Understanding Ghanaian sign language(s): history, linguistics, and ideology

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3.

SIGNED LANGUAGES USED IN GHANA: LEXICOSTATISTICS AND COMPARISON OF LEXICAL SIMILARITIES

In this chapter, I explore the relationship between ENGLISH and BROKEN signs on one hand and ASL sign on the other. While ENGLISH and BROKEN represent distinct signing systems, their shared lexicon leads me to treat them as a single entity in this chapter (i.e., formal GSL), due to its focus on the lexicon. It's crucial to highlight that, during the study for this chapter, the triglossic situation of GSL was not initially clear to me. I was only cognizant of the diglossic scenario, prompting me to employ the terms formal and informal GSL to represent the situation. In this context, informal GSL primarily represented LOCAL, while formal GSL encompassed signs from ENGLISH and BROKEN. Formal GSL is well known to share a historical and genetic connection with ASL, but the extent of their present lexical similarities remains unknown. My main focus is measuring these lexical similarities, shedding light on the degree of linguistic affinity between the lexicon of formal GSL and ASL on the one hand, and of GSL (formal & informal) and village sign languages (i.e., AdaSL & NanaSL) on the other hand.

Notably, ASL signs have evolved in Ghana, incorporating new signs, and are now recognised as 'GSL' by the local deaf community (see chapter 2). While historical ties between sign languages suggest potential similarities, genetically related sign languages may not exhibit a high lexical similarity rate at a given moment (Ebling et al., 2015). The main motivation for this chapter is therefore to understand how the Ghanaian forms of signing compare to each other and to ASL.

Over half a century since the introduction of ASL signs to Ghana, it is reasonable to anticipate both significant differences and remarkable similarities (Nyst, 2010). Despite claims of mutual intelligibility between GSL and ASL based on historical links, the linguistic evidence supporting this assertion remains limited (Edward, 2021a). Anecdotal reports have relied on historical contact and language influence, but empirical evidence still needs to be provided. Moreover, the broader lexical relationship between ASL and other signed languages used in Ghana, such as AdaSL and NanaSL, has yet to be thoroughly explored.

Little attention has been given to a lesser-known variety of GSL (i.e., informal GSL) used among deaf individuals in Ghana. However, it has been acknowledged in some selected works (Edward & Akanlig-Pare, 2021; Edward, 2021b; Abudu, 2019; Nyst, 2010). As all signed languages in Ghana are understudied, and extensive comparisons among them are lacking, I take this opportunity to explore the lexical similarities using comparative linguistics tools.

In the following section, I first provide a lexical variation study conducted on the sign language diversity in Ghana (Section 3.1). I then describe the research

methods employed in this study (Section 3.2). Two distinct comparison approaches for examining lexical similarity are presented: Woodward's (2000) approach using the modified Swadesh list for analysis between GSL and ASL elicited items (Subsection 3.2.1), and Parks' (2011) approach using the Levenshtein distance for analysis (Subsection 3.2.2). Detailed descriptions of data acquisition are provided for each approach, including the challenges faced while collecting the informal variety of GSL on a large scale through formal interviews (Subsection 3.2.2.1.1). I also acknowledge the limitations of each approach in subsections 3.2.1.2 and 3.2.2.3, respectively. Finally, the results obtained from both approaches are presented in Section 3.3, followed by a discussion and conclusion of my findings in Section 3.4. Through this investigation, the chapter aims to contribute to understanding the intricate relationship between GSL, ASL, and other signed languages in Ghana.

3.1 Lexical studies on GSL and their Contributions

Previous linguistic research on sign languages in Ghana is relatively scarce, leading to a limited number of lexical studies in the country. Furthermore, most of the existing research remains unpublished. Among the few known studies, only five have attempted lexical comparisons on sign languages in Ghana, and notably, all of these studies are yet to be published. Among these studies, Tagoe (2018) conducted her research as part of her undergraduate thesis, while Peprah (2021), Abudu (2019), and Oppong (1998) pursued their investigations at the master's (thesis) level. The fifth study, presented as a conference paper by Hadjah (2018), further contributes to this emerging body of work. Notably, three of these studies, specifically those conducted by Abudu (2019), Hadjah (2018), and Peprah (2021), have focused on investigating lexical variation within GSL. In contrast, Tagoe's (2018) research encompassed a broader scope, examining Ghana's three known sign languages: GSL, NanaSL, and AdaSL. Fragkiadakis' (2022), work from a Data Science background using an automated procedure, compared lexical sign in ASL and GSL. Lastly, Oppong's (1998) study stands out as one of the earliest comparative studies that delved into the lexical signs of GSL and ASL.

Unfortunately, Oppong's (1998) work is currently unavailable, and access to the full research has proven challenging.[68] The researcher (Oppong,1998) used primary data from GSL, which was obtained with the assistance of GNAD. The limited information suggests that his study indicated that ASL and GSL are distinct languages. However, without full access to the work, the framework and interpretation of the results remain unclear. If Crowley's (1992) interpretation of cognate reading (see Section 3.2.1 of this Chapter) were applied, GSL and ASL might be considered languages belonging to the same family. Nonetheless, the lack

[68] Throughout my research, I was only able to obtain the abstract of the work from the author in 2020.

of complete access to Oppong's study precludes a complete understanding of his findings.

Tagoe's (2018) work compared ten kinship terms in three sign languages in Ghana: GSL, AdaSL, and Nanabin SL. The kinship terms examined included MOTHER, FATHER, BROTHER, SISTER, UNCLE, AUNTY, GRANDFATHER, GRANDMOTHER, SON, and DAUGHTER. While the methodology analysis approach Tagoe (2018) used is not explicitly stated in the study, she illustrated how the elicited signs were articulated in each language. Her findings revealed that while the three sign languages in Ghana are distinct languages, AdaSL and NanaSL shared some common phonological features. For instance, signs for MOTHER, FATHER, BROTHER, SISTER, UNCLE, and GRANDFATHER exhibited similar phonological parameters. However, no "true friends" were identified among the signs compared.

Hadjah (2018) conducted an investigation using a combination of primary and secondary data sources that represented signers from diverse regions across Ghana. The primary focus of the study was to analyse 17 selected signs representing various animals[69] in GSL. Hadjah (2018) revealed regional variations within GSL through primary data analysis. These regional variations indicated distinctive patterns of phonological variations in specific lexical items, which remained mutually intelligible. The study identified 33 groups of phonologically related variants, with the following distribution of difference found: location accounted for 39%, handshape for 36%, orientation for 12%, handedness for 6%, and movement for 6%. Notably, the most prominent variations were observed in location, followed closely by handshape. The primary hypothesis posited in the study was that the phonological relatedness among variants could be attributed to two key factors: 1) iconicity and shared gestural repertoires, and 2) the language contact situation, which might have contributed to language leveling and a culture of mocking certain variants within the deaf school environment.

Furthermore, Hadjah's investigation also incorporated secondary data from dictionaries, specifically those of GNAD (n.d. [around 2001]) and McGuire and Deutsch (n.d. [around 2017]). This secondary data confirmed the presence of lexical variations in GSL lexemes. It was determined that the signs exhibited a high degree of mutual intelligibility, with most variants being phonologically related. Within this context, handshape emerged as the aspect of sign phonology most susceptible to variation.

Abudu's (2019) research centered on lexical variations within GSL using primary data. Her study focused on pre-Senior High School (SHS) students enrolled

[69] (i.e., BIRD, CHICKEN, COW, CRAB, CROCODILE, DOG, ELEPHANT, FISH, FROG, HORSE, LION, MONKEY, MOSQUITO, MOUSE, SHEEP, SNAIL, TIGER).

at the Mampong School for the Deaf[70] in the Eastern Region of Ghana. She conducted her study with a sample of 30 participants and analysed responses related to seven distinct concepts (namely, PREGNANT, DON'T KNOW, PAGE, DEVIL, AFTER, STEW & WITCHCRAFT) to inform her conclusions.

Within the school setting, Abudu identified significant variations in GSL usage among the students, attributing these variations to two primary factors: regional differences and family backgrounds. Notably, regional variation emerged as the predominant form of GSL variation, closely linked to locally evolved signs, which she termed "home signs." Her analysis also delved into the influence of family backgrounds, revealing that signers from educated and economically stable families tended to employ a foreign-based signing style, which she termed the "formal way." Furthermore, Abudu's findings suggested that although variant signs were transparent in meaning for student interaction, over time, as these pre-SHS students continued their education within the school environment, a process of language levelling occurs. This dynamic phenomenon underscored the ongoing evolution and adaptation of GSL in deaf education and among the student population.

Fragkiadakis' (2022) study was a pioneering attempt to evaluate an automated tool's ability to quantify variations in movement and location within sign languages, using ASL and GSL as case studies. The tool, which employed the Dynamic Time Warping (DTW) algorithm to analyse wrist trajectories from the dominant hand, allowed for an automated comparison of lexical variation. This approach eliminated the need for manual transcription, paving the way for a more efficient analysis of lexical differences. However, it is important to acknowledge the study's limitations. For instance, the tool struggled to recognise cognates with multiple repetitions of movement, and it was primarily designed for analysing single signs performed by signers in an upright position. Additionally, slight variations in handshapes, like laxness, could lead the program to consider two signs as distinct. Consequently, Fragkiadakis (2022) recommended that automated procedures undergo validation through manually transcribed data.

Fragkiadakis' (2022) comparison between ASL and GSL signs revealed that the lowest distances were observed within the lexical fields of time (e.g., morning, night, Saturday) and food (e.g., apple, banana, carrot). In contrast, the highest distances were found in categories such as adjectives (e.g., bad, beautiful), occupation (e.g., doctor, policeman), and emotions (e.g., angry, love). Notably, it's crucial to emphasise that Fragkiadakis (2022) based this comparison not on the movement and locations of the hands but the wrists. Another intriguing finding in his work was that, in most ASL signs, the wrist location tended to be upward, while

[70] The school is the sole institution in Ghana dedicated to offering secondary-level education exclusively for individuals who are deaf.

in GSL, the wrist location was predominantly downward compared to ASL signs. This offers insights into the linguistic distinctions between these sign languages.

Peprah's (2021) research on lexical variation in GSL explored a spectrum of lexical variants encompassing kinship terms, place names, numerical expressions, food items, and body parts. Her investigation engaged 20 participants. Notably, the research highlighted that the semantic category of food items exhibited a higher degree of lexical variation compared to other conceptual domains. Following closely in terms of variability were cardinal numbers. Region and age were identified as factors contributing significantly to the observed variations within GSL. Peprah's (2021) study also discerned tangible evidence of language change manifesting within GSL based on the use of cardinal numbers (i.e., 11 – 20). This observation offers insights into the evolving linguistic landscape of GSL, shedding light on how sociolinguistic factors like age influence its lexical repertoire.

Despite the scarcity of prior research on lexical variation in GSL, the studies conducted by Tagoe (2018), Hadjah (2018), Abudu (2019), and Peprah (2021) have significantly enriched our understanding of GSL's lexical landscape.

Tagoe's comparative analysis of kinship terms in GSL, AdaSL, and NanaSL demonstrated these sign languages' distinctiveness while uncovering intriguing phonological similarities, shedding light on the complex interplay of linguistic variation and shared features. Hadjah's investigation unearthed regional variations within GSL, offering insights into the phonological nuances and the influence of language contact situations. He informs us on the role of iconicity and shared gestural repertoires in shaping GSL's lexicon, highlighting the dynamic nature of sign language evolution within the deaf school environment. Abudu's research underscored the impact of regional differences and family backgrounds on sign language usage. Her findings hinted at the ongoing language levelling and adaptation process within GSL, reflecting the complex sociolinguistic dynamics at play. Peprah's study, further deepens our understanding of GSL's lexicon. Notably, her research unveiled the influence of sociolinguistic factors such as region and age on lexical variation and even pointed towards evidence of language change within GSL landscape.

Peprah's (2021) study generally influenced by prestige, led signers to potentially use formal GSL, resulting in reduced variation. However, in the context of food items, ASL lexical influence on English is limited due to lexical gap. This gap leads to increased variability, as these signs used in various regions are not based on ASL. This interpretation similarly applies to Fragkiadakis' (2022) work, where it is evident that food items are distinct from the lexical signs present in ASL.

Furthermore, there is an additional reason to believe that both Peprah's (2021) and Fragkiadakis' (2022) data were influenced by English. This is evident in their data acquisition methods, with Fragkiadakis (2022) using a dictionary and Peprah (2021) instructing participants to use their school-based variants. These

domains primarily involve English. This underscores the idea that the method of data elicitation can significantly impact our understanding of the GSL landscape. The subsequent section outlines the methodology employed in this chapter.

3.2 Method

In this chapter I conducted two studies, using the approaches of Woodward (2000) and Parks (2011) to investigate lexical comparison of sign languages. Woodward's system determined genetic relatedness between GSL and ASL by identifying "true friends" (i.e., signs that are the same in form and meaning). On the other hand, Parks' approach was applied to investigate lexical similarities among formal GSL and informal GSL, ASL, AdaSL, and NanaSL by identifying resemblances between their signs.

I employ these methods (i.e., Woodward, 2000 & Parks, 2011) to enhance the analysis (especially for GSL & ASL), combining different data sources and analytical techniques. For the investigation of lexical resemblances, I heavily relied on primary data and secondary data. By adopting these approaches, I aimed to enhance my findings' credibility and validity and gain deeper insights into the relationships between local sign languages used in Ghana and ASL (Hastings, 2010; Patton, 1999). The study involved the manual coding of comparable phonological features, while a computer software algorithm was used for automatic form and meaning matching of signs and their statistics.

I will introduce and explain each approach used in this study to measure lexical similarity in the following subsections. Section 3.2.1 will define my use of Woodward's approach, while section 3.2.2 will focus on Parks' approach. Finally, I will provide some observable limitations for using each approach: Subsection 3.2.1.1 will address the limitations of using Woodward's approach, and 3.2.2.2 will discuss the limitations of using Parks' approach.

3.2.1 Using Woodward's (2000) Approach: Lexicostatistics

Given the limited documentation and linguistic research on GSL, I used the lexicostatistic method as a comparative tool to establish a potential relationship between GSL and other sign languages. Lexicostatistics has been widely employed to hypothesise language relationships by identifying cognates (Woodward, 1996; Crowley, 1992).[71] In this study I use their method to identify "true friends[72]" in my study. In sign languages, "true friends" can be identified based on the parameters of the sign, such as handshape, location, movement, and palm orientation (Al-Fityani & Padden, 2008).

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[71] However, critiques of lexicostatistics as a method for assessing familial relatedness have surfaced in specific contexts (see Palfreyman, 2015, Chapter 2).
[72] Signs that are the same in form and meaning.

Lexicostatistics is a standard method for hypothesizing language relationships, especially for under-described languages like GSL (Lehmann, 1992; Crowley, 1992). While the 200-word Swadesh list proposed by Morris Swadesh in 1964 is well-known for lexicostatistic studies in spoken languages, sign language studies typically prefer a modified version (Crowley, 1992; Woodward, 2000). Crowley (1992: 170) provides specific labels for languages under lexicostatistic study based on the percentage of cognates they share:

1. "Dialect of the same language" if they exhibit a cognate rate ranging from 82% to 100%.
2. "Languages of a family" if they show a cognate rate between 37% and 81%.
3. "Family of a stock" if they share a cognate rate from 13% to 36%.
4. "Stocks of a microphylum" if they have a cognate rate between 5% and 12%.
5. "Microphyla of a mesophylum" if they share a cognate rate from 2% to 4%.
6. "Mesophyla of a macrophylum" if they have a shared cognate rate below 2%.

Crowley (1992) explains that these percentage thresholds for classifying language relationships are derived from the analysis of 1,000 years of records from historical linguistic studies involving 13 languages.

I implemented Woodward's approach in this study, using the modified Swadesh list (see

Table 8: Woodward's Modified Swadesh list for sign language comparison) to compare sign languages. The modified list consists of 100 words tailored to specifically sign language research. However, the Swadesh list tradition is not without criticism. Hoijer (1956) pointed out that the Swadesh list may not be entirely universal and culture-neutral, as it contains some words specific to European culture and language. Despite this limitation, the modified Swadesh list remains a valuable tool for suggesting potential lexical relationships between languages (Yu et al., 2018; McKee & Kennedy, 2000), making it suitable for adoption in this present study.

Table 8: Woodward's Modified Swadesh list for sign language comparison

1. all	26. grass	51. other	76. warm
2. animal	27. green	52. person	77. water
3. bad	28. heavy	53. play	78. wet
4. because	29. how	54. rain	79. what
5. bird	30. hunt	55. red	80. when
6. black	31.husband	56. right	81. where
7. blood	32. ice	57. river	82. white
8. child	33. if	58. rope	83. who
9. count	34. kill	59. salt	84. wide
10. day	35. laugh	60. sea	85. wife
11. die	36. leaf	61. sharp	86. wind
12. dirty	37. lie	62. short	87. with
13. dog	38. live	63. sing	88. woman
14. dry	39. long	64. sit	89. wood
15. dull	40. louse	65. smooth	90. worm
16. dust	41. man	66. snake	91. year
17. earth	42. meat	67. snow	92. yellow
18. egg	43. mother	68. stand	93. full
19. fat/grease	44. mountain	69. star	94. moon
20. father	45. name	70. stone	95. brother
21. feather	46. narrow	71. sun	96. cat
22. fire	47. new	72. tail	97. dance
23. fish	48. night	73. thin	98. pig
24. flower	49. not	74. tree	99. sister
25. good	50. old	75. vomit	100. work

This study compared pairs of signs with the same meaning based on their articulatory properties, including handedness, handshape (with handshape changes), location, palm orientation, movement, compound element/sign, and the presence of a based hand. However, for determining “true friends,” the focus was on the four major phonemic features: handshape, location, movement, and palm orientation, following Al-Fityani (2010) and McKee and Kennedy (2000). A specific description of these phonemic features was primarily based on Valli et al. (2011), considering various elements such as specific parts for sign location (e.g., lower lip, below the chin, on the nose), manner and direction of movement, palm orientation (e.g., palm-up, -in, -out, -down), and the number and posture of selected fingers with thumb position.

Following previous research (Ebling et al., 2015; Al-Fityani, 2010; McKee & Kennedy, 2000), the pairs of analysed signs were categorised as follows:

Category I: Signs that are identical in all four main phonological parameters (i.e., handshape, location, movement, palm orientation)

Category II: for signs that are similar but differ in one of the following features:

1. handedness (i.e., one-handed vs. two-handed),
2. one handshape of a 2-handed sign,
3. the presence of the base hand
4. handshape change
5. compound signs
6. internal movement
7. change in location or orientation.

Category III: Similar signs with three phonological parameters out of the four main ones.

Category IV: Similar signs with two phonological parameters out of the four main ones.

Category V: Similar signs in 1 or none of the four phonological parameters.

Examples of GSL and ASL signs were provided to illustrate each of these five categories. For instance, HAVE (Figure 17) falls under Category I since it shows the same handshape, location, movement, and palm orientation in GSL and ASL.

a. GSL sign (GSL App). b. ASL sign (Riekehof, 1978: 291)

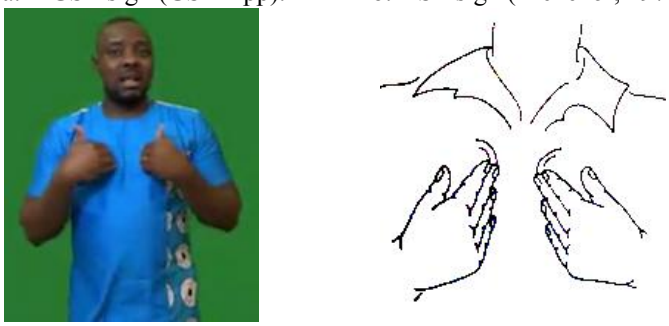

Figure 17: HAVE

Category II looks out for the minor phonological difference. For example, on the surface, the sign for HOW in both GSL and ASL has the same handshape, location, movement, and palm orientation. However, the articulation is slightly different. Based on location, the sign is articulated in neutral space; however, in the ASL sign (Figure 18b), the tip of the figures was in contact. In the case of GSL (see Figure 18a), the palm of the left hand was initially used as the base hand. As indicated, pairs of signs that differ in base hand, handedness, handshape change,

compounding, internal movement and change in location or orientation are all placed under category II.

Category II, which accounts for minor phonological differences, was exemplified by HOW (Figure 18), where both GSL and ASL signs appear similar but differ in specific details, such as using a base hand or the location of articulation.

Similarly, HEAVY (Figure 19) represents Category III, with the handshape being the only differing phonological parameter, while other parameters remain the same in both GSL and ASL.

Category IV includes pairs of signs that differ in two phonological parameters, as seen in KILL (Figure 20), where the handshape and palm orientation vary between GSL and ASL. For instance, GSL uses a K-handshape, whereas ASL uses the index-handshape.

Lastly, Category V involves pairs of signs where only one parameter is the same or none of the parameters matches, as shown in THIN (Figure 21) for both GSL and ASL. The handshape, location and movement are differently articulated in both languages.

a. GSL sign (GSL App)

b. ASL sign (Riekehof, 1978:30)

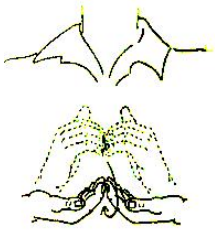

Figure 18: HOW

a. GSL sign (GSL App).

b. ASL sign (Riekehof, 1978:175)

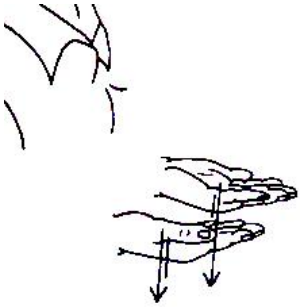

Figure 19: HEAVY

a. GSL sign (GSL App).

b. ASL sign (Riekehof, 1978:148)

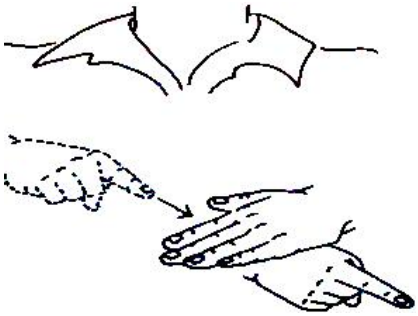

Figure 20: KILL

a. GSL sign (GSL App).

b. ASL sign (Riekehof, 1978:235)

Figure 21: THIN

Based on the five categories, “true friends” were identified by aggregating signs classified under "Category I", "Category II", and "Category III". This approach of identifying “true friends” is consistent with previous lexicostatistic studies of sign languages (e.g., Fragkiadakis’ (2022 Parks 2011), enhancing the accuracy and reliability of the findings in this study.

Compiling Datasets for Woodward’s approach

In selecting data for Woodward's approach, the study conducted two separate analyses to compare GSL with ASL. A third comparative study was also piloted, examining GSL signs from two timelines (2001 vs. 2020).

For the first analysis, GSL signs were obtained from a newly developed GSL-Dictionary App[73], while the ASL signs were collected from Riekehof's (1978)

[73] https://play.google.com/store/apps/details?id=com.ljsharp.gsldictionary

dictionary. The GSL App, a video dictionary, was launched in 2020. Featuring over 1,300 signs from GSL alongside their English equivalents. Spearheaded by the HANDS! Lab at Leiden University, this initiative represents a collaborative effort led by deaf Ghanaians, both in content creation and app development. On the other hand, Riekehof's dictionary (1978) also contains a collection of over 1,300 drawn ASL signs. The decision to use Riekehof's dictionary was based on a claim received from an eyewitness account, stating that the dictionary was being used in deaf schools in Ghana during Foster's time and continued to be used at the GNAD[74] office in the 1970s (G. Amenumey, Personal communication, September 26, 2015). During fieldwork in Ghana, several reports confirmed that Riekehof's (1978) dictionary was used in Deaf schools even after Rev. Foster left Ghana.

The second study involved data from the same GSL-App dictionary, but the ASL data was obtained from an online source, specifically ASL Signbank[75]. This second study compared current data from two sources that used video data instead of still images.

In the third study, the same cohort of signs from the 2020 GSL-App dictionary was used, but this time, it was compared with an older GSL dictionary produced by GNAD in approximately 2001. Using the modified Swadesh list, the study compared 52 matches in both dictionaries (i.e., GNAD, 2001 & GSL-App, 2020).

The data for analysis under Woodward's approach can be summarized as follows:

Analysis 1:
- Comparison of GSL signs from the GSL-App (2020) with ASL signs sourced from Riekehof (1978) dictionary.

Analysis 2:
- Comparison of GSL signs from the GSL-App (2020) with ASL signs sourced from ASL Signbank (2020) online dictionary.

Analysis 3:
- Comparison of GSL signs from the GSL-App (2020) with signs from an older GSL dictionary (GNAD, 2001).

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[74] Ghana National Association of the Deaf
[75] https://aslsignbank.haskins.yale.edu/about/conditions/ An online dictionary. Accessed 13 August 2019

By conducting these three separate analyses with different data sources and timelines, the study aimed to understand the lexical relationship between GSL and ASL.

Limitation of Using Woodward's Approach in Comparative Study of GSL and ASL

In this study, certain limitations need to be acknowledged. Firstly, the use of secondary data sources introduced potential issues regarding representativeness. It was unclear how well the signs in the dictionaries represented the overall signing community. Despite this limitation, using different secondary data sources was essential for a comparison between GSL and ASL. Other studies in sign language lexicostatistics analysis, such as Yu et al. (2018) and McKee and Kennedy (2000), also relied on secondary data, while Woodward (1996; 1978) adopted a combined method of both primary and secondary data. However, it is crucial to recognise that dictionaries may have biases and idiosyncrasies. The Deaf Association in Ghana created the GNAD (2001) dictionary without the involvement of lexicographers or linguists. For instance, some committee members involved in the dictionary's creation expressed concerns about representing GSL signs distinct from ASL, which could potentially have influenced the dictionary's content.

Another limitation of this study was the exclusion of non-manual marking (e.g., facial expressions) in the analysis. This exclusion was due to data of still images from dictionaries, which is not suitable for non-manual marking analysis. It is essential to note that manual articulations (with the hands) in sign languages are often associated with lexical signs. While non-manual marking could provide insights into the linguistic features of GSL and ASL, its exclusion in this study does not undermine the significance of the lexical comparison undertaken. However, it is essential to interpret the findings in light of the mentioned limitations and recognise their potential impact on the results.

3.2.2 Using Parks' (2011) Approach: Levenshtein Distance Algorithm

In the second approach, the analysis followed Parks' (2011) proposed methodology, which proved user-friendly, time-saving, and suitable for working with large datasets. Parks' approach builds on previous lexical comparisons and his research to develop a coding and scoring methodology.

Parks' approach uses the Levenshtein distance algorithm, also known as the edit distance, originally introduced by Levenshtein (1966) as a string metric for comparing and editing two sequences. In Parks' work, this system is applied to measure the similarities and differences in lexical signs. The Levenshtein distance algorithm calculates the number of steps or edits (e.g., insertions, deletions) required to make pairs of words identical, thus measuring their similarity. A significant

advantage of this system is its automation, as it can be implemented through computer-based programs, enabling efficient similarity judgments (Parks, 2011).

In the calculation of the Levenshtein distance for signed or spoken languages, words are paired based on their phonological forms, and the measurement of differences is achieved by counting the necessary steps or edits (e.g., insertions, deletions) to achieve identity between the pairs of words. The number of steps or edits is normalised to ensure accuracy in the results by averaging the Levenshtein distance (sum of edits). Normalisation is important to avoid inaccuracies from longer phonological forms or multiple sign variants for a particular concept. Parks (2011: 35) explains that the Levenshtein distance between two languages or varieties is obtained by calculating the average distance for each word list item.

Illustrating the application of the Levenshtein distance, Table 9 below shows how the distance can be measured between two variants of the name Abinaa (a female born on Tuesday) in the non-coastal dialects of Akan. According to Boadi (1984:443), two distinct forms can be identified: one with the nasal alveolar 'n' in the root (i.e., abinaa), and the other with 'l' or 'r' taking the place of 'n' (i.e., abiraa or abilaa). The table demonstrates the edits or steps required to transform the Akan name [abinaa] into [abiraa].

Table 9: Levenshtein Distance Calculation between two variants of the Akan word for soup

Initial form of one variant	**Edit**	**Final form of another variant**
abinaa	Delete “n”	abiaa
	Insert “ r ”	abiraa
# of steps or edit/ Levenshtein distance (non-normalised) = 2		
Levenshtein distance (normalized) = 2/4 = 0.5		

In sign languages, phonological parameters are coded and measured based on edits, but it is essential to note that the nature of these edits differs from those in spoken languages. Parks (2011: 36) highlights that while spoken languages may involve various types of edits, such as insertion, deletion, and others, in sign languages, edits mainly occur through substitutions of the phonological form. I illustrate the application of the Levenshtein distance with sign languages; examples from two GSL dictionaries (GNAD, 2010 & GSL App) will be provided.

Figure 22 below showcases the sign for SUN in GSL. When comparing the two sign variants (Figure 22a & b), the phonological parameters of handshape, location, and orientation appear to be the same, except for movement. As the only difference lies in the movement parameter, one edit will need to transform one variant into the other. In Table 10, I will capture this difference and demonstrate how the Levenshtein distance will be calculated for these sign variants.

a. GSL sign (GNAD, 2010:86) b. GSL sign (ASL App)

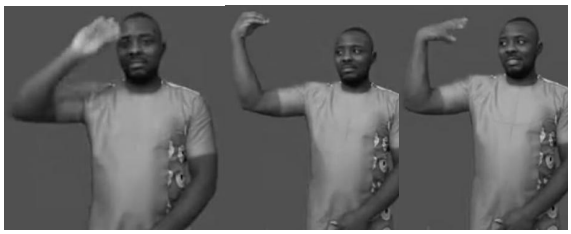

Figure 22: SUN

Table 10: Levenshtein Distance Calculation between the GSL signs for SUN

	1a: SUN	**1b: SUN**	**Value difference**	**Edit**
Handshape[76]	J10	J10	No	0
Location	space to side of the upper head	space to side of upper head	No	0
Orientation	Palm down	Palm down	No	0
Movement	Straight	Spiral	Yes	1
# of steps or edit/ Levenshtein distance (non-normalised) = 1				
Levenshtein distance (normalized) = 1/4 = 0.25				

The Levenshtein distance, in this case, was calculated as 1, which means the number of edits required to transform the sign variants was divided by 4, representing the number of parameters used. As a result, the normalised Levenshtein distance was determined to be 0.25, as illustrated in the seventh row of Table 10 above.

With the Levenshtein distance analysis, I have also adopted Parks' (2011) proposed phonological parameters for the coding system for this study. Parks acknowledges that signs in sign languages can be either simultaneous or sequential. Therefore, it is necessary to identify the handshape and location feature twice: once for the initial position and once for the final position of the sign. I will now illustrate Parks' approach using the sign for ELEPHANT (in Figure 23 and Table 11) below.

In Table 11, I present Parks' (2011) four phonological parameters for the sign ELEPHANT (i.e., initial handshape, final handshape, initial location, and final location) and how each phonological feature can be coded for the sign as shown in Figure 23.

[76] See Appendix B for a handshape chat.

Figure 23: GSL sign for ELEPHANT.

Table 11: Phonological Parameters and Coding for the GSL Sign ELEPHANT

#	Parameters	Value
1	Initial Handshape	 (D11)
2	Final Handshape	 (D11)
3	Initial Location	Infront Face (SFFace)
4	Final Location	Neutral space (SN)

Parks (2011) emphasises the importance of handshape and location as the primary parameters in wordlist analysis, a view that has been widely acknowledged. He further notes that certain movements in signs can be attributed to reaching for a specific location or handshape; in some cases, they involve changes in both handshape and location.

For the location inventory, I followed Parks' (2011) guidelines. However, regarding the handshape inventory, I decided to create my own to ensure consistency with the coding used in other chapters of this book. While Parks' (2011) location and handshape inventories are user-friendly, I found them somewhat limited for accurately coding the sign languages used in Ghana and possibly Africa. In my data, I encountered signs with unique location values (e.g., teeth, tongue, buttocks) absent in Parks' (2011) inventories.

The data were manually coded, and I used ELAN to ensure accurate capturing of handshape and location. The coded parameters were then compiled into an Excel spreadsheet and subsequently exported to an Algorithm software developed by Manolis Fragkiadakis[77]. This Algorithm software was employed to calculate the Levenshtein distance for each pair of signs in the wordlist selected. The software's output provided the normalised Levenshtein distance in a spreadsheet, allowing for efficient comparison of signs with all other signs in the wordlist.

[77] Special appreciation to Manolis Fragkiadakis for his invaluable contribution in this study. His exceptional software was utilized to calculate the Levenshtein distance for each sign pair, enhancing the accuracy and reliability of my research. Without his remarkable support, this chapter would not have been complete.

Compiling Datasets for Parks' Approach

In the following sections, I outline the process of selecting data for the five language varieties studied in this chapter: formal GSL, informal GSL, ASL, AdaSL & NanaSL. The documentation of informal GSL [78] on a large scale proved to be both exciting and challenging, an exploration detailed in the subsequent Subsection 3.2.2.1.1. It is worth noting that obtaining data for informal GSL was particularly demanding compared to other varieties. Moreover, the following subsections provide an overview of the methodology for collecting thefor NanaSL (Subsection 3.2.2.1.2), AdaSL (Subsection 3.2.2.1.3), and ASL (Subsection 3.2.2.1.4).

Formal and informal GSL Data Gathering

To collect informal GSL data for this study, my deaf research assistant and I aimed to engage around 20 deaf adults. We initially planned to recruit participants, focusing on signers with no formal education, as we believed they would be monolingual in informal GSL and have limited exposure to formal GSL signs. Our initial point of contact was Mr. Marco Nyarko, a deaf linguist among the deaf community in Ghana. He led us to meet a deaf preacher in Akuapem Mampong, who had connections with several semi-educated and unschooled deaf individuals in the Eastern Region.

The preacher then arranged a time and led us to a small town called Apirede[79], a 52-kilometre (1 & half-hour drive) north of the capital of Ghana, Accra. In Apirede, we contacted eight deaf adults (five females & three males) and acquainted ourselves with them. After leaving Apirede, we continued our journey to other communities to meet more semi-educated and unschooled deaf individuals. Our first stop was at Adukrom, located 3 km south of Apirede, where we had the opportunity to meet two deaf sisters and get acquainted with them. From Adukrom, we proceeded to Abiriw[80], which is 7.3 km south of Adukrom. In Abiriw, we had the pleasure of meeting two deaf adults, a man and a woman.

Before our subsequent data collection sessions in Apirede, Adukrom, and Abiriw, we arranged to meet a group of educated deaf individuals the following day for an interview related to our research topic. This group consisted of married deaf couples from Apirede, Mr. Nyarko, the deaf preacher in Akuapem Mampong, and

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[78] The pursuit of the informal variant of GSL was initiated based on information provided by Jonathan Amoah, a former vice president of GNAD, during the fieldwork. This motivated the study to explore and uncover the distinct informal variant of GSL used by the deaf community in Ghana.
[79] Sometimes spelt Apiredi.
[80] Sometimes spelt Abirew.

his deaf wife. It was anticipated that these educated deaf individuals might possess knowledge encompassing both the formal and informal lexical varieties of GSL. The primary objective of this initial meeting was to elicit informal GSL signs from this group and facilitate a focus group discussion regarding the existence of informal GSL. We opted to commence with the focus group discussion concerning informal GSL, and the outcomes of this discussion are detailed in Chapter 6.

During the focus group discussion, several informal GSL signs were used by the participants, which, as the moderator of the discussion, I could not fully comprehend. Thus, I had to ask for their meanings. The focus group discussion successfully observed their use of informal GSL signs; however, the same success could not be achieved with individual members during a picture elicitation task. The participants provided me with formal GSL signs, except for one individual who seemed influenced by his knowledge of AdaSL and provided some signs from that language instead. Our attempts to elicit informal GSL from this group using the picture task of the wordlist, as adopted from Parks (2011) and Parks and Parks (2008), were unsuccessful. The lack of success in eliciting informal GSL from this group could be attributed to two main reasons. Firstly, some participants did not fully understand what we meant by informal GSL during the elicitation task.[81] Secondly, most of them perceived me as a foreigner (i.e., non-Ghanaian) who had come to study GSL, which might have influenced their responses to use formal GSL. Despite our best efforts, the outcome did not align with our initial expectations.

Undeterred, we returned to Apirede the following day and met with the available deaf individuals (three females & two males).[82] However, they also struggled to understand the picture-naming task. We managed to engage them by physically showing them objects related to the pictures, but their vocabulary was limited, making it challenging to collect meaningful data. Ultimately, we decided not to rely on their data for my lexical study due to their limited vocabulary and social interaction with deaf members in the urban deaf community. From Apirede, based on availability, we met one semi-educated deaf individual at Abiriw township. He demonstrated knowledge of formal and informal GSL.

Continuing our quest for informal GSL, we journeyed to Koforidua, a larger city with a more socially active deaf community. In Koforidua, we contacted seven deaf individuals (three women & four men), a mix of educated, semi-educated, and uneducated/unschooled participants. Although Koforidua appeared promising

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[81] Note that during this time, it was unclear how singers refer to the informal GSL variant identified during the study in Chapters 5 & 6.

[82] Their age ranged from 25, 32, 45 and 59. Participants were mainly involved in farming and domestic work. During the data collection process, one male participant had to drop out due to a defect with the eyesight that hindered his ability to engage in the picture task adequately. As a result, he was unable to continue with the study, and his data could not be included in the final analysis.

for gathering informal GSL data, we faced the observer's paradox, as the informal variant of GSL had low social prestige, and some participants may not have wanted to be associated with it. Ultimately, we interviewed 16 deaf adults, but only two participants (one in Koforidua & the other in Abiriw) demonstrated fluency with informal GSL in the data collected. It was challenging to elicit the informal variants, as many participants defaulted to providing formal GSL signs. Despite this, the two consultants demonstrated ample knowledge of formal and informal GSL and provided the informal variants. Our consultant from Koforidua shared that he acquired informal GSL through interactions with unschooled or semi-educated deaf individual he met in church or as pedestrian. The consultant in Koforidua is a trader primarily involved in hawking. His frequent encounters with unschooled deaf individuals on the streets likely contributed to his proficiency in informal GSL, as he regularly interacts with members of the deaf community who predominantly use this form of sign language. Similarly, our consultant from Abiriw learned informal GSL at home and through social interactions in the deaf school at Mampong. While our initial goal was to gather data from 20 participants, the difficulty in eliciting informal GSL variants limited us to using data from the two participants who demonstrated competence in providing informal GSL signs. Their valuable contributions enabled us to gain insight into the informal GSL lexicon and language attitudes, and we explore this further in Chapter 6.

NanaSL Data Gathering

On 29th April 2021, we travelled to Akumfi Nanabin village, located 107 km from Ghana's capital, Accra, to collect NanaSL data. This visit marked my second time in the community, making finding our participants easier and spending a night there. Upon arrival, we engaged in social interactions and scheduled interviews for the following day. The interviews took place at the Okanto family house, known for being a multi-generational deaf family in the village, as represented by Nyst (2010:425).

During our interaction with the Okanto family, we learned they were instrumental in the emergence of NanaSL by creating a deaf space. Mrs. Okanto, who married into the family, shared that there were other deaf individuals in the community before, but they had limited interaction. Her marriage to Mr. Okanto, a deaf individual, and their subsequent deaf children created an environment conducive to the emergence of NanaSL. The Okanto children also learned NanaSL from their mother, emphasising the family's role in preserving sign language.

For our research, we conducted interviews with members of the Okanto family using the picture elicitation task. Due to technical challenges with our camera, we could only interview two family members – one educated and the other

unschooled. The educated participant demonstrated bilingual proficiency and knowledge in GSL and NanaSL. On the other hand, the unschooled participant was predominantly using NanaSL but had some fragmented knowledge of GSL due to language contact.

Despite the technical challenge, we successfully gathered NanaSL data from the Okanto family, and the situation allowed us to have the rest of the time to discuss their language and background in-depth. We also seized the opportunity to discuss language contact situations with the family, noting their questions about our research work and the significance of multiple visitations.

AdaSL Data Gathering

Through consultations, we identified an educated deaf woman in Adamorobe village, located 28 km from Accra, to participate in our study. She was a former pupil of Mr. Marco Nyarko and I also knew her from a linguistic summer school for Deaf Africans in Ghana.[83] We (my research assistant & I) visited Adamorobe village on the 10th of April 2021 for the data collection, having contacted our participant and scheduled an appointment in advance. Accompanied by Mr. Marco Nyarko, who was familiar with the village and its deaf community members, we located the home of our participant. This trip was not my initial visit to Adamorobe; I first visited the community for academic purposes in 2011.

During the interview at our participant's home, we were unexpectedly visited by a hearing onlooker who expressed concern about our visit. The onlooker questioned why we had not involved family members or a community leader in our engagement. Fortunately, my knowledge of the community as a Ghanaian and my familiarity with the participant, who was an adult, allowed us to address the concern appropriately. The onlooker shared an incident where a researcher had misrepresented the entire village as composed of deaf individuals due to not involving community members in their study. This encounter served as valuable advice for future researchers visiting Adamorobe.

ASL Data Gathering

I had to rely on secondary data for ASL, the only instance in this study where I used a secondary data source. Originally, the plan was to collect primary data for ASL,

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[83] See <https://deafstudies.weblog.leidenuniv.nl/asds-ghana-2019/> for more information on the summer school which was held in Ghana at the Linguistic Department, University of Ghana, 2019.

but unfortunately, my visit to the US was hindered due to the outbreak of COVID-19 and the resulting restrictions.

However, ASL is a sign language that has received significant research attention, and numerous online resources are available. To find an appropriate open-source lexical database for ASL, I sought advice from an American sign linguist, who recommended the ASL "Signbank." This lexical database was created by a team of linguists and is designed to support empirical linguistic research (ASL Signbank, 2020) [84]. The ASL "Signbank" proved to be an appropriate and reliable data source for my study, allowing me to gather valuable information on ASL signs for comparison.

Participants

For the primary data collection, I selected seven participants to represent different sign languages in the study. Among them, we had one participant for AdaSL and two participants each for NanaSL, informal GSL, and formal GSL. While GSL data was collected from approximately 16 participants initially, only the data from four participants (D, E, F, & G) were deemed suitable for this study.

When recruiting participants, one of my primary considerations was to ensure that they were active members of the deaf community. This criterion ensured we could obtain authentic and representative data for our analysis. Below (Table 12) is a summary of the demographic background of each participant (A – G):

Table 12: Participants' demographic background

Target language	Gender	Age	Locality	Education	Deaf family member	Deaf history
A AdaSL	Female	27	Adamorobe (Eastern Region)	Semi-educated	Yes (mother)	Born deaf
B NanaSL	Male	58	Ekumfi Nanabin	Educated	Yes (parent & siblings)	Born deaf
C NanaSL	Male	51	Ekumfi Nanabin	Un-schooled	Yes (parent & siblings)	Born deaf
D Informal GSL	Male	39	Abiriw (Eastern Region)	Semi-educated	No	Born deaf
E	Male	51	Koforidua	Educated	Yes	Born

[84] https://aslsignbank.haskins.yale.edu/about/conditions/\

Informal GSL			(Eastern Region)		(wife)	deaf
F Formal GSL	Male	62	Mampong Akuapem (Eastern Region)	Educated	Yes (wife)	Born deaf
G Formal GSL	Female	58	Mampong Akuapem (Eastern Region)	Semi-educated	Yes (husband)	Born deaf

These participants were crucial in providing valuable data for the study, allowing me to compare the different sign languages comprehensively.

Limitations of using Parks' Approach in Sign Language Lexical Analysis

Park's (2011) approach for calculating the Levenshtein distance metric in sign language research has limitations. While the Levenshtein distance is useful in comparing phonological forms, it may not accurately capture certain phylogenetic changes that could occur in a language, such as metathesis, reduplication, or fossilisation (Greenhill 2011). For instance, in comparing the sign for DEAF in formal GSL and ASL, the observed difference was a movement metathesis. However, Parks' approach would interpret this as a change in location. Furthermore, Parks' (2011) approach primarily focuses on synchronic analysis, identifying surface similarities among signs, and does not claim to identify loan signs.

A general limitation not related directly to Park's approach is that non-manual features, as an essential component of sign languages, were not considered in this study, as also observed in Subsection 3.2.1.2. Some signs were purely non-manual, and environmental factors (e.g., setting for data collection) could have influenced the non-manual expression of signers. Additionally, my presence as an educated hearing investigator (behind the camera) during data collection could have influenced the signers' behaviour, leading to variations in non-manual features, especially in the quest for informal GSL.

Finally, the sampling method used, which relied on my social network, introduces a potential bias in participant selection. The limited sample size and the specific demographics of the participants may affect the representativeness of the entire deaf community, limiting the generalizability of the findings.

3.3 Results

In this section, I present the result for the two comparison approaches, Woodward's and Park's, as outlined in the methodology (Section 3.2). The findings for applying Woodward's (2000) approach are presented in Section 3.3.1, featuring three analytical studies on GSL; Analysis 1: Lexicostatistical Contrasting a Contemporary

GSL Dictionary with a Historical ASL Dictionary Used in Ghanaian Deaf Education (section 3.3.1.1); Analysis 2: Lexicostatistical Examination of Contemporary Online Dictionaries: ASL vs. GSL (section 3.3.1.2); Analysis 3: Comparing Lexical Landscapes: The Premier GSL Dictionary (GNAD, 2010) vs. Contemporary GSL Dictionary (Online App) (section 3.3.1.3). This is followed by a summary of the major findings using Woodward's (2000) approach (Section 3.3.1.4). Section 3.3.2, on the other hand, presents the results obtained through Park's (2011) approach, focusing on a comparative analysis of the sign languages used in Ghana. The section also concludes with a summary of the key findings using Park's (2011) approach (Section 3.3.2.3).

3.3.1 Lexical Similarities and Relatedness between GSL and ASL

In this subsection, I present the findings of the lexicostatistic comparison conducted between ASL and GSL. This study aimed to explore the lexical similarities and differences between these two sign languages. By applying Woodward's (2000) approach, we gained insights into the degree of resemblance between both languages.

The results of the analysis demonstrate a remarkable closeness between the two languages. Several striking similarities were observed during the study. In the subsequent subsections, accompanied by relevant tables and examples, I present the outcomes of the lexical comparisons featuring three analytical studies on GSL:

Analysis 1: Lexicostatistical Contrast of a Contemporary GSL Dictionary with a Historical ASL Dictionary Used in Ghanaian Deaf Education (Section 3.3.1.1)

Analysis 2: Lexicostatistical Examination of Contemporary Online Dictionaries: ASL vs. GSL (Section 3.3.1.2)

Analysis 3: Comparative Lexical Landscapes: The Premier GSL Dictionary vs. Contemporary GSL Dictionary (Section 3.3.1.3)

Lexicostatistics: Contrasting a Contemporary GSL Dictionary with a Historical ASL Dictionary

This study yielded 88 pairs of signs identified in the GSL online App and the ASL dictionary by Riekehof (1978). These pairs were categorised as follows: 48 signs fell under Category I, 8 signs under Category II, 17 signs under Category III, six signs under Category IV, and 9 signs under Category V. Additionally, there were 12 missing signs[85], accounting for 12% of the word lists. See Appendix C for a table

[85] From GSL: DUST, FEATHER, HUNT, LOUSE, NARROW, ROPE, SHARP, SNOW, TAIL, WIDE, SMOOTH
From ASL: DUST, FEATHER, HUNT, LOUSE, LEAF

that provides a list of the identified “true friends” as well as the words that were missing in both dictionaries.

The presence of missing signs is notable, as it could influence the study's results. The absence of certain signs in the dictionaries may suggest that the Swadesh list might not encompass concepts highly frequent in the Ghanaian or African context. For instance, the absence of the sign for "snow" in the GSL dictionary is not surprising, considering snow is not a common phenomenon in Ghana. Alternatively it could also be argued that the missing signs may be the result of limited number of signs documented in the dictionaries (i.e., GSL App & Riekehof, 1978). As observed in other studies, these missing signs were excluded from the calculation for the percentage of “true friends” to ensure an accurate account of the “true friends” rate.

Based on the 88 available signs, the study revealed an 83% "true friends" rate between GSL and ASL signs. This percentage encompasses signs that are identical in all four parameters (Category I), similar signs with one differing feature (Category II), and signs similar in three out of the four parameters (Category III). Specifically, signs under Category I constituted 55%, those under Category II constituted 9%, and those under Category III constituted 19%. Table 13 provides a breakdown of the sign categorization and their respective frequencies. In applying Crowley's (1992) lexicostatistic model for interpretation, 83% is notably high and suggests that GSL and ASL can be considered dialects of the same language.

Table 13: Categorization of tokens of wordlist for GSL [GSL App] & ASL [Riekehof, 1978]

Categories	Frequency	Percentage
Category I: Signs identical in all 4 parameters	48	55%
Category II: signs similar but have 1 differing feature.	8	9%
Category III: signs similar in 3 out of the 4 parameters.	17	19%
Category IV: signs similar in 2 out of the 4 parameters.	6	7%
Category V: signs similar in only 1 or none of the parameters.	9	10%
Total	88	
Missing signs	12	

Table 14: Differences found in “true friends” signs.

Articulation properties	**Number of instances**	**Percentage (%)**
Handshape	25	23.3
Orientation	21	19.6
Movement	20	18.6

Location	11	10.2
Handedness	9	8.4
Base hand	9	8.4
Handshape Change	6	5.6
Compound	6	5.6

Table 14 above presents the results of the differences found in the tokens of articulatory properties. Handshape emerged as the most significant contributor to the distinction between the two languages concerning “true friends”, accounting for 23.3% of the differences. Orientation closely followed with 19.6%, and phonological movement contributed to 18.6% of the differences. Location difference, handedness, based hand, handshape change, and compounding differences were also observed.

The initial lexicostatistic comparison indicates a close resemblance between GSL and ASL, with a high “true friends” rate of 83%. However, certain differences distinguish the two languages regarding “true friends,” particularly in handshape.

Lexicostatistical Examination of Contemporary Online Dictionaries: ASL vs. GSL

In the second analysis, I conducted a comparison of lexical signs from two contemporary dictionaries to assess the lexical relations between ASL and GSL. The GSL data used in this analysis is identical to that used in the first analysis (i.e., Section 3.3.1.1). However, while the first analysis involved an old ASL dictionary (Riekehof, 1978), the ASL data in this second analysis was sourced from a contemporary online dictionary. Consequently, the "true friends" rate in this second analysis decreased from 83% to 79%, accompanied by an increase in the number of missing signs from 12 to 14. In simpler terms, the lexicostatistical examination of contemporary online dictionaries between ASL and GSL yielded a "true friends" rate of 79%. The study identified 47% of signs under Category I, 10% under Category II, 22% under Category III, 12% under Category IV, and 9% under Category V, based on the available 86 pairs of signs (see Table 15).

Table 15: Categorization of tokens of wordlist for GSL [GSL App] & ASL [Signbank]

Categories	Frequency	Percentage
Category I: Signs identical in all 4 parameters	40	47%
Category II: signs similar but have 1 differing feature.	9	10%
Category III: signs similar in 3 out of the 4 parameters.	19	22%

Category IV: signs similar in 2 out of the 4 parameters.	10	12%
Category V: signs similar in only 1 or none of the parameters.	8	9
Total	86	
Missing signs	14[86]	

Table 16: Differences found in "true friends" signs.

Articulation properties	Number of instances	Percentage (%)
Handshape	35	29.9%
Orientation	25	21.3%
Movement	19	16.2%
Location	11	9.4%
Handedness	10	8.5%
Base hand	8	6.8%
Handshape Change	6	5.1%
Compound	3	2.5%

Although slightly lower than the first study's result, the 79% "true friends" rate between GSL and ASL in this second study still indicates that the two languages are related and dialects of the same language. Once again, this interpretation is based on Crowley's (1992) lexicostatistic classificational definition of cognate percentages (see Section 3.2.1 of this Chapter).

As in the first study, the second study reports on percentages of articulatory differences among signs grouped under categories II and III. Interestingly, the results show a similar hierarchical rate of articulatory properties but with different values (see

Table 16 above). In the second analysis, handshape emerged again as the highest contributing factor to the observed differences. Furthermore, the order of differences in the articulation properties remained remarkably identical across both the first and second analyses.

In this second analysis, handshape contributed 29.9%, followed by orientation 21.3%, movement 16.2%, location 9.4%, handedness 8.5%, based hand 6.8%, handshape change 5.1%, and compounding 2.5%.

Comparing Lexical Landscapes: The Premier GSL Dictionary (GNAD, 2001) vs. Contemporary GSL Dictionary (Online App)

[86] See Appendix D for a table that provides a list of the identified "true friends" as well as the words that were missing in both dictionaries.

Analysis 3 contrasts GSL data from a premier dictionary with that from a contemporary dictionary. Using the modified Swadesh list, I identified 53 signs in both GSL data sources (GNAD, 2001 & GSL App). The results showed that 33 signs fell under Category I, 3 under Category II, 14 under Category III, 1 under Category IV, and 2 under Category V. The comparison of these available 53 signs revealed that GSL has remained consistent over decades, with 94.2% "true friends" still present. However, some phonological variations were observed among the identified "true friends." Table 17 below illustrates the result of the "true friends" comparison.

Table 17: Categorization of token of wordlist for GSL [GNAD (2001) & online App]

Categories	Frequency	Percentage
Category I: Signs identical in all 4 parameters	33	**62.2%**
Category II: signs similar but have 1 differing feature.	3[87]	**5.6%**
Category III: signs similar in 3 out of the 4 parameters.	14[88]	**26.4%**
Category IV: signs similar in 2 out of the 4 parameters.	1[89]	1.8%
Category V: signs similar in only 1 or none of the parameters.	2[90]	3.7%
TOTAL	53	
Missing sign	47	

Table 18: Differences found in "true friends" signs.

Articulation properties	**Number of instances**	**Percentage (%)**
Handshape	6	31.5%
Handedness	5	26.3%
Movement	4	21%
Orientation	2	10.5%
Location	1	5.2%
Compound[91]	1	5.2%
Handshape change	0	0%
Base hand	0	0%

[87] DAY, FISH, NIGHT

[88] ANIMAL, BECAUSE, COUNT, DOG, DIE, EGG, GRASS, LONG, LIVE, MEAT, PIG, SNAKE, SUN, VOMIT

[89] RAIN

[90] BIRD and FAT

[91] Where there was compound in one language and the other has dropped one of the morphemes the difference in the phonological features of the different morpheme was not considered in the table

In addition to identifying “true friends”, this study (3) reports on percentages of articulatory differences among signs. Recognising the difference becomes necessary since the signs grouped under categories II and III are all classified as “true friends” but may bear slight phonological differences between the target pair of signs.

Table 18 above illustrates, with percentages, some of the differences found among “true friends”.

As seen in

Table 18, handshape appeared to be the most significant phonological property, with the highest percentage rate (31.5%), contributing to the differences found among “true friends”. It was followed by handedness (26.3%), movement as a phonological property contributed to 21% of the differences, orientation with 10.5%, and location and compounding contributed 5.2%. Handshape change and base hand did not significantly affect the gaps identified among “true friends”. Note that the sequence of phonological properties influencing the differences observed among "true friends" in the preceding two studies (Section 3.3.1.1 & 3.3.1.2), which compared GSL with ASL, differs from the findings in this third study. In this section, where GSL signs from two distinct sources were compared, instances of phonological differences were constrained. In addition, except for handshape, the order of differences in articulation properties diverged from what was observed in Section 3.3.1.1 and Section 3.3.1.2

Summary of major findings

In Analyses 1, a high percentage of 83% “true friends” was found between GSL and ASL signs, indicating that the two languages are dialects of the same language. In Analyses 2, the “true friends” rate slightly decreased to 79%, suggesting that GSL and ASL are dialects of the same language, as interpreted using Crowley's (1992) lexicostatistic model. Across both Analyses 1 and 2, it became evident that handshape was the primary phonological feature contributing to the distinction between the two languages regarding “true friends”. This finding underscores the significance of handshape in understanding lexical similarities between GSL and ASL.

In Analyses 3, I compared the GSL data source used in Analyses 1 with the GSL data source used in Analyses 2, resulting in an impressive 94.2% “true friends” rate. Considering Crowley's interpretation, this high percentage further strengthens the conclusion that the two data sources represent the same language. Additioinally, in this comparison of the same language from two different data sources (Analyses 3), handshape emerged as a major phonological feature influencing the distinctions found in “true friends” between the two datasets. This result reaffirms the importance of handshape as a significant linguistic characteristic in GSL.

3.3.2 Sign Language Diversity and Relatedness: A Comparative Analysis of the sign languages used in Ghana.

In this section, by employing the Levenshtein Distance Matrix, I investigate the relationships between GSL and ASL and their connections to other sign languages used in Ghana. The study encompasses five language varieties: formal GSL, informal GSL, ASL, AdaSL, and NanaSL.

By using the Levenshtein Distance Matrix, I aimed to unveil the extent of differences and similarities among these sign languages. The subsequent subsections will present the results of this comparative analysis, shedding light on the linguistic connections and divergences between the languages under study.

Assessing lexical similarity using Levenshtein Distance

The Levenshtein Distance (LD) results for lexical similarity among the five language varieties (formal GSL, informal GSL, ASL, AdaSL, & NanaSL) are presented in Table 19 and Table 20. This analysis follows the methodologies of previous studies (e.g., Börstell et al., 2020; Parks, 2011).

Table 19 displays the language pairs, the number of concept matches found between each pair, and the corresponding Levenshtein Distance identified. In Table 20, I provide a similar report, but this time, I made sure the concept matches were equal (i.e., 124) across all language pairs to ensure transparency across all pairs. Additionally, I include the percentage for each paired comparison. Notably, employing an equal concept matches (i.e., 124) in Table 20 did not yield substantial differences in the Levenshtein Distance values presented in Table 19. The subsequent figures depict the outcomes, with Figure 24 illustrating the results of unequal concept matches and Figure 25 showing the calculation with equal concept matches.

Table 19: Levenshtein distance similarity groupings based on four parameters.

Pair	Concept Matches	Median	Levenshtein Distance	LD %
ASL vs Formal GSL	140	0.5	0.610707558	61 %
AdaSL vs NanaSL	154	0.375	0.401898734	40 %
Informal GSL vs NanaSL	152	0.375	0.380952381	38 %
AdaSL vs Informal GSL	151	0.25	0.336645223	34 %
Formal GSL vs NanaSL	154	0.25	0.266950847	27 %

Formal GSL vs Informal GSL	151	0.25	0.26198655	26 %
AdaSL vs Formal GSL	154	0.25	0.24123758	24 %
ASL vs Informal GSL	137	0.25	0.236677717	24 %
ASL vs NanaSL	139	0.125	0.223262032	22 %
AdaSL vs ASL	136	0.25	0.214625899	21 %

Table 20: Levenshtein distance similarity groupings based on four parameters with equal concept matches

Pair	**Concept Matches**	**Median**	**Levenshtein Distance**	**LD %**
ASL vs formal GSL	124	0.5	0.61201	61 %
AdaSL vs NanaSL	124	0.375	0.409448819	41 %
Informal GSL vs NanaSL	124	0.375	0.388625592	39 %
AdaSL vs Informal GSL	124	0.375	0.356050769	36 %
Formal GSL vs Informal GSL	124	0.25	0.271984397	27 %
Formal GSL vs NanaSL	124	0.25	0.26408662	26 %
ASL vs Informal GSL	124	0.25	0.240050877	24 %
AdaSL vs Formal GSL	124	0.25	0.234816279	23 %
ASL vs NanaSL	124	0.125	0.219852941	22 %
AdaSL vs ASL	124	0.25	0.211283465	21 %

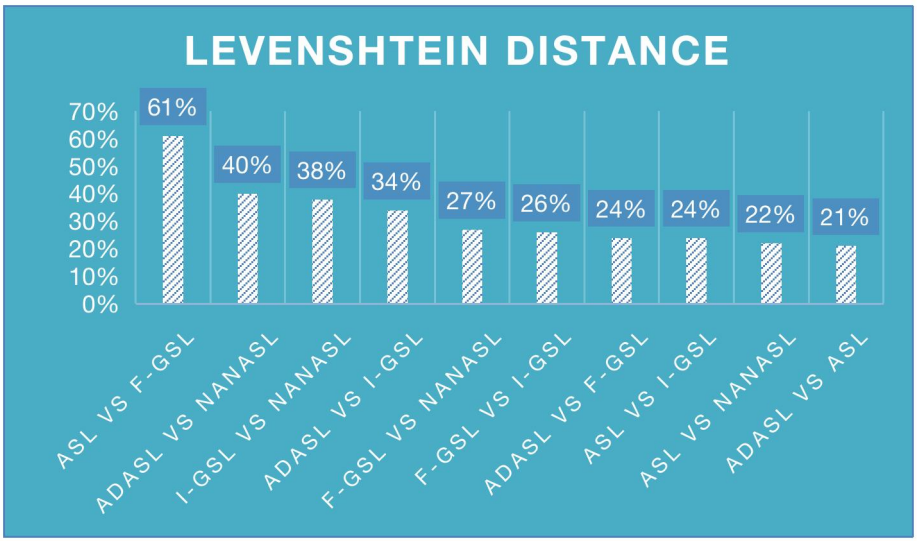


Figure 24: Distribution of Levenshtein Distance Scores with an unequal concept matches

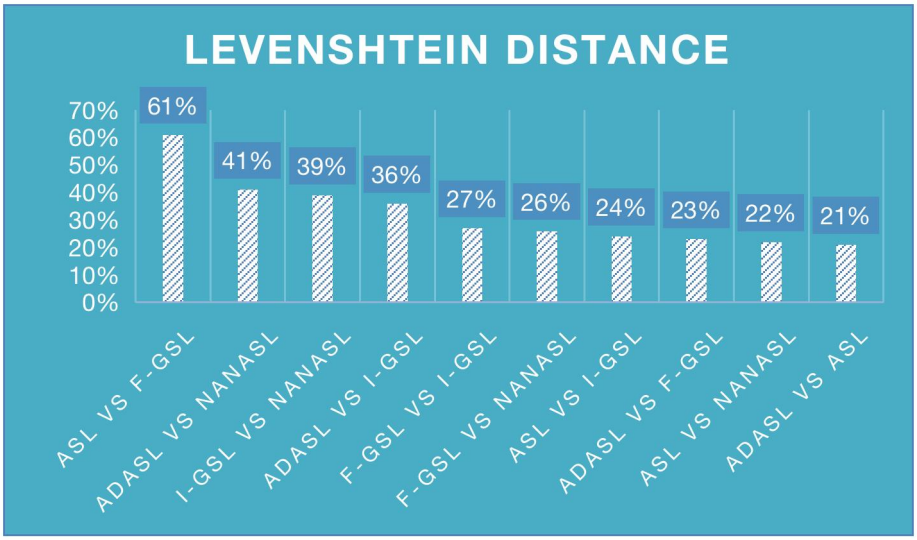


Figure 25: Distribution of Levenshtein Distance Scores with equal concept matches

Based on the percentage of the Levenshtein Distance in Figure 25, the lexical sign distance between AdaSL and ASL was 21%, ASL and NanaSL 22%, AdaSL and formal GSL 23%, ASL and informal GSL 24%, formal GSL and NanaSL 26%, formal GSL and informal GSL 27%, AdaSL and informal GSL 36%, informal GSL and NanaSL 39%, AdaSL and NanaSL 41%, and finally, ASL and formal GSL showed a distance of 61%.

The report indicates that apart from formal GSL, ASL exhibits a significant distance from the other sign languages used in Ghana, with an average of 22%. However, ASL is relatively closer to formal GSL, with a distance of 61%. Moreover, the comparison report highlights some variations in distance between formal GSL and the other sign language varieties in Ghana. Unlike ASL, the report shows that formal GSL signs are more distant from AdaSL with a 23% distance, while the distance is 27% for informal GSL and 26% for NanaSL.

Furthermore, the report underscores that the native sign language varieties (i.e., informal GSL, AdaSL, & NanaSL) are closer to each other than they are to ASL and formal GSL. Within the native sign language varieties, AdaSL and NanaSL exhibit more closeness to each other (41% distance) compared to informal GSL (36% distance). At the same time, NanaSL and informal GSL share a distance of 39%. The result is perhaps not surprising that sign languages that originate in the same area could share more similarities than a foreign language like ASL. Therefore, it is expected for ASL to be far distant from informal GSL, AdaSL, and NanaSL while showing relative proximity to formal GSL due to their historical link.

Overview of Phonological Features: A Focus on Handshapes and Location

Having described the lexical similarity using the Levenshtein Distance, in this section I now compared phonological features across the five different sign language varieties in my annotated dataset to establish shared phonological features. The parameters with a frequency of 6% and above are presented in Table 21 and Table 22. Table 21 focuses on handshapes, while Table 22 examines the location as a phonological feature.

Table 21: Handshape Parameter Frequency

Formal GSL		**ASL**		Informal GSL		**NanaSL**		**AdaSL**	
HS	**(%)**	**HS**	**(%)**	**HS**	**(%)**	**HS**	**(%)**	**HS**	**(%)**
	11		9		13		14		24
	6		9		10		12		13
	6		9		9		10		11
	5		6		8		7		6
	5		6		6		6		4
	4		6		4		5		4

The analysis of handshapes across the five sign languages did not reveal any consistent cross-linguistic pattern. However, two handshapes, C5 [] and C6 [], stood out with varying frequencies across the languages. C5 [] represents a non-spread flat hand with fingers extended, while C6 represents a spread flat hand with fingers extended.

C5 []emerged as the most frequent handshape in formal GSL and NanaSL, while C6 [] dominated AdaSL. Nyst (2007:61) also discovered that these handshapes [ & ] are among the most frequent in AdaSL and in other sign languages. Specifically, the occurrence percentages of C5 [] were 11% in informal GSL, 9% in ASL, 10% in formal GSL, 14% in NanaSL, and 6% in AdaSL. For C6 [], the percentages were 6% in informal GSL, 9% in ASL, 6% in formal GSL, 12% in NanaSL, and 24% in AdaSL.

ASL showed high frequencies for C5 [] and B2 [], the latter representing using the index finger. Additionally, informal GSL displayed a noteworthy frequency (13%) for the lax handshape K6 [], a bent finger spread handshape. This lax K6 [] handshape occurred in all the languages but had varying percentages: 7% in NanaSL, 3% in formal GSL and AdaSL, and only 1% in ASL.

Interestingly, all other sign languages predominantly exhibited signs with lax handshapes except for ASL. AdaSL had the highest number of signs (21) using a lax handshape, followed by NanaSL (17 signs), informal GSL (4 signs), and formal GSL (4 signs).

Lexical variation was also observed in the dataset, where some variants found in formal GSL were also present in ASL, while other variants were unique to each language. Handshape differences often accounted for these variations, with changes occurring in either the initial or final handshape or both.

Some of the variants in formal GSL were phonologically similar, differing mainly in thumb positioning [e.g.,  vs ] or the spreading of the fingers [ vs ]. Moreover, several signs in both ASL and formal GSL were initialised, including signs like TO LIVE, WATER, BLUE, DOCTOR, FAMILY, CHURCH,

MONDAY, TUESDAY, WEDNESDAY, FRIDAY, and SATURDAY. However, there were cases where initialisation differed between ASL and formal GSL signs. For instance, formal GSL initialised signs such as BLACK, GRASS, RED, ROCK, TO COOK, TO KILL, TO PAY, WIND, WOOD, GREEN, LEAF, RIVER, and ROCK, while ASL did not initialise them.

Table 22: Frequency of the location parameter values.

Formal GSL		**ASL**		Informal GSL		**NanaSL**		**AdaSL**	
Loc	%	Loc	%	Loc	%	Loc	%	Loc	%
SN	39	SN	34	SN	58	SN	63	SN	54
Palm	10	Cheek	10	Chest	5	Chest	5	Space in front of face (SFFace)	7
Cheek	7	Palm	10	Cheek	5	Palm	5	SFFace	7
SF-Face	7	Chest	6	Palm	5	SFFace	5	Cheek	6
Finger	5	Finger	6	Lips	4	Cheek	3	Chin	4
Chest	5	Forehead	5	Finger	3	Finger	3	Chest	3
Forehead	5	SFFace	5	Space in front of & above forehead SFAHead	3	Lips	3	Palm	3
Back of hand (Bhand)	3	Chin	4	SFFace	3	Chin	2	Lips	3
Chin	3	Lips	3	Chin	2	SFA-Head	2	Space to side of lower check/ head SLoCheek	3
Lips	3	Bhand	2	Forehead	2			SFAHead	2
SLo-Cheek	3	SLoCheek	2					Finger	2
SFA-Head	3	SFAHead	2						
Ribs	2	Side of hand (Shand)	2						

The data in Table 22 reveals that the neutral space is the most prevalent articulatory feature across all five sign language varieties. However, a striking observation is that the three native sign language varieties in Ghana heavily favour using neutral space. NanaSL, AdaSL, and informal GSL together accounted for over 50% of the usage of neutral space. Specifically, NanaSL used neutral space in 63% of signs, AdaSL in 54%, and informal GSL in 58%. In contrast, the other phonological locations combined contributed to less than 7% of the data in these native sign languages.

On the other hand, formal GSL and ASL did not show such a predominant use of neutral space, each contributing less than 50% to their signs. In formal GSL, the usage of neutral space was 39%, while in ASL, it was 34%. Based on these findings, we can hypothesise that school based sign languages (e.g., ASL & formal GSL), rely less on neutral space. Conversely, the two village sign languages (AdaSL & NanaSL) and informal GSL rely more heavily on neutral space in their linguistic expression. This report aligns with Nyst's (2007:67) findings on the use of location in AdaSL, wherein she noted that neutral space stands out as the most frequently employed location.

The data also revealed unconventional locations used as articulatory features in the native sign languages. Signs were identified on the buttocks, armpit, tongue, teeth, proximal to the feet, and even on the interlocutor's body as identified already for AdaSL by Nyst (2007). One noteworthy example included the sign for RED in NanaSL located on the tongue and signs like WHITE, DOG in AdaSL, which had locations on the teeth. Moreover, a single sign, SHOE, was located proximal to the feet and was used in AdaSL, informal GSL, and NanaSL.

Summary of major findings

This study revealed several interesting patterns and relationships among the five signing varieties used in Ghana (i.e., formal GSL, informal GSL, ASL, AdaSL, & NanaSL).

1. Similarity between ASL and formal GSL:
   ASL and formal GSL showed a high similarity coefficient index, indicating significant lexical similarities. The Levenshtein Distance of 61% using 4 parameters suggests a relatively close relationship between these two sign languages. However, ASL exhibited a considerable distance from the other sign languages used in Ghana, with a distance of 22%.

2. Native Sign Language Varieties:
   The native sign language varieties, namely informal GSL, AdaSL, and NanaSL, were found to be closer to each other than they were to ASL and formal GSL. Informal GSL showed higher proximity to the other native sign languages in

Ghana. AdaSL was closer to NanaSL than to informal GSL, while informal GSL showed a more intimate relationship with NanaSL than AdaSL.

3. Articulatory Features:
The analysis of articulatory features revealed distinct preferences among the sign languages. The native sign languages (i.e., informal GSL, AdaSL, & NanaSL) in Ghana demonstrated a greater inclination towards specific phonological features than formal GSL and ASL. Notably, using a lax handshape, neutral space, and unconventional locations was more prominent in the native sign languages, indicating potential linguistic uniqueness and creativity (cf. Nyst 2007).

3.4 Discussion and Conclusion

This study aimed to explore lexical similarities among sign languages used in Ghana, with a particular focus on ASL and GSL. To achieve this, I employed two approaches widely used to measure the lexical distance between signed languages. The first approach, inspired by Woodward's (2000) lexicostatistic methods, was aimed at comparing "true friends" between GSL and ASL, leveraging their relationship as a basis for analysis. On the other hand, the second approach, inspired by Parks' (2011) methodology, focused on comparing other sign languages in Ghana with ASL without relying on "true friends", acknowledging the absence of historical records to establish language relationships in modern times.

The detailed findings from this study shows the linguistic relationships and distinct characteristics of the sign languages used in Ghana. This result draws meaningful conclusions regarding the similarities and differences among these sign languages. Combining these diverse approaches gives us a better understanding of the intricate linguistic landscape within the Ghanaian signing community. The results shed light on the potential historical connections between ASL and GSL and the linguistic uniqueness of other Ghanaian sign languages. These findings enrich our knowledge of sign language evolution and contribute to a broader understanding of language relationships and diversity in the context of sign languages in Ghana.

3.4.1 Influence of Handshape and handedness on "True Friends" Distinction

The findings of this study consistently highlight the crucial role of handshape as a major contributing factor to the distinction between GSL and ASL "true friends". Handshape is a significant determinant in the sign language lexicon, playing a pivotal role in sign formation and contributing to the differentiation between related sign languages. The consistent significance of handshape in the results underscores its importance in shaping the linguistic structure of these sign languages. It indicates

its potential as a key criterion for further sign language comparison and classification.

An interesting example from study 3 (section 3.3.1.3) illustrates the impact of handshape on the "true friends" distinction. The sign for RAIN, as seen in Figure 3.11, was categorised under category IV and was the only pair of signs in this category. A notable difference was observed between the old dictionary (Figure 26a) and the new dictionary (Figure 26b) using a compound sign. The old dictionary's RAIN sign combined the WATER and the signs: FALLING, while the new dictionary did not use a compound sign. However, some phonological features from the old dictionary's sign were retained in the new dictionary's version. For instance, the initialised W-handshape [] for WATER in the compound sign RAIN was maintained.

a. GSL sign (GNAD, 2001:85).

b. GSL sign (GSL App)

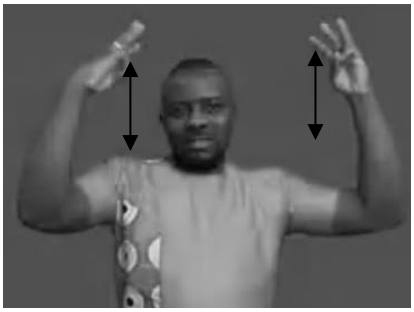
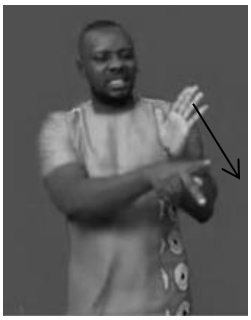


Figure 26: RAIN

A noteworthy feature that emerged in comparing GSL data with ASL data and comparing the two GSL dictionaries was initialisation and, intriguingly, finalisation. Initialisation involves using the English alphabetical handshape representing the first letter of the target English word within a sign. In contrast, finalisation uses the handshape corresponding to the last letter of the target English word when fingerspelled. In this study, nine "true friends" were identified to have linguistic initialisations. An example of initialisation in GSL for the sign KILL is found in Figure 20 repeated here as Figure 27 below. However, in ASL, as shown in Figure 27b, initialisation is not used for the sign KILL.[92] Similarly, one sign (i.e., IF) in the data employed finalisation, as seen in Figure 28. It is interesting to note that finalisation has also been reported in ASL by Mirus et al. (2012).

[92] I am, however, cognizant that ASL signs such as KILL, RED, PAY, and GREEN may frequently incorporate initialisation, potentially reflecting the influence of signed systems for English (E. Maroney, personal communication, April 22, 2024).

a. GSL sign (GSL App)



b. ASL sign (Riekehof, 1978:148)

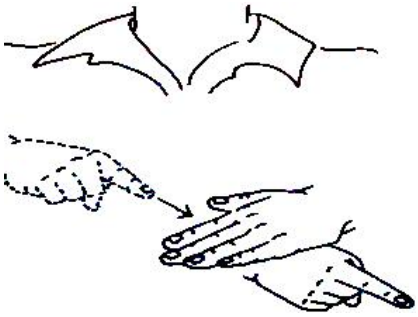


Figure 27: KILL

Figure 28: IF (GNAD 2001: 75)

In addition to initialisation and finalisation, some "true friends" were also identified as iconic and local signs. For example, signs for TREE, VOMIT, CAT, DOG, EGG, FIRE, RIVER, SEA, and SNAKE were deemed iconic, showcasing their representation of entities, movements, and natural gestures. Handshape differences among "true friends" pairs were observed in close handshape vs. spread handshape, thumb extended vs. thumb unflexed, iconicity vs. alphabetic handshape, and two selected fingers vs. five selected fingers. The prominence of handshapes in driving phonological differences in a lexicostatistic study aligns with findings from other signed languages (McKee and Kennedy, 2000).

Nonetheless, existing literature (Ormel et al., 2017; Battison et al., 1975) suggests that certain signs' thumb position can be influenced by neighbouring signs, or the phonological parameters of the target sign itself. This claim may extend to other unselected fingers in a target sign (Ormel et al., 2017), which may explain the extension of unselected fingers in some GSL signs, such as COUNT and ANIMAL.

The second phonological feature contributing to differences among "true friends" was handedness, particularly the preference for one-handed vs. two-handed signs. Four out of the five signs used one-handed signs in the old GSL dictionary (GNAD, 2001), while in the new dictionary (GSL App), these signs were articulated as two-handed signs. An example can be observed in Figure 29. The variation in the

number of hands used in signs may indicate language reconstruction or linguistic variation in GSL.

a. GSL sign (GNAD, 2001:29 b. GSL sign (GSL App)

Figure 29: FISH

In conclusion, handshape is a significant factor in distinguishing GSL and ASL "true friends" in this study. The use of initialisation and finalisation in certain signs and the presence of iconic and local signs further contribute to the differentiation among sign languages. The variation in handedness preference adds another layer of complexity to the linguistic structure of these languages. The findings highlight sign language's dynamic and multifaceted nature and emphasise the importance of handshape as a key criterion for future sign language research and classification.

3.4.2 Comparison of GSL Data Sources

In order to gain further insights into the development of GSL; the study (see Subsection 3.3.1.3) also compared "true friends" in GSL by analysing data from two different dictionaries (i.e., 2001 vs. 2020). The resulting "true friends" rate of 94.2% is remarkably high, suggesting that not much has changed in the language over the 19 years between the publication of the two dictionaries. However, Edward (2021b: 30) raises the possibility that some signs in the dictionary used in the study may have changed, such as modifications in articulatory parameters and a reduction in the use of initialised signs due to GNAD influence. The exact role of GNAD in these changes and modifications is not entirely clear. Yet, the observed variations in different phonological features of signs in GSL may indicate a certain linguistic variation rather than a definitive language change. This notion is supported by the concept of idiosyncrasy in sign languages and the lack of extensive linguistic research conducted nationally before compiling these dictionaries.

Another possible interpretation of the observed variations in GSL could be the ongoing process of phonological reconstruction within the language (Kusters, 2019: 7-8). Nyst (2010: 413), for instance, noted that the articulation of GSL tends

to be more lax than standard ASL, particularly in the handshape parameter. Additionally, Edward (2021b) pointed out that the modifications introduced by GNAD have resulted in reduced initialisation. However, the findings of this study indicate that initialisation is still favoured by GSL signers, as evident in both the primary and secondary data analysed.

Despite the potential influence of external factors and variations, the high "true friends" percentage from the comparison of GSL data sources (i.e., dictionaries) underscores the continuity and stability of the language over time. This outcome may also be attributed to codification, whereby the existence of a dictionary freezes the lexicon to some extent. It is also essential to recognise that sign languages, like spoken languages, are dynamic and can undergo changes and adaptations as they evolve in different social and linguistic contexts.

3.4.3 Similarity Index and Language Proximity

The similarity coefficient index between ASL and formal GSL indicates a close linguistic relationship, with formal GSL being more closely related to ASL (Levenshtein Distance of 61%) than the other sign languages used in Ghana. This finding is consistent with the earlier observations of high "true friends" percentages between these two languages, further reinforcing that they may be dialects of the same language.

The distance between lexical items was examined in the second approach to establish the relationship between formal GSL and ASL using the Levenshtein distance. The 61% distance score can be considered relatively high, especially considering a similarity percentage above 50% is often considered significant in linguistic similarity judgments for spoken languages (Blair, 1990: 33; McElhannon, 1967: 8).

The comparison results revealed that informal GSL exhibits closer linguistic proximity to the local sign languages in Ghana than ASL. This fact aligns with Nyst's (2010: 413) findings in the literature, who observed that handshape in GSL is more similar to AdaSL as both languages are "more lax than standard ASL." The distance scores between informal GSL and the local sign languages support this conclusion, with informal GSL showing a closer similarity to AdaSL (23%), NanaSL (26%), and informal GSL (27%) compared to its distance from ASL (22%).

The influence of formal GSL on the local sign languages in Ghana is evident, especially considering the shared ambient spoken language and culture between formal GSL and the local languages. The presence of bilingual deaf signers, familiar with formal GSL and ASL due to formal education, further contributes to the influence of formal GSL on AdaSL and NanaSL. Anecdotal reports and some studies also support the observation that formal GSL influences the local sign

languages in Ghana through language contact situations (Abudu, 2019; Edward, 2021b; Kusters, 2019; Nyst, 2007).

Additionally, this study identified that informal GSL is closer to AdaSL and NanaSL. These three indigenous sign languages exhibit certain similarities in articulatory features, lexicon, lexical strategies, and the use of space. Tagoe's (2018) work and Nyst's (2010: 425) observations also support these findings, revealing similarities between AdaSL and NanaSL regarding handshape and lexical items. Shared (Akan) culture and limited lexical borrowing between NanaSL and AdaSL may contribute to these similarities.

Furthermore, anecdotal reports of ASL users effectively engaging with formal GSL users with relative ease may also encourage the borrowing of lexical items and features from ASL by GSL community members. Such international exchange experiences can facilitate lexical similarities between formal GSL and ASL, as supported by the results of this study.

The similarity index and language proximity analysis provide insights into the relationships between the sign languages used in Ghana. The close relationship between ASL and formal GSL and the proximity of informal GSL, AdaSL, and NanaSL showcase the dynamic nature of sign languages and the influence of language contact situations. These findings contribute to the broader understanding of the linguistic characteristics and relationships among the sign languages used in Ghana while also highlighting the need for continued research to explore the dynamic linguistic landscape of these unique and vibrant languages.

3.4.4 Concluding remarks

In conclusion, this chapter encompassed four distinct studies using both Park's (2011) and Woodward's (2000) approaches to explore the relationships among the sign languages used in Ghana. Under Woodward's approach, three studies were conducted. Study one, compared GSL signs from a dictionary with ASL signs from a historical dictionary. The findings highlighted a substantial "true friends" rate of 83%, affirming the notion that formal GSL and ASL are dialects of the same language. The prominence of handshape as a primary distinguishing feature further underscored the significance of this phonological aspect in understanding lexical similarities between GSL and ASL. The second study compared the same GSL signs with ASL signs from a contemporary dictionary. The "true friends" rate slightly diminished to 79%, reinforcing the interpretation that GSL and ASL are dialects of the same language. The persistence of handshape as a key phonological feature in differentiating "true friends" maintained its significance across analyses. The third study compared the GSL signs with signs from an older GSL dictionary. This third analysis yielded 94.2% "true friends" rate, underscoring the effect of language codification in standardizing formal GSL over time, strengthening the conclusion

that the two data sources represent the same language. The persistent influence of handshape in GSL further validated its linguistic importance in the third study.

The fourth study used primary data except for ASL signs. This last study employed Park's approach, delving into the lexical similarity among formal GSL, informal GSL, ASL, AdaSL, and NanaSL. The analysis revealed distinct patterns and relationships among these signing varieties, emphasizing the close similarity between ASL and formal GSL, as well as unique preferences in articulatory features within the locally evolved sign languages of Ghana (i.e., informal GSL, AdaSL, and NanaSL). The study during it data collection for the fourth study revealed the influence of language ideologies on GSL usage, particularly in formal and informal settings. The language attitude of signers, especially during data collection, can influence the nature and formality of GSL in various contexts. The presence of informal GSL and variations in signs within the native sign languages may be attributed to the idiosyncratic preferences of users and the influence of external factors.

Future research in this area should adopt a sociolinguistic perspective to explore further the historical development of GSL and its ongoing relationship with ASL. Additionally, investigating the phonology, morphology, syntax, and semantics of the native sign languages in Ghana would provide deeper insights into their linguistic structures and characteristics. This study contributes to understanding the linguistic connections among sign languages used in Ghana and their relationship with ASL. The insights gained from this research can inform language planning, deaf education, and the development of GSL in Ghana. By recognising the linguistic diversity and heritage of the Ghanaian signing community, we can promote and preserve these valuable languages for future generations.