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Typology in sign languages: Can it be predictive?[1]

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1 Introduction

The implicational universals of Joseph Greenberg (1966) for spoken languages make predictions such as those in (1). All have the structure, if 'x' is true in a given language, then 'y' should be true as well; they are more like predictors of a distribution than like true linguistic universals. The objective of this paper is to determine if such predictive, distributional statements can be made for signed languages as well.

(1) Examples of predictive, implications universals (Greenberg 1966)
   a. If there are any gender distinctions in the plural of the pronoun, there are some gender distinctions in the singular also.
   b. If a language has discontinuous affixes, it always has either prefixing or suffixing or both.
   c. Languages with dominant VSO order are predominantly prepositional.

One advantage to such predictors of distribution is that they provide guideposts for fleshing out the grammars of understudied languages, and another advantage is that they divide languages into descriptive groups that are based on structural, rather than genetic characteristics. Most sign languages are understudied, and the genealogical connections among many of them have not been clearly established, so such predictors of distribution would be very useful.

Zeshan (2006) and Padden, *et al*. (2013), have both made proposals for how sign languages might be divided into typological classes. Zeshan (2006) conducted a large typological analysis of negation in sign languages, arguing that there are two main types—those that allow headshake to function as the sole marker of negation, and those that require a manual sign to accompany the head shake. As a follow-up to this typological survey, Quer (2012) used these two categories for treating negation as predictors for the scope of the headshake in sentences—i.e., the extent of headshake spreading.

Padden *et al*. (2013) argues that iconicity plays an important role in sign language typology, just as it plays an important role in sign language phonology (Eccarius 2008; Wilbur 2010; Brentari 2011, 2012) and morphology (Padden 1998; Meir 2002; Aronoff *et al*. 2005; Mathur & Rathmann 2011). Iconicity refers to mapping of a concrete source domain and the linguistic form (Taub 2001); it is one of the three Peircean semiotic notions of icon, index and symbol (Peirce

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1958). Padden and colleagues argue that because signed and spoken languages use iconicity differently and to different degrees, perhaps it would be best to base sign language typological categories on iconic preferences, at least in part, since iconicity is so important in these languages. In other words, the raw material that languages have to shape their grammars should play a role in delineating their typological categories.

Padden and colleagues (Aronoff *et al*. 2009; Padden *et al*. 2013) investigated the distribution of two types of handshape (HS) iconicity in sign language instrument nouns—those that use "hand-as-hand" iconicity, which will be referred to here as handling HSs, and those that use "hand-as-object" iconicity, which will be referred to here as object HSs; see examples in (2). They found that some sign languages prefer to use object HSs in instrument nouns (American, Swedish, Danish, and Al-Sayyid Bedouin Sign Languages), while others prefer to use handling HSs (British, New Zealand, Israeli, and Japanese Sign Languages).

(2) Examples of two kinds of HSs in sign languages[2]

a. object HSs

i. long-thin-object 

ii. small round object 

iii. flat object

b. handling HSs

i. handle brush: 

ii. handle flat object: 

iii. handle small object: 

This paper takes the descriptive findings of Aronoff *et al*. (2009) and Padden *et al*. (2013) and builds upon them, by asking whether knowing the handling or object HS preference for a sign language can truly predict typological membership, or whether more information might be needed. If more information is needed, what kind of information is helpful to predict the behavior of object and handling HSs in other parts of the grammar. Three areas of the lexicon will be investigated: nouns, classifier predicates, and what we will call "act-on" verbs (explained in more detail below).

Before proceeding, it is important to make an observation about the two types of predicates analyzed in this paper. Supalla's (1982) seminal work on *classifier predicates* considered these structures to be complex *spatial* predicates with two possible types of sign movement: those of location/spatial arrangement, in which the movement of the sign does not refer to the movement of the object (BE-AT stems), and those of movement, in which the movement of the sign does refer to movement of the object (MOVE stems). Moreover, classifier predicates are

[2] The notational conventions used in this paper are as follows. Handshapes will be provided as small icons whenever possible. Sign language glosses lexical items will be given in upper case (BRUSH-TEETH), while polymorphemic classifier predicates will be given in lower case (put-around). When two English words correspond to one sign there will be a hyphen between the glossed words.

typically produced in the neutral space in front of the signer. This contrasts with predicates, such as BRUSH-TEETH, EAT-WITH-FORK, or COMB-HAIR, which use iconic handshapes of the handling and object type just as classifier predicates do, but are not spatial predicates; they are verbs in the core lexicon since their handshapes cannot be substituted with other handshapes except under special circumstances. They refer to a typical way of engaging with objects in agentive clauses. In this paper, these will be called *act-on verbs.* These involve movements towards or on the body or an affected object. Sometimes an instrument is used (e.g., comb (hair), brush (teeth), apply (make-up), hammer (nail), slice (banana)), and sometimes the hand(s) are used alone (e.g., eat (fruit), holding (book), put on (clothing)).

The three types of structures in this analysis (classifier predicates, act-on verbs, and nouns) are shown in Figure 1 within their respective sub-components of the native sign language lexicon: classifier predicates [1]; act-on verbs [2]; and nouns [3]. Classifier predicates [1] are located in the spatial lexicon, where sub-lexical parts are morphological; act-on verbs [2] and nouns [3] are located in the core lexicon where sub-lexical handshapes, movement and location of stems are phonological (Brentari & Padden 2001). The distinctions in Figure 1 will become important as we proceed. Notice the overlap between the core and spatial components of the lexicon where nouns and act-on predicates are located; this is because all of these forms use iconic handling and object HSs.

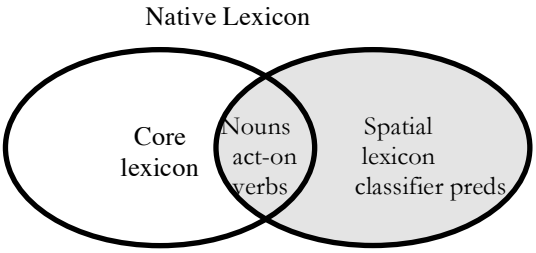


Figure 1: The location of the three structures relevant for the following analysis within their respective sub-components of the native sign language lexicon—[1] classifier predicates in the spatial lexicon, [2] act-on verbs; and [3] nouns. [2] and [3] are in the core lexicon (Brentari & Padden 2001)

In the following sections we will propose a componential analysis involving argument structure and iconicity that will give rise to a typological classification for the four sign languages that are the object of our investigation

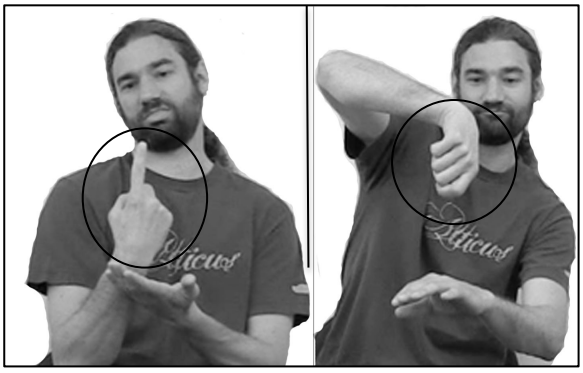
2 Background

In this section 3 uses of handling and object HSs in sign language grammars will be described: their use in the agentive/non-agentive opposition; their use in expressing agentive verbs with or without instrument; and their use to distinguish nouns from verbs.

2.1 The agentive distinction in sign language classifier predicates

At the heart of the agentive/non-agentive opposition is the difference argued for in Perlmutter (1978) and Benedicto & Brentari (2004) between transitive, agentive clauses (Eng. *John melted the butter*) and intransitive, unaccusative clauses with no agent (Eng. *The butter melts*). In some spoken languages this opposition is expressed transparently in the affixes on the verb or by the pronominal system, as it is in Tuki, a Native American language of Northern California (Mithun 2008). The pronoun ***ʔap*** is used in agentive clauses—***ʔap*** *lis k'an laʔaktekb* (Eng. *I talked fast*) — while ***ʔi:*** is used in non-agentive clauses ***ʔi:*** *k'aptek* (Eng. *I choked*).

If a sign language employs this morphosyntactic use of handshape, the object HSs in Figure 2 (left) would be used in the non-agentive form for *The lollipop is upside down*, while the handling HS in Figure 2 (right) would be used in the agentive form English *Someone put the lollipop upside down*.



LOLLIPOP CL: +MOVE (upside down) LOLLIPOP CL: + MOVE (upside down).

Figure 2: (left) non-agentive form containing an object HS in the clause *The lollipop is upside down*; (right) agentive form containing an handling HS in the clause *Someone put the lollipop upside down*. Only the predicate is shown is shown here.

These two types of HSs obtain different results on syntactic tests. Object HSs are sensitive to grammatical objects that appear as nonagentive subjects—DOOR object HS+OPEN, Eng.: *The door opened*. Handling HSs are sensitive to agentive subjects as well—DOOR handling HS+OPEN, Eng. *[someone] opened the door*. One such syntactic that is sensitive to agentive subjects test is the WILLING test (3).

(3) WILLING test for agentive subjects (cf. Benedicto & Brentari 2004)

a	NAME-CARDS	TABLE	**CL:**  **+**	put-around	WILLING?
	name cards	table	**handling classifier**	put-around	willing
b.*	NAME-CARDS	TABLE	**CL:**  +	put-around	WILLING?
	name cards	table	**object classifier**	put-around	willing

'Are you willing to put name cards around the table?'

Schick (1987) and Brentari *et al.* (2013) found that ASL children exhibit this opposition; Mazzoni (2009) showed that it is also found in LIS (adults and children). Brentari *et al.* (2015) and Goldin-Meadow *et al.* (2015) have also found this opposition in ASL, LIS, Nicaraguan Sign Language, and homesign using experimental tasks.

The data used for Benedicto & Brentari's (2004) analysis was based primarily on classifier predicates, and they acknowledged that more work was needed to establish the status of instrumentals in act-on verbs such as COMB and RAKE. We address this in the next section.

2.2 Instrumentals in sign languages

An instrumental is a noun by which an action is accomplished, often marked by a particular morphological marker, often (but not always) a case marker (Fillmore 1968). An example of a spoken language with instrumental case can be seen in the Russian sentence in (4); note the instrumental morpheme *ne.*

(4) Instrumental case in Russian

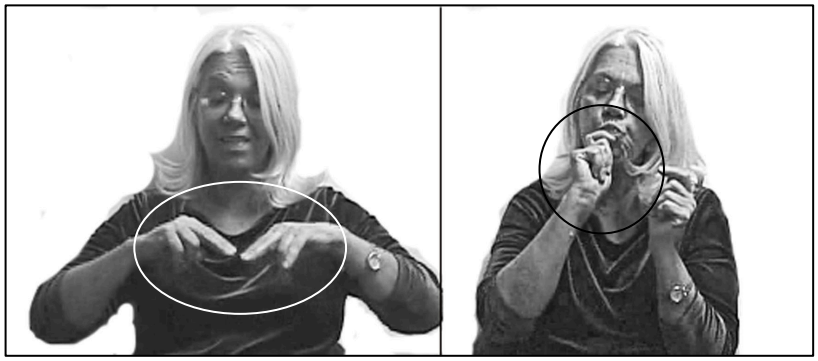
Я	написал	письмо	**пе**ром.
1SG	write-PAST	letter	**INSTR**-quill pen
'I	wrote	(the) letter	with (a) quill pen.'

Instruments have been characterized as the means of an event (Rappaport & Levin 1988; Jackendoff 1990), or a causal intermediary in an event (Talmy 1976; Croft 1991; Goldberg 2002; Koenig *et al.* 2008). Janis (1992) and Meir (1999) were the first to investigate this notion for ASL and Israeli Sign Language (ISL), respectively, and in these works syntactic diagnostics, such as doubling (4) were developed to make a distinction between theme and instrument. Typical handling classifier predicates allow doubling (4a), while instrumentals do not (4b) in ISL; however, at least in ASL, if the main verb SAW is modified with a manner adverb, expressed by the speed of movement and nonmanual behavior, it can be doubled as in (4c).

(5) Doubling in classifier predicates vs. instrumental (cf. ISL Meir 1999)

a.	COIN ()		**CL:**  +	MOVE
	coin		handling classifier	move
	'The coin fell.'			
b.*	SAW()	P-L-A-N-K	**CL**:  +	SAW-WOOD
	saw	planks	object classifier	saw wood
	'Use a saw to saw the planks.'			
				"mm"
c.	SAW()	P-L-A-N-K	**CL:**  +	SAW-WOOD
	saw	planks	object classifier	Saw wood with care
	'Use a saw to saw the planks carefully.'			

Here we propose that instruments in sign languages often do important, lexical semantic work in act-on verbs, and that they play a larger role in some languages than others. We predict that if a language is *instrument sensitive*, object HSs will be used in such instrumental act-on verbs even when the predicate is agentive, while handling HSs will be used in act-on verbs that do not involve instruments. This is shown in Figure 3, where we see a contrast between an object HS used in TAPE-BOX (instrument act-on verb) vs. a handling HS used in EAT-LOLLIPOP (non-instrument act-on verb).



 TAPE-BOX (instrument verb)  EAT-LOLLIPOP (non-instrument verb)

Figure 3: Act-on verbs in ASL: (left) an instrumental act-on verb containing an object HS: Eng. *[someone] tapes a box*; (right) a non-instrumental act-on verb containing a handling HS: Eng.: *[someone] eats a lollipop*.

In ASL, predicates with instrument handshapes respond positively to syntactic tests sensitive to objects, but not to those that are sensitive to agentive subjects (Benedicto & Brentari 2004). These authors acknowledge, however, that there is some degree of individual variation on these judgments concerning act-on verbs,

and they called for more work on them. In an earlier analysis, Engberg-Pedersen (1993) treated instrument handshapes in act-on verbs as a type of "handling" handshape functionally, even though their form is that of object handshapes.

2.3 The noun-verb distinction in sign languages

In the introduction we have already articulated the possible role that the iconic handshape preference in instrument nouns plays in typological membership, (Aronoff *et al.* 2009; Padden *et al*. 2013). In the work presented in the current analysis, we will also investigate whether the noun-verb contrast is expressed via HS. If such a mechanism were used in a sign language, the object HS would be used for the noun, and handling HS would be used for verbs as shown in Figure 4—e.g., TOOTHBRUSH vs. BRUSH-TEETH. This use of object and handling HSs to express the noun-verb contrast has been attested in homesign (Hunsicker *et al.* 2015), but until now, not in sign languages.

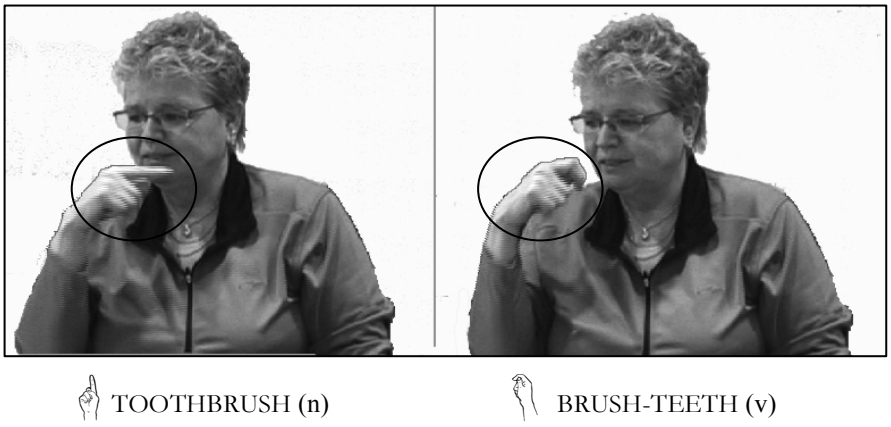


Figure 4: The ASL sign TOOTHBRUSH produced with an object HS (left) and the verb BRUSH-TEETH produced with a handling HS (right).

There are four additional attested ways to express the derivational noun-verb distinction. Three involve movement rather than handshape, which can be characterized as producing smaller movements in nouns, and larger movements in verbs. Supalla & Newport (1978) demonstrated that some nouns that use iconic HSs in ASL have restrained, reduplicated movements, while verbs tend to have single movements—e.g., AIRPLANE (noun) vs. TO-FLY (verb); this finding has been extended to more abstract nouns as well (Abner 2013). In addition, in 2-handed verbs with trilled movements are produced in activity nouns (i.e., small, rapidly repeated uncountable movements), while larger movements are produced in the corresponding verb (Padden & Perlmutter 1987)—e.g., ACTING (activity noun) vs. ACT (verb). Finally, it has been shown that movements produced by distal articulators (i.e., those farther from the center of the body) are used in nouns, while movements produced by proximal articulators (i.e., those closer to the center of the body) are used in verbs (Abner *et al.* 2015)—e.g., COMB (noun)

vs. COMB-HAIR (verb). Finally, for a small class of signs, a fingerspelled form is used in the noun while the lexical sign is used in the verb (Shay 2002)—L-O-V-E (noun) vs. LOVE (verb).

2.4 Proposal

In this analysis, we propose an explanation for crosslinguistic variation in handling and object HS distribution based on typological membership that affects classifier predicates, act-on verbs, and nouns, but which originate in the core lexicon. The factors involved are given in (6):

(6) Factors involved in typological membership
   a. the *iconic handshape preference* expressed in instrument nouns (object HS (O-HS) or handling HS (H-HS)), and
   b. whether the language is *instrument-sensitive*.
      i) If a sign language is not instrument-sensitive only iconic preference in nouns will affect variation in the expression of morphological use of HSs to express agency in classifier predicates.
      ii) If a sign language is instrument-sensitive it will tend to use object HSs for instruments, regardless of handshape preference in nouns, or the agentive status of the clause.

Theses parameters will give rise to four possible typological classes of sign languages, shown in Table 1. Languages in classes A and B fall under (i) above; they are not instrument sensitive but they have different handshape preferences in instrument nouns. Languages in classes C and D fall under (ii) above; they are instrument sensitive and also have different handshape preferences in instrument nouns.

	Noun HS preference	
instrument sensitivity	*H-HS*	*O-HS*
NO H-HS (H-HSs in all act-on verbs)	A	B
YES (H-HS > O-HSs / instrumentals)	C	D

Table 1: Four possible typological classes based on noun handshape preference and instrument sensitivity.

To be concrete, sign languages in the "A class" will exhibit 1-way interference of the handling HS preference in nouns by unexpected use of handling non-agentive classifier predicates, because it i) does not have a sensitivity to instruments in act-on verbs, and ii) it has a handling handshape preference (H-HS) in nouns. Sign languages in the "B class" will exhibit 1-way interference in the opposite direction; because it i) does not have instrument sensitivity in act-on verbs, and ii) it has an object handshape preference (O-HS) in nouns. If a language has

sensitivity to instruments (C, D classes), there will be 2-way interference on classifier predicates expressing the agentive/non-agentive distinction. The derived nominals from instruments will unexpectedly tend to appear in classifier predicates as object handshapes regardless of their use as agentives, and the preference in nouns will also have an effect. Sign languages in the "C class" will exhibit instrument-sensitivity effects, plus the preference for handling HSs in nouns, while those in the "D class" will exhibit instrument-sensitivity effects, plus the preference for object HSs in nouns.

3 The Data

3.1 Participants

The data for this analysis come from four sign languages, 10 from each language, 40 signers in all: American Sign Language (ASL), British Sign Language (BSL), Italian Sign Language (LIS), and Hong Kong Sign Language (HKSL). 10 Deaf, adult native signers or early learners from each sign language participated. "Native" means that the signers was raised in a home where at least one family member was a Deaf signer, and began acquiring the language at birth; being "early learners" means that these signers came from a hearing family, and began to learn and use the language as the primary language typically when they entered school, sometime between age 3-7 years of age.

3.2 Stimuli and Procedures

The sign language data are the videotaped responses to items from three separate production tasks, described in (7), and designed to elicit nouns, act-on verbs, and classifier predicates. In each case, the instructions were to "describe what you see", and the interlocutor was a signer of the same sign language. All three tasks consisted of PowerPoint presentations containing the items as photos (the noun naming task), short video clips (the verb naming task) or a mixture of both (the classifier predicate task). The noun and lexical verb tasks contained 41 related items; i.e., a photo of a comb in the noun task, and a clip of a woman combing her hair in the verb task—12 non-instruments and 29 instrumental verbs. In the classifier predicate production task there were also related items: a block of 5 stimuli without an agent and a block of 5 stimuli with an agent.

(7) Task Descriptions
   a. noun task (41 items):
      i. non-instruments: toy airplane, marble, book, cigar, coin, gloves, hat, jacket, jeans, shoes, socks, lollipop
      ii. instruments: lipstick, comb, toothbrush, tweezers, mascara, nail file, nail polish, hairdryer, hairbrush, spoon, fork, hammer, knives, broom, mop, vacuum, rake, paint brush, pen, phone, scissors, screwdriver, string, tape, TV
   b. act-on verb naming task (41 items):

i. non-instruments: play with toy airplane, play with marble, read book, smoke cigar, drop coin in purse, put on gloves, put on hat, put on jacket, put on jeans, put on shoes, put on socks, eat lollipop
ii. instruments: put on lipstick, comb hair, brush teeth, tweeze eyebrows, apply mascara, file nails, apply nail polish, blow-dry hair, eat with spoon, eat with fork, hammer nail, cut with knife, clean with broom, clean with mop, clean with vacuum, rake leaves, paint furniture, write with pen, talk on phone, cut with scissors, use screwdriver, tie with string, close box with tape, turn on TV (with remote control device)

c. classifier task (44 items): toy airplane, book, lollipop, marble, pen
i. non-agentive forms: [object] on table, [object] on table upside down, Multiple [objects] on table (regular arrangement in row/s, Multiple [objects] on table(random arrangement), [object] falling
ii. agentive forms: put [object] on table, put [object] on table upside down, put multiple [objects] on table (regular arrangement in row/s, put multiple [objects] on table, (random arrangement), demonstrate function of [object]

3.1.1 Coding and transcription

The videotaped responses of the participants were captured using iMovie, clipped into files for ease of transcription, and transcribed using ELAN (EUDICO Linguistic Annotator), a tool developed at the Max Planck Institute for Psycholinguistics, Nijmegen, for the analysis of language, sign language, and gesture (Crasborn & Sloetjes 2008).

The responses consisted of one or more signs, so we needed to assign word classes (nouns, type of predicate) to each sign using consistent criteria. For the classifier task, classifier predicates were categorized as such because they are spatial predicates. Classifier predicates can also be distinguished from nouns by their location in signing space. Because all of the vignettes used in the classifier task of our study show items on a table or being put on a table, we were able to use the location and orientation of the sign to categorize it as a classifier predicate or noun. If the participant used an orientation that mirrored the movement or arrangement in the vignette, the sign was considered a classifier predicate; classifier predicates were typically produced in a specific location within a single plane, [3] most often in the horizontal plane of the signing space (reflecting the fact that the objects in our stimuli were placed on a table). If the participant produced the sign on the body or at a nonspecific location in one of the three planes of neutral space in responding to an item on the classifier task, the sign was considered a noun. For the noun and verb tasks both types of signs are likely to be produced in the same location, so we followed Flaherty (2014) and Abner *et al.*

[3] There are three planes in the signing space: the horizontal plane, the vertical plane, and the mid-sagittal plane (Brentari 1998).

(2015), who found that clausal responses to stimuli of this type tended to be verb final, and we used word order to distinguish nouns from verbs. If two forms were produced in a response, the first one was considered the noun and the second the verb.

After assigning the lexical category nouns, verbs, and classifier predicates were annotated for their handshape type: (1) *object* handshapes captured features of the item they represented, either the whole item or size and shape dimensions of the item, and (2) *handling* handshapes captured features of the hand manipulating the item. The following types of handshapes were excluded from the analyses because their handshapes could not easily be categorized as *object* or *handling*: (a) handshapes derived from fingerspelling (e.g., #P-E-N); (b) predicates with a neutral handshape (a lax B- or a 1-handshape that traced the movement of the object). If responses to items on the noun or verb task included both object and handling HSs these were excluded as well (5% on the noun task, 1% on the verb task). Because a single response on the classifier task contained both a handling and object HS relatively often, if a form contained the "expected" handshape at least once, this one was counted in the analysis (i.e., a handling HS in response to an item with an agent, or an object HS in response to an item without an agent). If such a handshape was not used, then a mismatching handshape was counted in the analysis.

The mean number of *object* and *handling* handshapes used in nouns and classifier predicates was calculated first for individuals and then for each group. Only one response was used per item. It is important to note that even though the number of participants from each language was relatively small, the total number of observations analyzed was not: in total, 8,372 handshapes were transcribed and included in the analyses that follow.

3.2 Results and analysis

These results are intended to demonstrate the range of variation across nouns, act-on verbs and classifier predicates with regard to handling and object HSs in the four participating sign languages. All significant results between groups reported here are based on the Mann Whitney U Test, a nonparametric statistical test than can be used with small numbers of participants. Since there were 10 participants in all groups, the crucial U value for obtaining significance was 27 in each analysis. The full results for the group comparisons reported here are given in the Appendix.

3.2.1 Agentive/non-agentive opposition using handshape

Let us begin with the use of handshape to express the agentive/non-agentive opposition, which we find is very robust across all 4 sign languages in classifier predicates (Figure 5, top). This replicates previous results (Benedicto & Brentari 2001; Goldin-Meadow *et al.* 2015; Mazzoni 2009; Schick 1987; Brentari *et al.* 2013; Brentari *et al.* 2015).

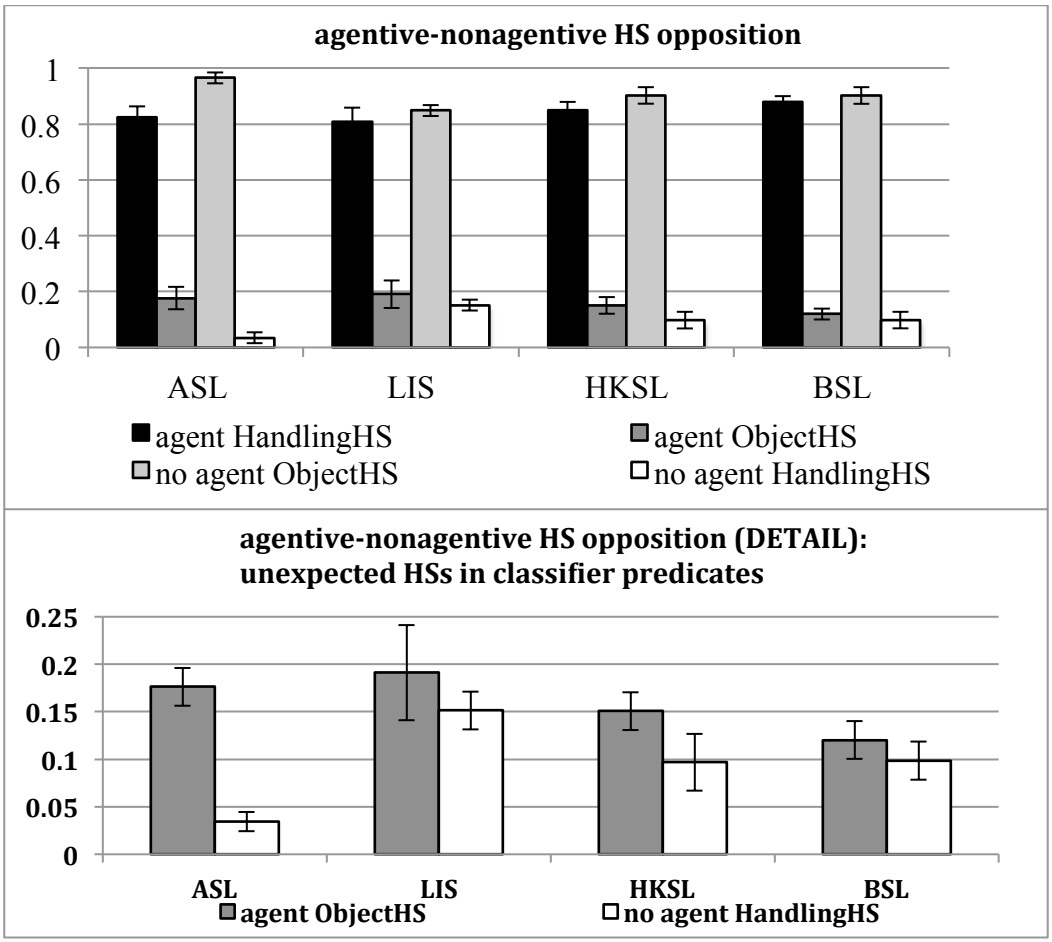


Figure 5: (top) the overall distribution of handling and object HSs to express the agentive/non-agentive opposition across 4 sign languages, with standard error bars; (bottom) a detail of distribution of unexpected uses of handling and object HSs to express the agentive/non-agentive opposition, with standard error bars.

Within this clear pattern, there is also crosslinguistic variation, observed first in Brentari *et al.* (2015) between ASL and LIS, and again here, regarding all four sign languages. To be more precise, "unexpected" handshapes appear in both directions'; this is seen in Figure 5 (bottom), a detail of the larger pattern in Figure 5 (top).

Object handshapes are sometimes used in agentive clauses, and this does not differ significantly crosslinguistically. These forms occur due to a variety of periphrastic grammatical strategies, such as including a sign PERSON or a lexical verb PUT to express the agentive. Handling HSs are sometimes used unexpectedly in non-agentive clauses, and there is a significant difference between ASL and the other three sign languages along this dimension ($p < 0.05$).

In the next two sections we investigate two motivations for this crosslinguistic variation: a high sensitivity to instrument arguments in act-on verbs, and the iconic preference of handshape for instrument nouns (object HS or handling HS).

3.2.2 Instrument sensitivity in act-on verbs

The distribution of handling and object HSs in act-on verbs is shown in Figure 6. In the combined measure (all act-on verbs, regardless of its type, Figure 6 (left)), ASL is significantly different than LIS or HKSL, and BSL is significantly different than LIS or HKSL (p's < 0.05). Crucially ASL and BSL are not significantly different from one another, nor are LIS and HKSL different from one another.

To understand this finding better, the responses to stimuli that included or did not include an instrument were examined separately. Statistical tests were not done on these forms because the total number of items that included or did not include an instrument are very different from one another—12 items without an instrument, which included a direct object (e.g., PUT-ON-PANTS) and 29 items with an instrument (e.g., APPLY-LIPSTICK). If we compare Figure 6 (center) with Figure 6 (right) it is quite clear that the group of act-on verbs with instruments are responsible for the combined results.

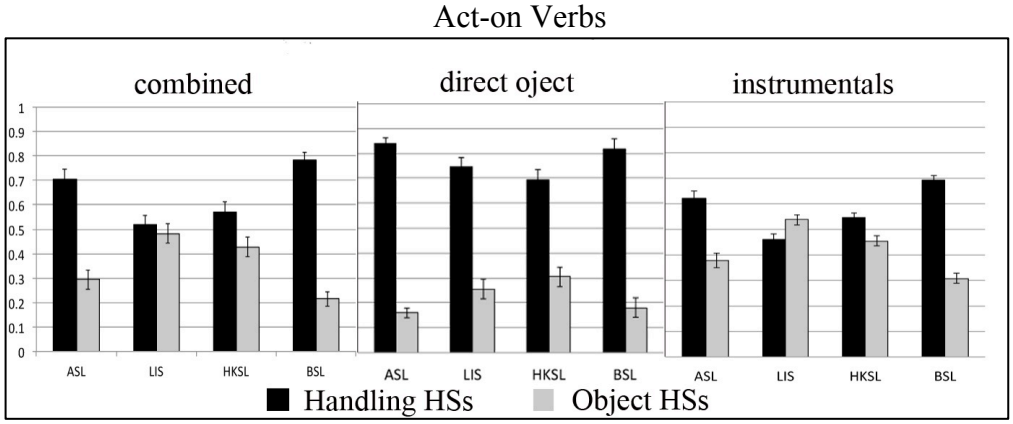


Figure 6: Act-on verbs: (left) the proportion of handling and object HSs used in all act-on verbs; (center) the proportion of handling and object HSs used in act-on verbs that have a direct object (DO), and (right) the proportion of handling and object HSs used in act-on verbs that have an instrument, with standard error bars.

Moreover, it is clear that ASL and BSL have less sensitivity to the presence of an instrument in the lexical semantics of the verb, preferring to use handling HSs for all agentive clauses, while LIS and HKSL have a stronger sensitivity to the lexical semantics of instruments. When an instrument is involved, there is a tendency to use a higher proportion of object HSs, despite the fact that the clause is agentive. We now turn to the behavior of handling and object HSs in nouns to add the final piece to this overall typological pattern.

3.2.3 Iconic handshape preference in nouns

The results from the noun task are given in Figure 7. Looking at all of the nouns as one combined group we see two different patterns. ASL and LIS exhibit an object HS preference, and HKSL and BSL exhibit a handling HS preference, thus confirming the Aronoff, *et al.* (2009) findings for ASL and BSL. Except for the ASL and LIS group comparisons, all others are significantly different from one another (all p's < 0.05).

Notice, however, that when the nouns associated with act-on verbs with and without instruments are examined separately, we gain insight into how the instrumental sensitivity interacts with the iconic handshape preference in the four languages. Even though the iconic HS preferences still are in evidence, it is also clear that the lexical semantics of the verb to which these nouns are related also plays more of a role in HKSL and LIS and less of a role in ASL and BSL. Like BSL, HKSL has a handling HS preference in nouns, but is also instrument sensitive; thus for non-instrument nouns HKSL show an even higher preference for handling HSs than BSL in this class of nouns. And like ASL, LIS has an object handshape preference in nouns, but is also instrument sensitive; thus in instrument nouns they show an even higher preference for object HSs than ASL.

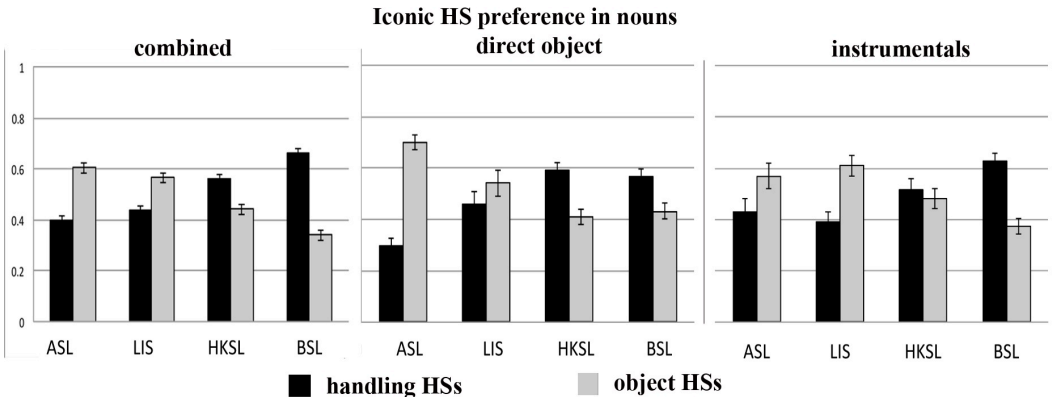


Figure 7: (left) the proportion of handling and object HSs used in all nouns; (center) the proportion of handling and object HSs used in nouns having a direct object (DO) in their lexical semantics, and (right) the proportion of handling and object HSs used in nouns having an instrument in their lexical semantics, with standard error bars.

Summarizing, the four categories that result from the two factors contributing to typological membership are exemplified by the four sign languages of this study, as shown in Table 2.

	noun preference	
instrument sensitivity	*H-HS*	*O-HS*
NO H-HS (H-HSs in all act-on verbs)	BSL	ASL
YES (H-HS > O-HSs / instrumentals)	HKSL	LIS

Table 2: The analysis of the 4 sign languages under investigation laid out according to the factors of i) iconic handshape preference in nouns and ii) instrument sensitivity.

4 Discussion

There are two generalizations that have emerged from these analyses. First, in order to explain typological membership in this set of cases it is important to understand an interaction of two factors. Knowing one factor or the other (either iconic handshape preference in nouns, or instrument-sensitivity) will not be sufficient to explain this behavior. Second, while the factor of instrument sensitivity has not been widely discussed in the sign language literature with the exceptions of Janis (1992) and Meir (1999), this topic has received a lot of attention in the spoken language literature, from the 1960s to the present time, in a number of different frameworks (Lees 1960; Chomsky 1970; Bierwisch 1989; Grimshaw 1990; Giannakidou & Rathert 2009; Borer 2012; Alexiadou & Borer 2015). Bierwisch (1989) describes the situation succinctly: "Derived nouns inherit their argument structure in some form from their verbal source." Borrowing from the work on the lexical semantics of verbs in spoken languages, we propose that act-on verbs and their related nouns in these four sign languages can be decomposed into elements present in the lexical semantics, which may display their associated argument structure to varying degrees.

It would appear that there are three ways to proceed with this analysis. One would be to characterize the relationship between the use of handling and object HSs in the agentive/non-agentive and the instrumental/non-instrumental oppositions as one of competition. Each language would then have a different weight associated with these two uses of handling and object HSs in predicates (agency vs. instrument-sensitivity). Another possible analysis to pursue is that while some sign languages exclusively use handling and object *handshapes* to express the agentive, other sign languages may express the agentive in more than one way, such as marking agency on the body (Tang & He 2013), or using movement instead of handshape to mark the agentive (see Horton et al. (submitted) for an analysis of movement to express agentivity). In instrumental verbs the role of agency might then be shifted to an alternative means of expression. The third and related avenue to pursue in this analysis is to clarify the status of handling and object HSs in act-on verbs with respect to their cousins realized as morphemes in classifier predicates.

Moreover, all of the patterns seen involve variation; however, this variation does not appear to be individual variation because the error bars are quite small, indicating that inter-subject variation is low. The likely explanation has to do with the specific verbs or specific combinations of verbs and arguments (movement

and handshapes) in a verb phrase. There are a number of categories of instrumentals that languages use, and in the following paragraphs we will sketch what these categories might be for sign languages. In future studies to tease apart the differential behavior of instruments across sign languages, more careful attention will be paid to the specific verbs and nouns used in the tasks, as well as to typical and atypical uses of instrumentals. Here we can only sketch the directions this work might take.

Since an instrument can have semantic status, syntactic status, or both, we will need to explore the status of instrumentals in each of these four sign languages. Some sign languages may treat certain instruments as syntactic arguments, while other sign languages may treat instruments as adjuncts. Given our findings thus far, ASL and BSL may treat them more like adjuncts while LIS and HKSL may treat instruments more like arguments, but we must keep in mind that all of the findings discussed in the current work are based exclusively on the crosslinguistic distribution of handling and object HSs in these three diverse linguistic contexts. No syntactic tests have been used.

Some authors have described the instrument as an "intermediary" (Talmy 1976; Goldberg 2002; Croft 1991), while others have used the term "facilitating" for such instruments (Marantz 1984). Schlesinger (1995) proposes different instrumental roles based on the association of the verb with the function of the instrument (8), while other researchers have proposed generic predicates to capture these multiple role types; for example, in Rappaport & Levin (1998), the agent acts on the patient BY MEANS OF the instrument.

(8) Instrumental roles have been proposed by Schlesinger (1995).
   a. John hit Mary on the head with a club. (Intermediary)
   b. John ate the ice cream with a spoon. (Enabling)
   c. He kicked the ball with his left foot. (Proper part)
   d. Martha changed the light bulb with a ladder. (Ancillary)

Using an experimental design Rissman (2013) and Rissman *et al*. (2015) have argued that sensitivity to instrumentals is gradient, and depends to a large extent on the individual verb. The status of the instrument as obligatory or typical may also play a role. Koenig *et al.* (2007) propose that English verbs such as *slice, write* and *dig* semantically 'require' an instrument, whereas *eat, break* and *open* 'allow' an instrument but do not require one. Typicality may also be important: *slice with a knife* vs. *slice with a wire*. Some, all, or none of these categories regarding instrumentals in sign language may be relevant, and it will require future studies with careful attention to the type and typicality of instrumentals to tease apart which precise factors are important. Diagnostic tests sensitive to argument structure might be devised for each of the four sign languages to address this issue in the languages in our study.

5 Conclusion

On the basis of distributional evidence, this investigation has shown that there is crosslinguistic variation in the iconic handshape preference in nouns and in instrument sensitivity. These two factors conspire to create four typological categories that can explain some of the variation in the use of handling and object HSs in classifier predicates, core lexical nouns and act-on verbs. This work has the potential to add our understanding of instrument verbs more generally, but it is preliminary in nature, and more research is needed to determine whether typicality, type of facilitation by the instrument, or other factors, are responsible for the crosslinguistic variation shown here.

References

Abner, N. 2013. Classifying reduplicated nominals in ASL. Presented at Theoretical Issues in Sign Language Research 11. University College London, London, England.

Abner, N., M Flaherty, K. Stangl, D. Brentari, & S. Goldin-Meadow. 2015. *Emergent Lexical Categories: Nouns and Verbs in Homesign and Nicaraguan Sign Language*.

Alexiadou, A, & H. Borer. 2015. *The Syntax of Roots and the Roots of Syntax*. Oxford, UK: OUP.

Aronoff, M., I. Meir, & W. Sandler. (2005) The paradox of sign language morphology. *Language* 81.301–344.

Aronoff, M., I. Meir, C. Padden, & W. Sandler. 2009. Instrument vs. handling in sign language lexicalization patterns, Presentation at the annual meeting of the Linguistic Society of America. San Francisco.

Benedicto, E., & D. Brentari. 2004. Where did all the arguments go? Argument changing properties of classifies in ASL. *Natural Language and Linguistic Theory* 22.743–810.

Bierwisch, M. 1989. Event nominalizations: proposals and problems. *Linguistische Studien* 194.1–73. Berlin: ZISW, Akademie der Wissenschaften.

Borer, H. 2012. *Structuring Sense. Vol. III: Taking Form*. Oxford: Oxford University Press.

Brentari, D. 1998. *A Prosodic Model of Sign Language Phonology*. Cambridge, MA: MIT Press.

Brentari, D. 2011. Sign language phonology. In *The Handbook of Phonological Theory, Second Edition*, ed. by J. Goldsmith, J. Riggle, & A. Yu, 691–721. Blackwell, New York/Oxford,

Brentari, D. 2012. Sign language phonology: the word and sub-lexical structure. In *Handbook of Sign Language Linguistics*, ed. by R. Pfau, M. Steinbach, & B. Woll, 21-54. Berlin: Mouton.

Brentari, D, & C. Padden. 2001. A language with multiple origins: native and foreign vocabulary in American Sign Language. In *Foreign Vocabulary in Sign Language: A Crosslinguistic Investigation of Word Formation*, ed. by D. Brentari, 87–119. Mahwah, NJ: Lawrence Erlbaum.

Brentari, D., M. Coppola, A. Jung, & S. Goldin-Meadow. 2013. Acquiring word class distinctions in American Sign Language. *Language Learning and Development* 9(2).130-150.

Brentari, D., A. Di Renzo, J. Keane, & V. Volterra. 2015. Cognitive, cultural and linguistic sources of a handshape distinction expressing agentivity. *TopiCS,* 7(1).95-123.

Chomsky, N. 1970. Remarks on nominalization. In *Readings in Transformational Grammar*, ed. by R. K. Jacobs, & P. S. Rosenbaum, 184-221. Waltham, MA: Ginn and Company.

Crasborn, O., & H. Sloetjes. 2008. Enhanced ELAN functionality for sign language corpora. In *Proceedings of LREC 2008, Sixth International Conference on Language Resources and Evaluation.*

Croft, W. 1991. *Syntactic Categories and Grammatical Relations: The Cognitive Organization of Information*. Chicago: University of Chicago Press.

Eccarius, P. 2008. A constraint-based account of handshape contrast in sign languages. Doctoral dissertation. West Lafayette, IN: Purdue University.

Engberg-Pedersen, E. 1993. *Space in Danish Sign Language*. Hamburg: SIGNUM.

Fillmore, C. J. 1968. The case for case. In *Universals in Linguistic Theory,* ed. by E. W. Bach, & R. T. Harms, 1-25. NY: Holt, Rinehart and Winston.

Flaherty, M. 2014. The emergence of argument structural devices in Nicaraguan Sign Language. Doctoral dissertation. Chicago: University of Chicago.

Giannakidou, A., & M. Rathert, 2009. *Quantification, Definiteness, and Nominalization*. Oxford: Oxford University Press.

Goldberg, A. E. 2002. Surface generalizations: an alternative to alternations. *Cognitive Linguistics* 13(4).327-356.

Goldin-Meadow, S., D. Brentari, M. Coppola, L. Horton, A. Senghas. 2015. Watching language grow in the manual modality: Nominals, predicates, and handshapes. *Cognition* 136.381-395.

Greenberg, J. 1966. Some universals of grammar with particular reference to the order of meaningful elements. In *Universals of Language* (2nd edition), 110-113. Cambridge: MIT Press,

Grimshaw, J. (1990). *Argument Structure*. Cambridge, MA: MIT Press.

Hunsicker, D., & S. Goldin-Meadow. 2015. How handshape type can distinguish between nouns and verbs in homesign. In *Where Do Nouns Come From?*, ed. by J. B. Haviland, 111-133. Amsterdam: John Benjamins.

Jackendoff, R. 1972. *Semantic Interpretation in Generative Grammar*. Cambridge, MA: MIT Press.

Jackendoff, R. 1990. *Semantic Structures*. Cambridge, MA: MIT Press.

Janis, W. 1992. Morphosyntax of the ASL Verb Phrase. Doctoral dissertation, State University of New York, Buffalo.

Koenig, J.-P., Mauner, G., Bienvenue, B., & Conklin, K. 2008. What with? The Anatomy of a (proto)-role. *Journal of Semantics* 25(2).175-220.

Lees, R. B. 1960. *The Grammar of English Nominalizations*. The Hague: Mouton de Gruyter

Marantz, A. 1984. *On the Nature of Grammatical Relations.* Cambridge, Mass.: MIT Press.

Mathur, G., & Rathmann, C. 2011. Two types of nonconcatenative morphology in sign languages. In *Deaf Around the World: The Impact of Language*, ed. by D. J. Napoli, & G. Mathur, 54-82. New York/Oxford: Oxford University Press.

Mazzoni, L. 2009. *Classificatori e impersonamento nella Lingua dei Segni Italiana*. Pisa: Plus.

Meir, I. 1999. Verb classifiers as noun incorporation in Israeli Sign Language. In *Yearbook of Morphology 1999*, ed. by G. Booij, & J. van Marle, 295-315. Dordrecht: Kluwer.

Mithun, M. 2008. The emergence of agentive systems. In *The typology of semantic alignment systems,* ed. by M. Donohue, & S. Wichmann, 297-333. Oxford, UK: Oxford University Press.

Peirce, C. S. 1958. *Collected Papers of Charles Sanders Peirce, 1931-1935*. Cambridge, MA: Harvard University Press.

Padden, C., & D. Perlmutter. 1987. American Sign Language and the architecture of phonological theory. *Natural Language & Linguistic Theory* 5.335-375.

Padden, C., I. Meir, R. Lepic., So-One Hwang, S. Seegers, & T. Sampson. 2013. Patterned iconicity in sign language lexicons. *Gesture* 13(3).287–308.

Perlmutter, D. 1978. Impersonal passives and the unaccusative hypothesis. In *Proceedings of the Fourth Annual Meeting of the Berkeley Linguistics Society,* 157-189. University of California, Berkeley: Berkeley Linguistic Society.

Quer, J. 2012. Negation. In *Handbook of Sign Language Linguistics,* ed. by R. Pfau, M. Steinbach, & B. Woll, 316-339. Berlin: Mouton.

Rappaport-Hovav, M., & Levin, B. (1998). Building verb meanings. In *The projection of arguments: lexical and compositional factors*, ed. by M. Butt & W. Geuder, 97-134. Stanford, CA: CSLI.

Rathert, M., & A. Alexiadou. 2010. *The Syntax of Nominalization Across Languages and Frameworks*. Berlin: Mouton de Gruyter.
Rissman, L. 2013. Event participant representations and the instrumental role: A cross-linguistic study. Doctoral dissertation. Baltimore, MD: Johns Hopkins
Rissman, L., K. Rawlins, & B. Landau. 2015. Using instruments to understand argument structure: Evidence for gradient representation. *Cognition* 142.266–290.
Schlesinger, I. 1995. *Cognitive Space and Linguistic Case.* Cambridge, England: Cambridge University Press.
Schick, B. 1987. The Acquisition of Classifier Predicates in American Sign Language. Doctoral dissertation, West Lafayette, IN: Purdue University.
Shay, R., 2002. Grammaticalization and Lexicalization Analysis of Fingerspelling, Unpublished MA thesis, West Lafayette, IN: Purdue University,
Supalla, T. 1982. Structure and Acquisition of Verbs of Motion and Location in American Sign Language, Doctoral dissertation, University of California, San Diego.
Supalla, T., & E. Newport. 1978. How many seats in a chair? The derivation of nouns and verbs in American Sign Language. In *Understanding Language Through Sign Language Research*, ed. by P. Siple, 91–132. NY: Academic Press.
Talmy, L. 1976. Semantic causative types. In *Syntax and Semantics, vol. 6: The Grammar of Causative Constructions*, ed. by M. Shibatani, 43-116. NY: Academic Press.
Tang, G., & J. He 2013. On the nature of instrument in the classifier predicates of Hong Kong Sign Language and Tianjin Sign Language. Paper presented at International Conference on Sign Linguistics and Deaf Education in Asia. Hong Kong: Chinese University of Hong Kong
Taub, S. 2001. *Language from the Body: Iconicity and Metaphor in American Sign Language*. Cambridge, UK: Cambridge University Press.
Wilbur, R. 2010. The semantics–phonology interface. In *Sign Languages: A Cambridge Language Survey*, ed. by D. Brentari, 357-382.Cambridge, MA: Cambridge University Press.
Zeshan, U. 2006. *Interrogative and Negative Constructions in Sign Languages*. Nijmegen: Ishara Press.

APPENDIX

CLASSIFIER PREDICATES: unexpected handshapes							
agentive: Object HSs				**nonagentive: Handling HSs**			
ASL-LIS	z= -0.39	U=49	p=0.34	ASL-LIS	z= -2.80	U=12	p=0.003***
ASL-HKSL	z= -0.19	U=47	p=0.42	ASL-HKSL	z= -1.55	U=27	p=0.05*
ASL-BSL	z= 1.09	U=35	p=013	ASL-BSL	z= -1.58	U=27	p=0.05*
LIS-HKSL	z= -0.19	U=47	p=0.42	LIS-HKSL	z= -1.28	U=33	p=0.09
LIS-BSL	z= -0.19	U=47	p=0.42	LIS-BSL	z= 1.17	U=34	p=0.21
HKSL-BSL	z= 0.49	U=43	p=0.31	HKSL-BSL	z= -0.23	U=47	p=0.41
ACT-ON VERBS				**NOUNS**			
combined: instr. & noninstr. verbs				**combined: derived from instr. & noninst. verbs**			
ASL-LIS	z= 2.31	U=19	p=0.01**	ASL-LIS	z= -0.60	U=42	p=0.27
ASL-HKSL	z= 1.86	U=25	p=0.03*	ASL-HKSL	z= -3.29	U=6	p=0.005**
ASL-BSL	z=-1.06	U=36	p=0.14	ASL-BSL	z= -3.74	U=0	p<0.0001****
LIS-HKSL	z=-0.95	U=37	p=0.17	LIS-HKSL	z=-2.61	U=15	p=0.005**
LIS-BSL	z= -3.09	U=9	p=0.001***	LIS-BSL	z= -3.74	U=1	p<0.0001****
HKSL-BSL	z= -3.02	U=10	p=0.001***	HKSL-BSL	z= -2.50	U=17	p=0.006**