Learning to Count Spatially:
The Acquisition of Plurality in ASL Verbs of Location

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1. Introduction

1.1 The Expression of Plurality in Signed Languages

Plurality in signed languages may be expressed in several ways –including the insertion of a numeral or quantifier within a construction, by the reduplication of a sign, or the incorporation of a plural classifier (Fischer, 1973; Baker-Shenk & Cokely, 1980; Hoffmeister, 1984; and Pfau & Steinbach, 2006). Examining plurality, there are differences when we compare classifiers in a signed language to those classifiers that occur in spoken languages. Aside from the obvious difference in modality (spoken vs. signed), one of the most notable differences is the fact that while many spoken languages employ numeral classifiers to express plurality, signed languages express plurality through the use of "classificatory verbs of handling, motion and location" (Aikenvald, 2003; p.15). These verbs of handling, motion and location differ from numeral classifiers of spoken languages not only in their form but also in the fact that they may *optionally* occur with a numeral. This is in contrast to spoken languages employing numeral classifiers, as they require the presence of a numeral in order to appear grammatical.

In signed languages, classifier handshape morphemes combine with movement morphemes to indicate plurality. These handshapes are often derived from SASSes and semantic classifier handshape groups and may be either marked or unmarked[2]. When the *stative/displaced* (Supalla, 1982), or *extension* (Engberg-Pedersen, 1993) movement category is employed, the goal is either to articulate the outward, 'whole' appearance of a mass by using a *tracing* movement (Supalla, 1982) or to show the extent and arrangement of a range of objects by using a *sweeping* movement (Hoffmeister, 1992). For example, to show a 'huge herd of sheep', a signer would form a curved-5 classifier handshape on each hand and then proceed to move both hands forward in a path along the signing space tracing the extent of the location of the 'herd'. Such verbs of location indicate the *mass* or *extent* of the herd in a location (stative intent).

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[2] Unmarked handshapes refer to those that are typically easier to acquire and produce than marked handshapes. The "5" handshape is an example of an unmarked handshape while the "3" handshape serves as an example of a marked handshape. Refer to Baker-Shenk & Cokely (1980) for further reading.

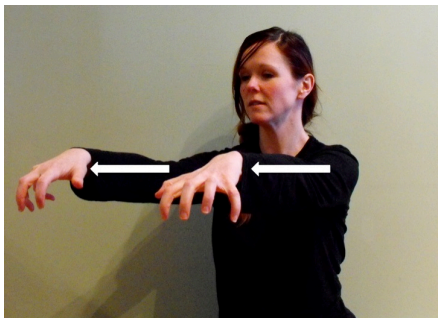

Figure 1: 'herd of sheep'

This combination of both hands forming the same specific handshape (e.g. 5, curved 5, B, 4) while using a tracing movement is often used to indicate mass in a plural verb of location construction of ASL (Baker-Shenk & Cokely, 1980). The tracing movement serves as a means of framing the boundaries of a mass. This *trace* type of movement has been documented cross-linguistically in other signed languages as well (Miljan, 2003; Zwitserlood, 2003).

Another type of movement frequently found among verbs of location involves a sweeping movement. This movement is often employed when the mass of objects appear in a linear or arc arrangement. To demonstrate this arrangement, the signer, typically using the same handshape for both hands, holds the nondominant hand in the signing space where the arrangement starts and then proceeds to move the dominant handshape away from the nondominant hand in a sweeping movement following either a linear or arc path. This movement treats all of the individual objects as one mass arranged in a specific way.

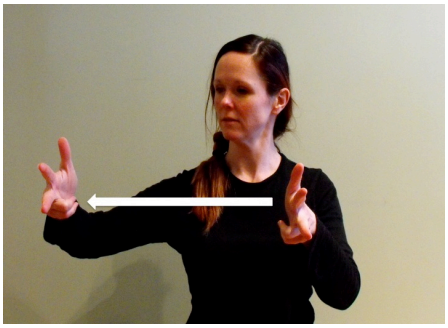

Figure 2: 'row of cars'

As an example of this (as demonstrated in Figure (2) above), where a signer wanted to show a row of several cars, would involve employing the "3" classifier handshape on both the dominant and nondominant hands to refer to a number/group of objects (e.g. cars) in a linear arrangement. With the hands placed side by side, the signer would then make a sweeping movement with the

dominant hand as it moves away from the nondominant hand (holding the original location) focuses on the objects (e.g. cars) as a group rather than as individual objects. Like the tracing movement, the sweeping movement (which we define as a *hold sweep*) indicates the location of the object(s)/mass within the signing space –making them verbs of location.

The third type of movement category, which has been referred to as *contact* (Supalla, 1982), *position* (Engberg-Pedersen, 1993), or *stamp* (Hoffmeister, 1978 & 1992) also allows verbs of location to express plurality. The handshapes employed in these constructions may be either marked or unmarked and the same handshape is used for both the dominant and non-dominant hands. The handshapes are then combined with a stamping movement along a path to show plural while containing the individual identity of each instance of an object. When this type of movement is employed, the objects depicted are considered as a countable set (as opposed to a mass). When producing a stamping movement, the signer typically will set up the non-dominant hand as a *hold* within the signing space. The dominant hand is placed next to the non-dominant hand and then reduplicated[3] across a linear or arc path to show the arrangement of several countable objects. We will refer to this type of movement as *hold stamp*.

Figure 3: 'cars in a row'

An example of this movement (as seen in Figure (3) above) would involve depiction of the arrangement of a *few* cars in a row, by the signer forming the '3' classifier handshape (both hands) to signify the objects (e.g. cars). After both hands are placed in the signing space, the dominant hand is then reduplicated three times or more in the signing space, each time moving further away from the non-dominant hand which is held at the starting point of the path. As the dominant hand is stamped moving away in a linear movement, the signer is able to show the arrangement of this small set of cars. Thus, this movement away from the non-dominant hand serves not only to show plurality and countability

[3] Reduplication occurs in both spoken and signed languages and may be used to demonstrate plurality. In signed languages, both lexical signs and classifiers are capable of undergoing this process that involves a repeating of the sign in the signing space.

(to an extent) of objects but also their spatial arrangement with respect to each other within the signing space.

A second type of stamping movement occurring within the contact/position/stamp category involves the simultaneous movement of both hands in the signing space. With this movement, which we will refer to as *dual stamping*, both hands, sharing the same classifier handshape are stamped along the signing space in either an orderly or random arrangement.

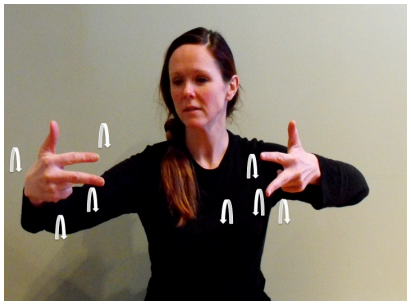

Figure 4: 'cars arranged throughout the signing space'

As can be seen in the above example (4), in dual stamping, the hands typically alternate movement to show several instances of objects in different locations. For example, if several cars were arranged in no particular order, the signer would form the '3' handshape with both hands and then simultaneously and repeatedly stamp both hands throughout the signing space. Or the signer may use a 'pair of handshapes' to indicate multiple sets of objects (i.e. stamping both '3' handshapes together several times in the signing space). As with hold stamping, dual stamping also suggests countability among a group of objects. Cross-linguistically, stamping has been noted as showing countability in verbs of location (Miljan, 2003).

The difference between the choice of using a *trace, hold sweep, hold stamp,* or *dual stamp* movement is dependent upon how the signer is referring to the objects. While each of the movements acknowledge the plurality of objects, they differ with respect to the extent of plurality. With stamping movement, the signer is able to communicate an exact number of instances of a noun in the signing space, which makes it the most countable movement. The sweeping movement, on the other hand, treats the objects in the signing space as a group arranged in a specific way. Countability of individual members of the group is not possible; only several groups (i.e. several sweeps in the signing space) are capable of being counted. Finally, the tracing movement focuses solely on the mass the objects create and countability is deemed impossible. Considering the range between the concepts of count and mass, one may consider the stamping movement as closest to count, followed by the sweeping movement as closer to mass and the tracing movement at the end of the continuum. When used in

conjunction with classifier handshapes, stamp, sweep, and tracing movements function as verbs of location since they show the existence and arrangement of nouns within the signing space.

1.2 Child Acquisition of Plurality in Verbs of Location

Given the fact that verbs of motion and location are unique to each signed language, it stands to reason that deaf children must be exposed to a specific signed language in order to acquire these verbal structures. In a study of the acquisition of verbs of motion and location in ASL, Kantor (1980) found that deaf children progress through specific stages of development between the ages of 3 and 11. Observing data from deaf children with deaf parents (DCDP), Kantor found location is acquired first and foremost. This is then followed by motion (or movement), and handshape (with correct orientation). Kantor found that the youngest children (age 3) in her sample were more prone to delete and modify much of the information required to express the classifier predicate. Though movement appeared to be largely responsible for this diminished competence in the younger children, Kantor believed this was implausible since the same children were able to use the correct movements and handshapes in non-classifier signs. The findings suggested an apparent gap between morphological and semantic development among the children.

Supalla (1982) also found a specific progression of development in classifier constructions. In his study of three young children (ages 3-5), the deaf children began using unmarked classifier handshapes before learning to master more complex, marked ones. Likewise, he observed that in the earliest stages, children often fail to acknowledge the presence of secondary objects in their constructions. However, given ample time, the deaf children began to include these in their constructions and eventually learned how to demonstrate agreement within their verbs of motion and location.

In a study devoted specifically to plurality in verbs of location, Hoffmeister (1992) found a significant effect for age ($r = .49$, $N=77$, $p< .001$). Younger deaf children faced the most difficulty on items involving complex handshapes and those requiring the use of two hands. For instance, in test items requiring a stamping movement, which require a reduplication of the dominant handshape, children faced difficulty in holding the nondominant hand in the signing space while reduplicating the handshape on the dominant hand. Likewise, when dual stamping movement was required of both hands, younger children systematically struggled with this aspect of plural classifier constructions. For the subjects in Hoffmeister's study, plural classifier proficiency appeared to be mastered around the age of 11 for deaf children of both deaf (DCDP) and hearing (DCHP) parents.

The foregoing studies suggest the acquisition of verbs of motion and location is made possible through consistent, long-term exposure to these structures. As Supalla noted, "there are many interacting subsystems, all of which interact in the signing of a single verb" (1982, p. 64). Indeed, Newport

and Meier (1985) suggested the trouble with verbs of motion and location for deaf children tends to be due to their complexity. Thus, in order to master each of the individual subsystems within verbs of motion and location, deaf children must receive ample input from their environment.

Analysis of the different movements among verbs of location suggests that some may be acquired more easily than others. In particular, the ease of using a tracing movement within a verb of location appears to be a feature that could be easily understood and acquired by deaf children who have not had significant exposure to a signed language. The fact this movement type (*trace*) often involves a single movement that focuses on describing the outward appearance of a mass of objects would appear to be an easier movement for children to learn. This is in contrast to the other movements such as sweep and hold or dual stamp, which involve showing not only the plurality of a group of nouns but the arrangement and relationships among those nouns.

With the above considerations in mind, the following hypotheses were proposed: (1) the advantageous status of DCDP and older subjects, through their greater exposure to a signed language will result in their achieving higher scores in a test of Plurals and Arrangement while (2) DCHP and younger subjects in the sample will receive lower scores in a test of Plurals and Arrangement. Furthermore, (3) as a group, subjects will perform significantly better on test items involving a tracing movement in comparison to those requiring the more complex sweep or stamp movements.

2. Methodology

2.1 Sample

The subjects for the present study consisted of 782 deaf students who were recruited from two residential and two day school programs for the deaf. The mean age for the sample was 12 with a range from 4 to 18 years of age. Of these students, approximately 23% (180) were deaf children of deaf parents (DCDP) while 77% (602) were deaf children of hearing parents (DCHP).

2.2 Measures

In the present study, the Plurals and Arrangement test, a subtest of the American Sign Language Assessment Instrument (ASLAI)[4] was employed to measure comprehension of plural marking with ASL classifiers.

[4] The ASLAI, designed by the Center for the Study of Communication and the Deaf of Boston University (Hoffmeister, 1999) involves a series of 8 subtests. Each of the subtests were developed to test subject ability across several linguistic domains in ASL. The Real Objects (RO), Same Time/While (ST/W), Narrative Production (RTS) and Complex Sentences subtests assess subject expressive fluency. The Synonyms, Antonyms and Plurals and Arrangements subtests measure subject receptive comprehension within each task.

In the Plurals and Arrangement subtask, a multiple-choice format is employed. Administration of the measure involves the use of a video depicting 21 different test items. For each test item, the video shows a picture of an animate or inanimate representation of "more than one" object in specific quantity arrangements. For example, in Figure 1, a picture of several chairs in a series of rows is shown. The picture is then faded out and a signer appears on the screen. The signer proceeds to present 4 possible answers (A, B, C, and D) for how the entities in the picture may be signed. The student is instructed to select one answer (A, B, C, or D) for the test item. Each test item was carefully developed with the assistance of native signers to ensure accurate measurement of data.

Question 1

A

B

C

D

Figure 5: Rows of chairs (with four response choices)

2.3 Procedure

Prior to testing, consent forms were obtained by the parent or guardian of each student. In order to ensure confidentiality, each student was then assigned an ID number for testing. Answers were recorded under this ID number for each student tested from the schools for the deaf.

Administration of the test was conducted in a special testing area within each of the schools. These areas were arranged to promote subdued and calm environments and eliminate any possible distractions.

During the test, students were provided with an answer sheet to record their responses on. This answer sheet included the frozen picture frames (as pictured in Figure 5) for each question. Each student was tested individually and allowed ample time to complete the measure. Upon completion of the test, student responses were recorded in a spreadsheet of a Microsoft excel program.

4. Results

4.1 Overall performance

Following the proposed hypothesis that students would perform better depending on the movement required by the plural classifier, items were divided into the following groups: Trace, Hold Stamp, Dual Stamp, and Hold Sweep.

Analysis of the overall percentage of correct responses for items in the Plurals and Arrangement subtest found that students earned the highest percentage of correct answers on trace and dual stamp test items at 63% and the lowest percentage of correct answers on hold stamp test items at 51%. As a group, students scored an average of 57% on the measure.

A One-Way ANOVA indicated that results across test item groups (Trace, Hold Sweep, Hold Stamp and Dual Stamp) were significant. Pairwise comparisons suggested that performance on Trace (63%) and Dual Stamp (63%) test items was significantly greater than both Hold Stamp (51%) and Hold Sweep (54%) test items (all p's < 0.00). Interestingly though, there was no significant difference among Trace vs. Dual Stamp test items ($t = .286$, $p = .775$).

4.2 Comparison by Parental Status

In nearly all test items (with the exception of items 6 and 15) Deaf Children of Deaf Parents (n = 180), scored higher than Deaf Children of Hearing Parents (n = 602). Overall, DCDP scored an average of 63% in contrast to DCHP who scored 55% on the measure (62.91% vs. 54.85%, $t = 6.076$, $p = .001$). Among test items of the Trace group, DCDP scored an average of 72% in comparison to DCHP who scored approximately 60% ($t = 6.574$, $p < .001$). In comparing results of the Hold Sweep test items, DCDP answered correctly approximately 60% of the time while DCHP averaged 52% ($t = 4.434$, $p < .001$). On Hold Stamp test items, DCDP scored 56% in comparison to the 50% DCHP averaged across these items ($t = 3.310$, $p = .001$). Finally, DCDP scored higher on Dual Stamp test items at 67% in comparison to DCHP at 62% ($t = 1.773$, $p = .077$).

These results indicate that for DCDP, Trace test items were the easiest, followed by Dual Stamp, Hold Sweep and Hold Stamp. For DCHP, performance was highest on Dual Stamp test items, followed by Trace, Hold Sweep and Hold Stamp.

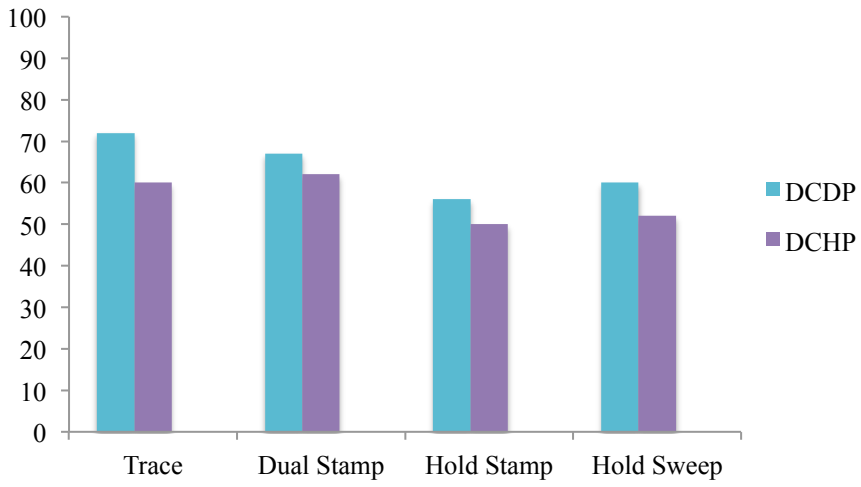

Figure 6: Comparison of movement scores by parentage

An ANOVA test of parental status revealed the differences were significant both between DCDP and DCHP and within their scores on among the test item groups (between subjects: $f = 24.361$, $p < .001$; within subjects = $f = 54.337$, $p < .001$).

Pairwise Comparisons of DCDP and DCHP scores demonstrated significant differences in performance for both DCDP and DCHP on all test item groups (all p's < .05). The lone exception to this was the difference between DCHP performance on Trace vs. Dual test items which indicated only a marginal difference ($t = 1.441$, $p = .150$).

4.3 Comparison by Age

In an effort to examine whether age played any role in scores on the Plurals and Arrangement subtest, student results were divided into the following age groups: 4-6, 7-9, 10-12, 13-15, and 16-18. Results revealed that age did play a role in student proficiency on the test. This was apparent based on the fact that students from the lowest age group scored a mean of 39% on the measure while students in the older groups (ages 13-15 and 16-18) each scored averages of 62%. Likewise, in an ANOVA test of overall comparison of age scores,

significant differences were found among all age groups ($f = 38.461$, $p < .001$) and between almost all age groups. The exception to this was the finding that no significant difference existed among scores between age groups 13-15 and 16-18 ($t = .273$, $p > .785$) –suggesting a ceiling effect for acquisition after age 13.

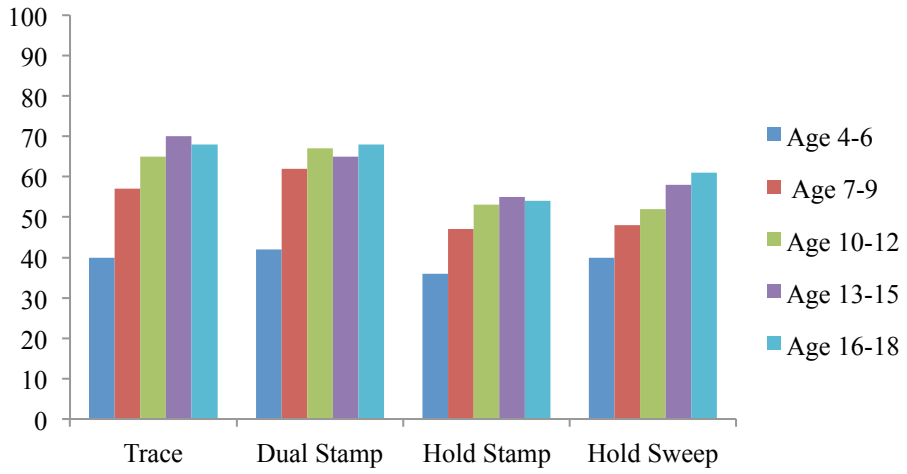

Figure 7: Comparison of movement scores by age group

An ANOVA test of age revealed the results were significant between the age groups and among their scores on each of the test item groups at the .05 level of significance (between subjects: $f = 34.263$, $p < .001$; within subjects = $f = 55.293$, $p < .001$). Pairwise comparisons within the 4-6 year olds found no significant differences in their performance among any of the test items. Among the 7-9 year olds, significant differences were found among all the test items with the exception of the Hold Sweep vs. Hold Stamp test items ($t = .867$, $p = .387$). Students in this group performed best on Dual Stamp test items followed by Trace test items, and then Hold Sweep and Hold Stamp items.

For the 10-12 year olds, their performance on the Trace and Dual Stamp test items was not significantly different ($t = .702$, $p = .484$) but certainly better than performance on the Hold Sweep and Hold Stamp items. Likewise, no difference was found between performance on the Hold Sweep and Hold Stamp items ($t = .434$, $p = .665$). Thus, students tended to perform more similarly on Trace and Dual Stamp items and Hold Sweep and Hold Stamp items, with the latter two test item groups being more difficult.

Among the 13-15 year olds, their performance across each of the test item groups was significantly different. For the 13-15 year olds, their performance was best on the Trace test items, followed by Dual Stamp, Hold Sweep and then Hold Stamp items. For the 16-18 year olds, their performance was best but not

significantly different (t = .177, p = .860) on the Trace and Dual Stamp test items. Their scores on the Hold Sweep test items followed, with scores on the Hold Stamp items being lowest among all four groups.

5. Discussion

This study aimed to explore the acquisition of plural classifier constructions among deaf children and observe whether movement morphemes play any role in this process. The data was expected to yield a direct relationship between deaf children's exposure to ASL and their performance on the Plurals and Arrangement subtest of the ASLAI. A decreased level of exposure to ASL was expected to coincide with a poorer performance on the assessment, while increased exposure to ASL was predicted to result in a greater performance on the tests. In addition, it was proposed that certain movement morphemes in classifier constructions would be acquired more effortlessly than others. Results collected from the present sample offered support in favor of the hypotheses.

The findings that age and parental status influenced student performance on the test falls in line with previous studies of deaf children's acquisition of plural classifier constructions (Hoffmeister, 1992 & 2000). The fact deaf children of hearing parents improved upon their understanding of verbs of location and movement morphemes with age suggests they were able to readjust their internal grammars in accord with the rules of ASL. The reason for this occurrence – not only in the acquisition of plural classifier constructions but in other areas as well - is due to children's underlying motivation to communicate more effectively with the world around them.

Interestingly, the results comparing movement morphemes within the verbs of motion/location (Trace vs. Hold Sweep vs. Hold Stamp vs. Dual Stamp) revealed significant differences in student performance. For all students, test items involving the Trace movement appeared to be the easiest to master, followed by Dual Stamp. Hold Sweep and Hold Stamp movements, on the other hand, appeared to be more challenging for students.

Both age and parental status were identified as contributing not only to student performance on the test in general but also to their comprehension of the individual movement morphemes. All students, including those with deaf parents those who were older performed better on test items calling for Trace or Dual Stamp movements. The increased complexity of Hold Sweep and Hold Stamp movements, in contrast to the simpler nature of the Trace and Dual Stamp (where students either 'trace' the outline of a mass or identify a few items in space using both hands) movements may be a reason for these outcomes. Further research is warranted to confirm such propositions.

The fact that the Plurals and Arrangement test was not specifically designed for assessing differences among movement morphemes in verbs of location opens the possibility that other unforeseen factors could have contributed to the results. Future investigations may suffice to clarify how movement influences the acquisition of plural verbs of location. Moreover, it would be helpful to

conduct a longitudinal study of individual subjects to observe the conditions under which students acquire each of the morphemes (handshape and movement) involved in the production of verbs of motion and location constructions. Data examining the acquisition of classifier handshapes and their effect upon competence within verbs of motion and location have revealed inconclusive findings (Supalla, 1982 & Fish et. al, 2003). Perhaps further testing designed to specifically address the acquisition of individual handshape and movement morphemes in plural classifiers will draw more conclusive evidence regarding which morphemes prove more challenging to acquire than others.

In addition, it would be interesting to examine how children acquire other aspects of number and/or plurality. For instance, does the visual nature of ASL provide an exclusive impetus for deaf children learning concepts related to number and plurality? Likewise, are deaf children able to apply what they understand about number in ASL towards their acquisition of number words in English? While these and many other questions remain and the answers may not be altogether simple, it is plausible that subsequent study will help to shed light upon these issues.

References

Aikhenvald, Alexandra Yurievna. (2003). *Classifiers: A typology of noun classification devices*. Oxford: Oxford University Press.

Baker-Shenk, Charlotte. & Cokely, Dennis. (1980). *American Sign Language: A Teacher's Resource Text on Grammar and Culture.* Silver Spring, MD: T.J. Publishers.

Emmorey, Karen. (2002). *Language, Cognition and the Brain.* Mahwah, NJ: Lawrence Erlbaum Associates.

Engberg-Pedersen, Elisabeth. (1993). *Space in Danish Sign Language: The Semantics and Morphosyntax of the use of space in a visual language.* Hamburg: Signum Press.

Fish, Sarah., Moren, Bruce., Hoffmeister, Robert., & Schick, Brenda. (2003). The Acquisition of Classifier Phonology in ASL by Deaf Children: Evidence from Descriptions of Objects in Specific Spatial Arrangements. In B. Beachley, A. Brown & F. Conlin, *Proceedings of the 27th Annual Boston University Conference on Language Development.* Somerville, MA: Cascadilla Press.

Fischer, Susan. (1973). Two Processes of Reduplication in American Sign Language. *Foundations of Language, 9,* p. 469-480.

Frishberg, Nancy. (1975). Arbitrariness and iconicity: Historical change in American Sign Language. *Language, 51*, 676-710.

Hoffmeister, Robert. (1984). *The Development of Pluralization in Deaf Children of Deaf Parents.* Boston University: Center for the Study of Communication and Deafness.

Hoffmeister, Robert. (1992). *Mapping Number and Arrangement in the Language of Deaf Children: Plurals and Many Things*. Center for the Study of Communication and the Deaf, Boston University.

Hoffmeister, Robert. (1999). *American Sign Language Assessment Instrument (ASLAI)*. Manuscript, Center for the Study of Communication and the Deaf, Boston University.

Hoffmeister, Robert. (2000). A Piece of the Puzzle: ASL and Reading Comprehension in Deaf Children. In C. Chamberlain, J.P. Morford, and R. Mayberry (Eds.), *Language Acquisition by Eye.* Mahwah, NJ: Lawrence Erlbaum Associates.

Kantor, Rebecca. (1980). The Acquisition of Classifiers in American Sign Language. *Sign Language Studies, 28,* p. 193-209.

Miljan, Merilin. (2003). Number in Estonian Sign Language. *Trames, 3,* p. 203-223.

Newport, Elissa., & Meier, Richard. (1985). The acquisition of American Sign Language. In D. Slobin (Ed.), *The crosslinguistic study of language acquisition. Vol. 1: The data* (pp. 881–938). Hillsdale, NJ: Lawrence Erlbaum Associates.

Pfau, Roland. & Steinbach, Markus. (2006). Pluralization in sign and in speech: A cross-modal typological study. *Linguistic Typology, 10,* p. 135-182.

Supalla, Ted. (1982). Structure and acquisition of verbs of motion and location in American Sign Language. Unpublished Doctoral Dissertation, University of California, San Diego.

Zwitserlood, Inge. (2003). *Classifying Hand Configurations in Nederlandse Gebarentaal.* Utrecht: LOT.