0.0001$]. Final holds were also significantly longer under intensification in both signs with [$t(70)=3.88$; $p=0.000237$] and without [$t(26)=3.27$; $p=0.003$] a path movement.

At the same time, duration of movement was also significantly longer under intensification in signs with [$t(70)=6.22$; $p=3.225\times10^{-8}$] and without [$t(26)=3.07$; $p=0.005$] a path movement, and so was duration of the sign as a whole, in both signs with [$t(70)=10.76$; $p < 2.2\times10^{-16}$] and without [$t(26)=7.06$; $p=1.697\times10^{-7}$] a path movement.

4.2 Repetition of movement

Contrary to the previous claim (Klima and Bellugi 1979, Padden 1988) but consistent with my own initial observations, repetition of movement is not lost under intensification (Table 2). Of the 15 signs that had a repeated path movement in their non-intensified form, six signs had the same number of cycles, and seven signs had a greater number of cycles under intensification. Even in the two signs with fewer cycles of movement under intensification, namely EMBARRASSED and AWKWARD, the repetition was not lost, meaning that there were still more than one cycle of movement; these signs had 3 cycles each in their non-intensified form, and they had, respectively, 2 and 2.5 cycles under intensification. Although the data set is small, a paired t-test shows that the number of repetitions of path movement did vary between non-intensified and intensified forms, with the repetitions increasing under intensification [$t(14)=2.108$; $p=0.0268$].

Movement type	Fewer	Same	Greater	Total
Path	2	6	7	15
Local	4	3	3	10

Table 2: Number of movement cycles under intensification compared to the non-intensified form

Loss of repetition was not supported with respect to local movement either. Of the 10 signs with a repeated local movement in their non-intensified form, the majority of signs had either the same or even greater number of cycles under intensification. Of the four signs that had fewer cycles of movement under intensification, two signs, namely HAPPY and NOISY, had 1.5 cycles each in their intensified forms, as compared to 2 cycles each in their non-intensified forms. For the remaining two signs, namely COLD and SILLY, the intensified forms did have a single, non-repeated path movement, but the lexical movement in their non-intensified form was a TM rather than a true local movement. (Recall that TMs

were classified as a local movement for the purpose of coding.) Statistically, there was no significant difference in the number of repetitions between non-intensified and intensified forms [t(9)=0.104; p=0.540].

4.3 Rate of movement

Increased rate of movement is not supported by the current data. Paired t-tests show that the differences in Visible Amplitude between non-intensified and intensified forms were insignificant in both signs with only a path movement [t(37)=1.44; p=0.158] and those with only a local movement [t(17)=0.178; p=0.861].

It is true that presence of nonmanual movement aligned with the manual movement might have affected the overall Visible Amplitude in some signs. In addition, a "continuous" body contact has been claimed to cause a slower movement under 'stress' (Friedman 1976: 161), which would then result in a smaller Visible Amplitude. However, statistical significance was not achieved even after applicable signs were excluded from the analysis.

4.4 Size of movement

Enlargement of a movement path under intensification is supported by the data (Table 3). In 57 out of 69 signs with a path movement, the movement path was larger in the intensified form than in the non-intensified form. A binominal test shows that enlargement of path movement under intensification happened significantly more often than would be expected by chance [$p=3.742\times10^{-8}$]. For signs with only a local movement, 12 out of 16 signs had a larger movement under intensification, although statistical significance was not reached [p=0.077], possibly due to the size of the data set.

Movement type	Smaller	Same	Larger	Total
Path	4	8	57	69
Local	2	2	12	16

Table 3: Size of movement under intensification compared to the non-intensified form

4.5 Joints involved in each movement

Recall that both path and local movements can be articulated by a joint that is not canonically involved in the articulation of that movement (Brentari 1998). If the intensified form involved a joint that was not involved in the non-intensified form, in most cases, it was through proximalization rather than distalization. Out of 71 signs with a lexical path movement, 10 signs (14.1%) exhibited proximalization (Table 4). For example, the sign SCARED had a path movement articulated by the elbows in the non-intensified form, and under intensification, the shoulders were also involved. Signs with only a local movement are even more susceptible to proximalization, as 33.3% (9/27) of such signs involved a more proximal joint under intensification. For example, the sign EASY was articulated by the wrist in the non-intensified form, and the elbow was also involved under intensification.

Lexical movement type	Proximalized
Path	14.1% (10/71)
Local only	33.3% (9/27)

Table 4: Percentage (number) of signs with proximalization under intensification

Since proximalization is considered "phonetic enhancement" (Brentari 1998: 134), one might expect that proximalization would be associated with the enlargement of movement described above. It is also intuitive that a more proximal joint would generate a larger movement. Notably, all of the 10 signs with proximalization of a path movement had a larger path under intensification. In addition, in all of the nine signs with a proximalized local movement, the movement was articulated by the shoulder and/or elbow joint(s) in the intensified form, which are usually involved in articulation of a path movement. Although Fisher's exact tests do not show statistical association between proximalization and enlargement of movement with respect to either path [p=0.94] or local [p=0.11] movements, it would not be surprising to find such association in a larger data set.

4.6 Nonmanual movement

Intensified signs show increased involvement of head or torso movements aligned with the manual movement in rhythm or direction (Table 5). While only 29.6% (21/71) of signs with a path movement involved a head or torso movement mirroring the manual movement in the non-intensified form, the percentage increased to 62.0% (44/71) under intensification. Similarly, only 14.8% (4/27) of signs with only a local movement involved such nonmanual movement in the non-intensified form, but the percentage increased to 55.6% (15/27) under intensification. Fisher's exact tests show an association between intensification and involvement of nonmanual movement mirroring the manual movement, in both signs with [$p=9.38\times10^{-05}$] and without [p=0.0019] a path movement.

Movement type	Non-intensified	Intensified
Path / Path and local	29.6% (21/71)	62.0% (44/71)
Local only	14.8% (4/27)	55.6% (15/27)

Table 5: Percentage (number) of signs with nonmanual movement mirroring manual movement

Even greater increase in involvement of nonmanual movement is seen in the subset of signs with only a local movement in which the hand(s) are anchored to the body throughout the movement (i.e., have a "holding" contact in Friedman's (1976: 161) terms). While only two out of nine such signs (22%) had a head or torso movement mirroring the manual movement in the non-intensified form, eight signs (89%) had such nonmanual movement under intensification. For example, the sign STUBBORN has a local movement articulated by the fingers, and the hand is anchored to the forehead throughout the movement. In the intensified form, the contact was maintained, and there was a head

movement aligned with the local movement in rhythm and direction. Again, a Fisher's exact test shows an association between body anchoring and involvement of nonmanual movement mirroring the hands under intensification [p=0.0175] in signs with only a local movement.

5. Discussion

5.1 Duration

Durations of initial and final holds are significantly longer under intensification in both signs with and without a path movement. These results support the previous claim that path and local movements are affected equally with respect to lengthening of a preceding hold (Brentari 1998). The data also suggest that not only the presence but also lengthening of a final hold is part of the intensification process. It must be noted, however, that the current coding procedure of calculating the number of frames abstracts away from the question of whether all signs have initial and final holds in their phonological representation. Moreover, recall that durations of the movement and the sign as a whole are also significantly longer under intensification. This raises a new question of whether lengthening of duration targets holds in particular as opposed to both holds and movements or the sign as a whole.

5.2 Repetition

Contrary to previous claims (Klima and Bellugi 1979, Padden 1988), repetitions of both path and local movements are usually maintained or even increased under intensification, and crucially, it is never lost entirely. In the only two cases which appear that a repeated local movement is replaced by a non-repeated path movement, the lexical movement is a TM, which is distinguished from local movements by some authors (e.g., Brentari 1996). Although the number of signs with only a local movement or a TM in the current data is relatively small, the data suggest that repetitions of path and local movements are not lost under intensification, while TMs may behave differently and can be replaced by a single movement.

5.3 Rate of movement

Increased rate of movement under intensification is not supported by the current data. However, it cannot be concluded that the rate of movement is irrelevant for intensification. It would be worth testing whether Visible Amplitude is significantly affected in a larger data set, as well as whether other possible measures of rate of movement, such as acceleration (Wilbur and Martinez 2002) and peak velocity, are relevant in the current data.

5.4 Enlarged movements and nonmanual movements as proximalization

Enlargement of a path movement under intensification is supported, and local movements also tend to be enlarged. The current data do not show an association between enlargement

of movement and proximalization. However, all 10 signs with a proximalized path movement have a larger path, and all nine cases of an enlarged local movement involve the shoulder or elbow joints, which are articulators of a path movement. It may be that proximalization is one of the sources of enlargement (Fig. 2). If that is the case, signs with only a local movement obtain a path movement by, rather than epenthesizing it, spreading the existing, lexical local movement to articulators of path movements through proximalization, a process that can apply to both path and local movements.

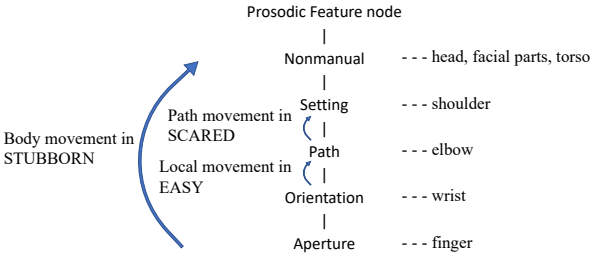

Figure 2: Schematic representations of proximalization

Moreover, regardless of the type of lexical movement, intensified forms show greater involvement of head and torso movements mirroring the manual movement. Furthermore, within the group of signs with only a local movement, body-anchored signs are more likely to have such nonmanual movement than non-anchored signs. Recall that in Brentari's (1998) Prosodic Model, nonmanual properties are included in the representation of movement and located at the most proximal node. Therefore, alignment of nonmanual movements with the manual movement may also be an instance of proximalization (Fig. 2).

If enlargement of path and local movements and the addition of head and torso movements mirroring the manual movement are different manifestations of proximalization, that would not only allow for a unified account of behaviours of path and local movements under intensification but also explain why body-anchored signs are more likely to have nonmanual movements mirroring the manual movement. Since body-anchoring blocks spreading of a local movement to the path and setting nodes, spreading to the nonmanual node is the only available option for proximalization.

6. Conclusion

This study has provided statistical support for longer duration of initial and final holds as well as enlargement of path movement under intensification, and the data suggest that local movements also tend to be enlarged. At the same time, counter-evidence was found for the previous claim that repetition is lost under intensification. There is greater involvement of head and torso movements mirroring the manual movement under intensification, which is even more likely to be observed in signs with a body-anchored local movement. Based on these results, I have proposed that enlargement of manual movements and involvement of nonmanual movements mirroring the manual movement can be all represented as

proximalization in Brentari's (1998) Prosodic Model, with the implication that path and local movements are subject to the same phonological process under intensification.

There are a number of remaining issues. This study is based on production data from a single signer. Especially given that some properties, including articulatory sites of a movement, could vary even across productions, an attempt to formalize intensification would benefit from investigating the extent of inter-signer variability and consistency in a larger-scale study. Perception studies would be necessary to test whether and which of the properties identified in this study are used by signers as cues to intensification. Moreover, one needs to establish inter-signer consistency in both perception and production if intensification were to be argued to be morphological rather than paralinguistic, since one of the arguments for its morphological status is the apparent systematicity of formational changes and its applicability to a whole group of signs. Still, how intensification can then be distinguished from paralinguistic yet systematic phenomena such as vowel length in English is not entirely clear.

If intensification is indeed morphological, another issue concerns which formational properties are to be included in the phonological representation of this process as opposed to being a phonetic correlate of another formational change. For example, if there is an association between proximalization and enlargement of movement, are they both part of the phonological representation, or is e.g. the proximalization the primary cue, with enlargement an accidental side effect (or vice versa)?

Finally, results of this study may facilitate investigations of whether some of the formational properties of intensification are subject to different degrees of changes corresponding to semantic degrees of intensification, as proposed by some authors (Wilbur et al. 2012). For example, contexts could be set up in such a way that there is a three-way distinction between the baseline, intensified, and even more intensified contexts.

This study revisited a widely recognized phenomenon of intensification in ASL and provided statistical support and counter-evidence for some of the long-standing claims in the literature. It may serve as a methodological example for reinvestigating properties of other modulations that have been claimed to be inflectional in the language.

Appendix

Target adjectives with a lexical path movement (N=71)

ANGRY, AWKWARD, AWESOME, BAD, BEAUTIFUL, BIG-HEADED, BRAVE, CAREFUL, CHEAP, CLEAR, CLOSE, CONFIDENT, CROWDED, CRUEL, DEEP, DELICIOUS, DRUNK, EMBARRASSED, EXCITED, EXPENSIVE, FAR, FASCINATING, FAST, FAT, FINE/GROOVY, FRIENDLY, FRUSTRATED, FULL, FUN, GOOD, GUILTY, HARD, HEAVY, HONEST, HUNGRY, IMPORTANT, LARGE1, LARGE2, LAZY, LONELY, LONG1, LONG2, LOUSY, LOYAL, LUCKY, MOTIVATED, NEW, OLD, PATIENT, QUIET, RELAXED, RUDE1, SAD, SCARED, SHINY, SHORT1, SICK, SLEEPY, SMALL1, SMALL2, SMART, SORRY, STRICT, STRONG, TALL, THIN, THIRSTY, UGLY, WARM, WET, WORRIED

Target adjectives without a lexical local movement (N=27)

AMAZED, BORED, COLD, CURIOUS, CUTE, DIRTY, EASY, FUNNY, HAPPY, HORRIBLE, JEALOUS, LATE, LIGHT, NEAT, NOISY, ODD, RUDE2, SERIOUS, SHORT2, SHY, SILLY, STUBBORN, SURPRISED, SWEET, TIRED, WEAK, YOUNG

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