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

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4.

A DESCRIPTIVE ANALYSIS OF SASS USAGE AMONG (GSL) SIGNERS AND (GHANAIAN) GESTURERS

This chapter examines the expression of size and shape specifiers (henceforth SASS) in GSL and their comparable gestures used by Akan[93] speakers in Ghana. Among the approximately 70 languages in Ghana, Akan is a prominent lingua franca and a widely spoken language, contributing to about 45.7% of the country's population of 30.8 million, [94] according to the 2021 Housing and Population Census.

Expressions related to size and shape are prevalent in various sign languages but exhibit diverse forms (Kyuseva, 2020; Lu & Goldin-Meadow, 2018; Nyst, 2016a; Nyst & Tano, 2018). The existence of such expressions in sign languages is not surprising, given that our world is replete with diverse geometric shapes, and vision is our primary sense. However, the question arises whether size and shape expressions in sign languages differ from their equivalent gestures produced by hearing speakers. Some studies in sign languages (Nyst, 2016a; Tano & Nyst, 2018) have suggested that certain size and shape expressions may have originated in the gestural environment; thus, gestures contribute to sign language's linguistic structure or lexicon. Yet, the timing of this influence of gesture on sign language structure remains uncertain. We do not know if this effect occurs only during the emergence of a new sign language or if an already established sign language can also be influenced by its gestural environment.

The cases of AdaSL and Bouakako Sign Language (emerging sign language of Côte d'Ivoire) demonstrate some resemblance in their SASS expression with what is used by gesturers in their respective environments (Nyst, 2007; Nyst & Tano, 2018). However, they cannot provide insights into the timing of this influence, lacking intermediate steps of argumentation. Even though one is established and the other emerging, no conclusion can be drawn as both sign languages emerged within the same gestural environment where they share SASS. In contrast, ENGLISH was introduced in Ghana in 1957 as an already established sign language, providing a unique opportunity to explore if a new gestural environment can also influence an established sign language. The history of sign language landscape in Ghana adds an intriguing dimension to this investigation. SASS and their associated gestures play a significant role in daily communication; however, there are limited studies on this type of linguistic communication, particularly among users of spoken languages. For

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[93] The term Akan can refer to the language or the ethnic group.
[94](https://statsghana.gov.gh/gssmain/storage/img/infobank/Volume%203%20Highlights.pdf)

instance, Nyst (2007:126) observed that Akan gesturers in Ghana produce SASS gestures resembling those in AdaSL but without providing any detailed account on gestures.

Within the body of literature concerning sign languages, disparity emerges between the prevalence of independent space-based SASS and the distinct existence of body-based SASS in AdaSL and Bouakako Sign Language, both located within their respective gestural environments, as noted by Nyst in her works from 2007 and 2019. Research undertaken by Nyst in 2007 and 2019, along with the collaborative efforts of Nyst and Tano in 2018, delves into SASS gestures in Ghana. However, this research involves a relatively small number of speakers. Their collective findings underline a significant correlation between the use of body-based SASS in sign language and gestures within the same environment, coinciding with observed restrictions on handshapes and a limited application of space-based SASS. Drawing from Nyst (2018, 2019), one can infer that culture-specific patterns within the gestural environment hold the potential to shape cross-linguistic disparities in SASS morphology and handshape phonology, thereby offering an explanation for both the similarities and distinctions found in sign languages, beyond the influence of shared linguistic heritage, language contact, and iconicity.

AdaSL and Bouakako Sign Language, village sign languages featured in Nyst's work from 2007, 2019, and Nyst and Tano's research in 2018, shed light on the existence of these linguistic phenomena within a specific context. This raises the question of how urban deaf signers in Ghana navigate the realm of SASS. Is there a comparable correlation between signers and gestures in this urban setting? This chapter aims to explore these correlations and to address the notable gap in gesture data related to SASS by providing a morphophonological in-depth analysis of SASS in GSL and by Ghanaian gesturers. Consequently, this chapter discusses the findings on SASS signs and gestures to assess and validate the conclusions established in prior literature (e.g., Nyst, 2007, 2019; Nyst and Tano, 2018).

In the following sections, I first provide a review of SASS to situate this study (Section 4.1). This is followed by a methodology for this chapter (Section 4.2). Under the methodology section, I overview the data source used, and the tokens of data gathered. The data are presented for analysis in Section 4.3. In Subsection 4.3.1, shape for shape depiction is described under the subsections; entity handshape (Section 4.3.1.1), tracing hand shape (Section4.3.1.2) and handling hand (Section 4.3.1.3). I then provide a summary of section 4.3.1 in the subsection 4.3.1.4. In section 4.3.2, distance for size depiction with two main subsections. Size depiction in space (Section 4.3.2.1) and size depiction on the body (Section 4.3.2.2). Under Section 4.3.2.1, I describe distance delimited between two hands (Subsection 4.3.2.1.1), distance delimited hand-internally (Section 4.3.2.1.2), and distance delimited between hand and ground (Subsection 4.3.2.1.3) and distance delimited between hand and body (Subsection 4.3.2.1.4).

Under Section 4.3.2.2, I describe size denoted hand-internally (Subsection 4.3.2.2.1), size indicated with two hands on the body (Subsection 4.3.2.2.2) and size indicated with one hand on the body (Subsection 4.3.2.2.3). Finally, the chapter ends in Section 4.4 with a discussion and Section 4.5 with a conclusion.

4.1 The Complexity of Size and Shape Specifiers (SASS) in Sign Languages

Size and Shape Specifiers (SASS) have captured the attention of linguists for their unique role in sign languages, providing insights into how signers convey the dimensions and forms of various entities. While the discussion of SASS has grown, it has given rise to varying perspectives and terminologies, making it an intriguing area of study in sign linguistics.

A subset of the academic community, including scholars such as Taub (2001), Supalla (1986, 1982), Galea (2006), and Nyst (2016a), perceives SASS as a distinctive classifier within sign languages designed to portray the contours or magnitudes of an entity. However, this view is not universally accepted. Some, like Tkachman and Sandler (2013) and Sandler et al. (2011), refrain from categorising SASS as a classifier. This divergence in perspective can be attributed to the ongoing exploration of classifiers in sign languages (Zwitserlood, 2003; 2012).

Supalla (1982) delineated SASS as a classifier system intricately linked to motion and location verbs. Extending on this, Nyst (2007) opined that those signs reflecting the size and/or shape of an entity, either in fully or partially, can be categorised as SASS. This categorisation also extends to signs or sub-lexical entities that encapsulate the dimensions and form of an object. Taking a phonological stance, Wallin (2000) depicted SASS as primarily reliant on movement and articulator components, either solely through handshapes or in conjunction with orientation. This perspective is augmented by Safar and Chan (2020), who suggested that SASS might not always mimic an object's exact dimensions or form but might denote the broader category to which the object belongs.

A recurring theme in the discourse on SASS is their iconicity, as Nyst (2016a) and Galea (2006) noted. This iconic nature lends transparency, allowing easy comprehension by interlocutors (Nyst & Tano, 2018). However, challenges arise in the inconsistent usage of the term 'SASS', leading to ambiguities. For instance, a sign might employ elements hinting at dimensions and form but not semantically align with these concepts. Differentiating between these intricate nuances—whether SASS elements are embedded within lexical signs or operate as standalone entities—is a task that has puzzled many, including Nyst and Tano (2018).

Take, for instance, the GSL sign for HOUSE (as illustrated in Figure 30). While the sign may represent a dwelling at first glance, elements hinting at size and shape become evident upon closer inspection. On a lexical level, the primary significance of this sign does not necessarily concern size or shape. Still, it subtly conveys or alludes to such elements (particularly the shape of a house). Contrastingly, SASS can also manifest as independent signs, solely representing size and shape (as illustrated in Figure 31), free from the confines of lexical embedding or any affixation. Nyst and Tano (2018) highlight that differentiating between lexical signs with embedded size and shape elements (e.g., Figure 30) and standalone SASS/productive SASS (e.g., Figure 31) can be challenging, given that both types of signs might appear the same in form.

This complexity is underscored when we consider that, visually, both sign types (embedded SASS elements & productive SASS) might bear striking resemblances. Let us revisit the GSL sign in Figure 30 for a clearer depiction. While primarily associated with another concept (i.e., house), this sign could simultaneously describe a triangular-shaped object.

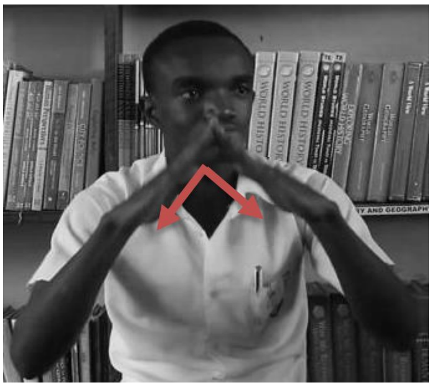

Figure 30: HOUSE (Hadjah 2016:83)

Figure 31: Size of a snake

Kuyseva (2020:261) offers a more delineated perspective, defining SASS as signs that depict an object's size and/or shape but without indicating the object's spatial location or movement. Nyst and Tano (2018), therefore, assert that the key differentiation for such signs lies in their semantic specialisation towards a specific type of referent. However, it is pertinent to note the inconsistency in using SASS in the literature, particularly regarding their distinction as independent lexical signs or sub-lexical elements within a sign. Considering these discussions and for this book, the emphasis will predominantly be on SASS as standalone signs specifically designed to express size and/or shape.

Versatility and Variability Roles of SASS

SASS is an instrumental tool within various sign languages, delineating clarity and ensuring reduced ambiguity in compound-like structures (Safar & Chan, 2020; Tkachman & Sandler, 2013). Their primary function is to specify the size or shape of the referent in question. In AdaSL, for instance, the application of SASS varies based on the object's size relative to the signer's upper limb; this variance manifests either in measuring (stick) signs or tracing signs (Nyst, 2007).

Broadening the geographical scope, Kuyseva (2020) delved into Russian Sign Languages (RSL), aiming to discern SASS's unique properties, structural elements, and semantics. Her findings suggest that the positioning of SASS, whether in a neutral space or on the body, can influence the meanings and representations they encapsulate.

Italian Sign Language (LIS) also offers insights into SASS's multifaceted nature, as Fornasiero (2020) explored. Her research identifies SASS as a vital tool for articulating LIS's diminutive and augmentative distinctions, categorising them as extension and surface classifiers. However, she underscores the complexity inherent in their classification, challenging their description as mere classifiers or bound morphemes.

The positioning flexibility of SASS is apparent across various sign languages. They can stand alone, occur in conjunction with a head sign in a compound-like construction, and appear in multiple positions within a sign, be it final, middle, or initial (Meir et al., 2010; Safar & Chan, 2020; Tkachman & Sandler, 2013). Safar and Chan (2020) argue for the necessity of SASS in some lexical contexts, underlining their potential mandatory use or their application for schematic classification.

The potential of SASS to function as a nominal marker has gained significant attention in the literature (Haviland, 2013; Safar & Chan, 2020; Safar, 2020; Tkachman & Sandler, 2013). For instance, SASS has been identified as a strategy to distinguish nouns from verbs in Israeli Sign Language (ISL) and Al-Sayyid Bedouin Sign Language (ABSL) (Tkachman & Sandler, 2013). However, it is noteworthy that its use as a nominal marker is not obligatory across all sign languages. Moreover, YMSL and ISL employ other strategies, such as patterned iconicity and manner of movement, to indicate nominal marking.

Diving deeper, Schick (1987) posits SASS as a predicate adjective in ASL, emphasising ASL's proclivity towards SASS usage, even when a simple lexeme might suffice. Furthermore, contrasting perspectives abound regarding the nature of SASS. While Meir et al. (2010) view SASS as bound morphemes, Zwitserlood (2003) discerns a distinction, deeming Tracing SASS as free morphemes and Static SASS as bound. This disparity in understanding could be attributed to varying research aims or differences in the languages studied. For instance, while Meir et al. (2010) concentrated on compounding, Zwitserlood's (2003) focus was on hand configurations in the Sign Language of the Netherlands (NGT).

Furthermore, the role of SASS as a compound constituent is not universal. While its usage is prominent in languages like ASL (Vercellotti & Mortensen, 2012; Aronoff et al., 2003; Newport & Bellugi, 1979), others, such as Ethiopia SL, display minimal use in compounding (Kidane, 2013). Some researchers, like Bergman and Wallin (2001), working on Swedish SL, even challenge the established notion of SASS and nouns forming a compound unit, suggesting that SASS could function as a separate unit based on their analyses.

SASS is a versatile linguistic tool across various sign languages, playing critical roles in clarity, size and shape depiction, and even noun-verb differentiation. However, its classification and usage vary widely, underscoring sign language's global richness and complexity.

4.1.1 Static and Tracing SASS: Classification and Function

Research in sign languages worldwide has led to the classification of SASS into two prominent categories: Static SASS and Tracing SASS.

Static SASS:

These signs, often devoid of movement, emphasise the size of a referent while providing minimal information regarding its shape. While these signs were originally termed by Supalla (1982, 1986), subsequent research by Kuyseva (2020) and Fornasiero (2020) has reframed and expanded upon these initial definitions.

Generally, they serve as adjectival predicates in sentences, emphasising a referent's size or general shape. However, they can have limitations in terms of the diversity of shapes they depict due to restricted hand configurations. Typically, they spotlight certain defining features of the entities they represent instead of detailing the complete shape (Zwitserlood, 2003).

Tracing SASS:

As illuminated by Kuyseva (2020), these signs involve tracing the contours of an object through movement, delivering specifics about both its size and shape. Morphologically, they exhibit semantically charged movement and have the versatility to function as nouns, adjectives, or predicates.

The movement intrinsic to Tracing SASS is essential for detailing an entity's referent (Zwitserlood, 2003). These movements might depict extension distance for size and are distinctive from other classifiers where movement might have different semantic roles. Zwitserlood (2003) indicated that Tracing SASS is not typically employed with motion verbs[95] but can be associated with location verbs[96]. Conversely, Zwitserlood (2003: 158) asserts that Static SASS can be applied with motion and location verbs.

Fornasiero's Study (2020) on Italian Sign Language (LIS) and Kuyseva's Dissertation (2020) resonate in their adoption of the classification above. Kuyseva's work further elucidates what signs fall under the SASS umbrella, expanding on Zwitserlood's (2003) preliminary analysis.

Nyst's analysis (2007, 2016a) on AdaSL provided a detailed structure for Tracing SASS. She identified four types:

- Tracing an outline in neutral space (Figure 32).
- Tracing close to the body (Figure 34).
- Tracing a one-dimensional line on the body (Figure 33).
- Representing an entity with the hand while creating a trace to indicate its extent in space (Figure 35).

The four distinct subcategories are illustrated below. It should be noted that AdaSL is not the exclusive sign language on which Tracing SASS reported on the body has been documented. For example, Galea (2006) has also reported instances of the phenomenon in Maltese Sign Language.

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[95] Verbs that indicate the path of its referent
[96] Verbs that indicate the location of its referent

Figure 32: KIOSK (Nyst, 2007: 131)

Figure 33: NORTHERNER (Nyst, 2007: 131)

Figure 34: SATISFIED (Nyst, 2007: 131)

Figure 35:STICK (Nyst, 2007: 129)

Tracing SASS's movement plays a pivotal role in delineating the reference of an entity (Zwitserlood 2003: 155). Nyst (2016a) suggests that tracing can represent both extension and distance in size. This distinct function of movement in SASS sets it apart from other classifiers where movement may indicate aspects other than size or shape. In a comparative study between ASL and NGT, Nyst (2016a) noted that AdaSL employs a distinct handshape for depicting entities, especially cylindrical ones. Whereas ASL and NGT predominantly use finger and thumb opposition (e.g., ) for representing cylindrical objects, AdaSL favours articulation with cylindrical body parts like a chosen finger, fist, or forearm.

Supalla (1986) posits that both the forearm and hand, including the fingers, serve as articulators for SASS, with each articulatory unit, such as fingers, having its distinct meaning. In his 1982 thesis, Supalla categorised shapes in SASS into two primary groups: straight (as shown in Figure 36a) and round (as depicted in Figure 36b). Figure 36 illustrates these SASS groups, demonstrating how fingers can be positioned to represent the width or depth of an entity. In elaborating on this, Supalla (1982:36) specified that the forearm can indicate length for straight entities. In contrast, for round entities, the aperture between the hands denotes size, ranging from compact to large.

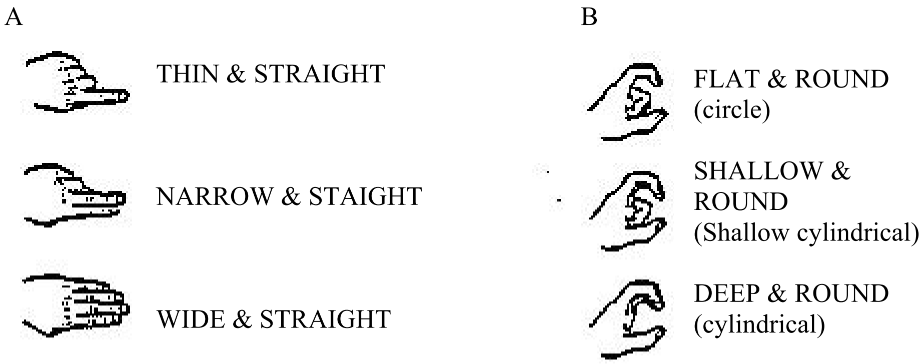


Figure 36: Some examples of SASS handshapes (Supalla, 1982:38)

Other linguists (e.g., Kuyseva, 2020; Wallin, 2000; Zwitserlood, 2003) have correlated hand configuration with the dimension of the referent, emphasising that the choice of handshape, orientation, and the number of articulators is influenced by the size and shape concept to be expressed. While Static and Tracing SASS may appear universally across different sign languages, the way they are employed and differences in their use can be unique to each language. These distinctions and similarities have been highlighted by numerous studies, from Tkachman and Sandler's (2013) exploration of ISL and ABSL to Safar and Chan's (2020) insights into YMSLs.

In the literature, nonmanual markers, encompassing facial expressions, mouth movements, and other bodily actions, are crucial in enhancing the expressivity of SASS in sign languages. Wallin (2000), Nyst (2007), and Sutton-Spence and Woll (1999) have emphasised the role of these markers in sign languages. For instance, in AdaSL, Nyst (2007) identifies fixed mouthing associated with signs like BIG or SMALL, possibly influenced by local spoken languages. In British and Swedish Sign Languages, nonmanual markers, such as puffed cheeks or focused eye gaze, emphasise, and provide context to SASS (Bergman & Wallin, 2001; Sutton-Spence & Woll, 1999). Kuyseva's (2020) study on Russian Sign Language further underscores the importance of mouth articulation in SASS, suggesting its role is not merely mimetic but can shape conversation context. While SASS is instrumental in sign languages, its effectiveness and clarity are often enhanced by accompanying nonmanual markers. Understanding SASS in sign languages worldwide remains an exciting avenue for linguistic inquiry.

4.1.2 Exhaustive model for SASS Classification

Many linguists have explored the vast realm of SASS extensively, with Nyst's exhaustive model (2016a) serving as a pivotal touchstone in the literature for

African-based SLs. This section endeavours to shed light on the classification and structuring of SASS by surveying key contributions.

Nyst's Model based on AdaSL Data

Nyst (2016a) furnished a detailed model for SASS classification, leveraging AdaSL data. Her model is categorised into 1) Shape for Shape Depiction and 2) Distance for Size Depiction:

1) Shape for Shape Depiction:

a. Entity handshape: Represents the size and shape of an entity.
b. Tracing handshape: Indicates size and shape by tracing an imaginary entity.
c. Depiction of hand: Either handles an entity or shows interaction with the entity.
   This includes:
   I. Handling hand: Movement depicts the extent.
   II. Non-handling hand: Movement may indicate actions (e.g. swimming or pushing).

Nyst (2016a) classification builds on Taub (2001) model which offers a distinct perspective on categorising size and shape depiction. In contrast to Nyst's proposals, Taub (2001:7) emphasises the iconic role of movement in shaping depiction. Specifically, Taub presents three principal categories for representing size and shape:

1. **Path for Shape:** Here, the articulator's path movement reflects the visual image's shape.
2. **Shape for Shape Depiction:** In this category, the form of the articulator mirrors the image's shape.
3. **Size for Size Depiction:** The size of the articulation corresponds directly to the size of the image.

Nyst's model underlines the possibility of overlap between the classifications, reminiscent of Galea's (2006) observation on Maltese Sign Language—for instance, the ambiguity surrounding categorising a container as a handling handshape or an entity handshape. Nyst also broaches the consideration of space between opposing thumb and fingers for distance-for-size depiction in specific handshapes.

2) Distance for Size Depiction:

a. On the Body: Can be hand-internal or involve both hands.
b. In Space: Covers two hands, hand-internal, hand-and-ground, and hand-and-body categories.

The intricacies of movement (either path or hand-internal) play a pivotal role, potentially contributing to size or shape specification. A graphical representation of classifications can be found in Figure 37 and Figure 38 illustration Nyst model.

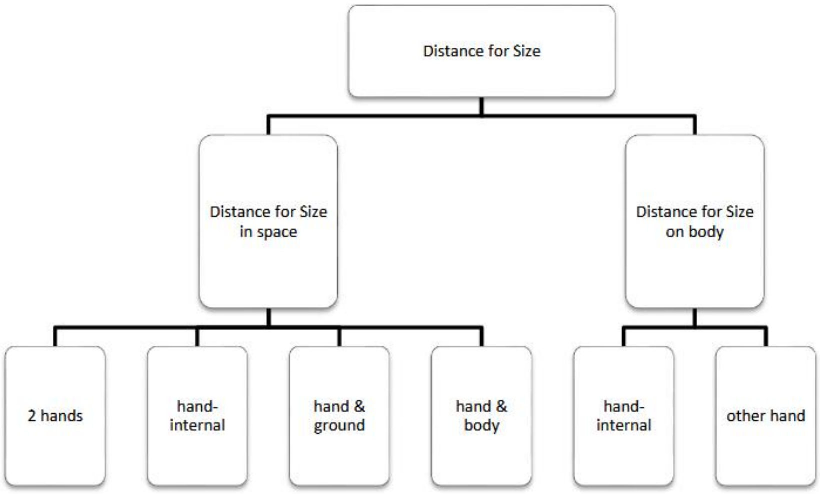


Figure 37: Model for size depiction (Nyst, 2016a as cited in Nyst, 2018:358)

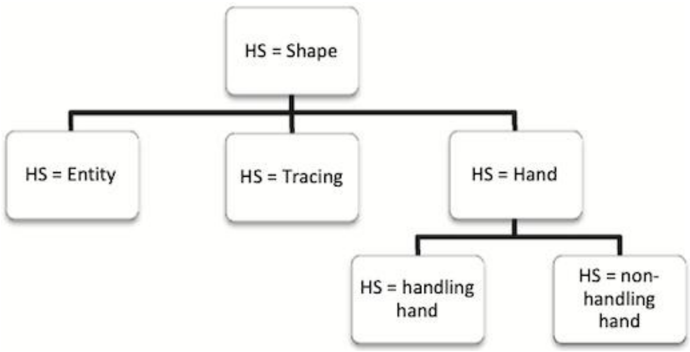


Figure 38: Model for shape depiction (Nyst, 2016a:82)
[NB: HS refers to Handshape]

Articulatory movements in sign languages often convey diverse meanings, especially concerning referenced objects (e.g., classifiers). A closer look at the literature provides varied insights into how these movements are structured and what they imply. One fundamental observation comes from Nyst (2018), who notes that articulatory movement, be it path or hand-internal, plays a significant role in denoting size or extent. This is not an isolated view. Newport and Bellugi's (1979: 238ff) study on ASL made similar observations. They posited that the size and shape of a SASS may not always directly represent the actual size and shape of the object it refers to. Illustrating this, they highlighted how a single Static SASS (e.g.,

) could symbolise various round entities such as cookies, melon seeds, coins, and grapes, regardless of their physical disparities (Newport & Bellugi, 1979).

However, Schick (1987) brought forth an alternative perspective on ASL. While acknowledging that a handshape might remain constant, Schick stressed that the aperture between the fingers or the hands could differ, signifying the variance in the size of the referenced object.

Swedish Sign Language (Swedish SL) also mirrors this phenomenon. Wallin (2000) observed that in Swedish SL, the extent of path movement directly corresponds to the size of the referenced object. This relationship extends further, with Wallin (2000) elucidating a specific rule in Swedish SL regarding the phonological movement of two-handed SASS. He describes that a rounded object or an oblong entity would require a single stroke of movement. In contrast, an object with three sides, like a triangle, demands two strokes, while a four-sided object, such as a rectangle, requires three strokes of movement. This rule pertains predominantly to two-handed SASS with distinct path movements of the hands. However, Wallin (2000) also alludes to the existence of one-handed tracing SASS and two-handed SASS in which only one hand is active. Regrettably, he did not elaborate on these forms in his work. Additionally, Schick (1987) delves into the categorisation of SASS, introducing concepts of single and complex SASS. While a single SASS is a straightforward construction representing one entity, a complex SASS denotes two or more entities, reflecting a more intricate construction.

Body-based-SASS in AdaSL and Cross-linguistic Observations

Nyst's (2007) exploration into AdaSL greatly enhanced our language comprehension, particularly in the 'internal modification' domain. This method, which uses the body to depict size and shape by manipulating or pulling a body part, showcases the intricate ways AdaSL communicates shades of size and shape. The discovery of realistic and unrealistic pulls enriches our understanding of the depth of SASS in AdaSL.

Newport and Bellugi (1979) and Schick (1987) emphasise that SASS is not always a literal representation of physical size and shape. Instead, a combination of approximation and iconicity ensures effective communication. Such insights illuminate the flexibility embedded in sign languages.

A notable instance of body-based SASS in AdaSL, as identified by Nyst (2007), involves a part of the body, such as the ear or nose, being held and pulled. This act can be portrayed realistically, as shown in Figure 39 or more abstractly, as in Figure 40. Nyst (2016a) elaborated that such 'internal modifications' could be seen as a handling hand performing realistic or unrealistic pulls.

Figure 39: Ears of a wild animal (Nyst, 2007:152)

Figure 40: LONG-NOSE (of turkey) (Nyst, 2007:152)

Concerning body-based SASS, Nyst (2007) sheds light on 'measure signs', which predominantly express the size of an entity. These signs are of two main types: 'growth-line' and 'measuring stick'. The 'growth line' represents an abstract vertical line, while the 'measuring stick' could involve one or both hands, dependent on the referent. Specifically, the one-hand variants cater to smaller objects, primarily using the thumb and index finger for articulation. However, Nyst (2016a) posits that these might lean more towards being lexical signs than productive constructions due to their limited number and fixed form.

Nyst and Tano (2018) delve deeper into the various forms SASS adopt. For AdaSL, the hands play a significant role in size and shape depiction, with distinct hand parts and shapes employed. One-handed or two-handed signs can be used, with an active hand often performing the task of delimitation or pointing. Notably, body-based SASS in AdaSL and Bouakako Sign Language (Bouakako SL) share several similarities, such as using fingertips, fingers, the entire hand, or arm parts. However, a marked distinction arises in using the upper leg in Bouakako SL, which is an intriguing deviation from the norm.

In recent literature, the presence of body-based SASS in RSL has been highlighted by Kyuseva (2020). However, it is essential to differentiate this from the body-based SASS identified by Nyst and Tano in West African sign languages. In RSL, the referent for the body-based SASS must consistently pertain to or be a part of the body (e.g., a moustache). In contrast, the body-based SASS highlighted by Nyst (2007) and later by Nyst and Tano (2018) does not necessarily relate to parts of the body. However, the chosen body part for articulation typically mirrors the shape or size of the intended referent iconically.

Kyuseva's study on RSL emphasises the location of SASS—whether produced in the neutral space in front of the signer or directly on the signer's body. According to Kyuseva (2020), the distinction between these two locations may be attributed primarily to the potent iconicity inherent to bodily representations. Building on this, Kyuseva (2020) recognises and references Nyst and Tano's (2018) findings, which show that body-based SASS in AdaSL and Bouakako SL, prevalent in West Africa, are markedly iconic. In these languages, the passive hand often symbolises the object, while the active hand conveys the object's size.

It is rare cross-linguistically for signs to be articulated below the groin, making Bouakako SL's thigh-based signs, as used by neighbouring Anyi speakers, an interesting study point. Nyst and Tano (2018) speculate that this might be due to Bouakako being a younger village sign language and that these signs may evolve with time. AdaSL, with its richer history, has already ingrained size and shape depiction into its grammar.

With AdaSL and its comparison to Bouakako SL, Nyst and Tano (2018) provided a comprehensive comparison between AdaSL and other sign languages, with a pronounced emphasis on Bouakako SL. This comparison showcased different strategies adopted by sign languages in using body parts for SASS, which could be influenced by attributes such as the language's age, the size of its user population, and interactions with other languages. Compelling evidence suggests that the body-based SASS in AdaSL and Bouakako sign language may have originated from gestures prevalent in their respective environments. Nonetheless, given AdaSL's longer linguistic history, it appears to have evolved and refined some of its signs in contrast to Bouakako sign language (Nyst & Tano, 2018).

4.1.3 Evidence Suggesting Culture-Specificity in SASS

Nyst's (2019) cross-linguistic study provides significant insights into how culture influence SASS. By examining sign languages from Africa (AdaSL, Malian SL, Bouakako SL), Australia (Australian SL), and Europe (NGT & French SL), she discovered variations in size depictions across languages. Specifically, West African sign languages preferred body-based delimitation, while non-African sign languages favoured space-based delimitation. This difference is evident in the data, with non-African sign languages showing a 21% preference for space-based depiction compared to 6% in African SLs. Sociolinguistic variables like community size and language age exist, but cultural interaction, especially the close gestural contact observed in West Africa, greatly influences signing preferences (Nyst, 2019).

Tkachman and Sandler's (2013) study on ABSL and ISL shows differences in SASS distribution, with ABSL's SASS being more lexically driven and ISL's being signer driven. However, individual signer idiosyncrasies also affect SASS use, as Safar and Chan (2020) further explored, SASS use can be influenced by "interactional groups," suggesting that SASS might be the outcome of cultural conventions.

Interestingly, some SASS elements, such as those termed "measuring stick and growth line" by Nyst (2007), are predominant in West African gestures and sign languages but less common elsewhere. Studies like Padden et al. (2015) and Safar and Chan (2020) further highlight similarities between gestures and signs in different communities, suggesting a shared repertoire of iconic gestures/signs. For instance, similarities exist between gestures in Yucatec Maya and the SASS in YMSLs and between Anyi speakers' gestures and Bouakako Sign Language in Côte d'Ivoire (Nyst & Tano, 2018). The concept that SASS in YMSLs may have evolved from conventional gestures is further supported by Safar and Chan (2020).

Nyst's (2016b) work emphasises that size and shape depictions in gestures and sign languages are culturally embedded. Her studies on AdaSL signers and Akan gesturers in Ghana reflect this cultural influence, with frequent usage of body-based/part size and shape depictions. Nyst (2016b) theorised that signers might have incorporated gestures from their surrounding environment into their language.

Moreover, other linguistic studies (e.g., Padden et al. 2013) suggest that sign languages often borrow from iconic gestures. This lends credence to the notion that SASS is culture specific. However, more empirical research is essential to establish this definitively.

4.1.4 Concluding remarks on SASS

This literature review delved into SASS within signed languages. By exploring how languages articulate this phenomenon via the visual-manual modality, this review offers a foundational background for this chapter.

The existing corpus of empirical research on SASS, notably cross-linguistic studies, still needs to be expanded. Nonetheless, the current literature recognises SASS as languages' visual manifestation of actual objects, often aligning them with geometric shapes, size descriptors, measures, or stages of maturity.

Nyst's (2016a) comprehensive model for SASS analysis, while seemingly encompassing all facets of the SASS component found in the literature, awaits broader empirical validation. Interestingly, the literature suggests distinct strategies in SASS across regions. Western European sign languages typically employ space delineation for size representation (e.g., Fornasiero, 2020; Kuyseva, 2020; Nyst, 2019), whereas West African sign languages lean towards body-part delimitation (Nyst, 2019). Given this and considering my focus on an African sign language variety, Nyst's model framework (2016a, 2019) is an appropriate foundation for my inquiries.

4.2 Methodology

In order to collect and compare SASS in signs and gestures, several methods were employed, which included: 1) Spontaneous description discourse on farm produce (e.g., food, fruit, & crops), 2) a picture naming task, 3) a cartoon retelling task, 4) a matching haptic task, and 5) an animal encounter narrative. Due to time constraints, the chapter primarily focuses on the last two elicitation methods: An experimental haptic task and a personal narrative of an animal encounter. Detailed information about these two methods can be found in the following sections 4.2.1. The chapter proceeds with an in-depth examination of the data collection procedures (Subsection 4.2.2), followed by the transcription and annotation processes (Subsection 4.2.3).

From these two elicitation methods, a total of 226 tokens of gestures were compared to 820 tokens of SASS in the GSL, which were similar to the gestures produced by Akan speakers. The signs and gestures elicited were categorised using Nyst's (2016a) model, as elaborated in the literature review on SASS (Section 4.1). This categorisation offers shows the extent to which environmental gestures specific to Ghanaians have been incorporated into GSL.

4.2.1 Instruments for data collection

Matching haptic tasks

The matching task employed in this study involved a set of plastic 2D and 3D printed objects to elicit SASS data from both signers and gesturers. During the task, an addresser instructed an addressee to arrange the objects in specific patterns. These objects, developed specifically for this study, served as visual stimuli to elicit SASS responses. In this subsection, I provide a theoretical background that underlies the design of these newly developed materials for eliciting SASS.

Our physical environment consists of many objects that can be described based on their shape and size characteristics (Dryden & Mardia, 2016; Eysenck & Keane, 2015). Size and shape can be defined as “the geometric information that remains when [factors such as] location and rotational effects are removed from an object” (Dryden & Mardia, 2016:2).

Various disciplines, including biology, chemistry, astronomy, medicine, image analysis, archaeology, bioinformatics, geology, genetics, geography, law, pharmacy, and physiotherapy, have shown interest in analysing size and shape for different purposes (Dryden & Mardia, 2016). In sign language linguistics, size and shape analysis is equally important, and this study aims to investigate this concept from a linguistic perspective. Thus, developing a set of stimulus objects was essential to collect data for the judicious use of SASS in communication.

In 1987, Biederman proposed the recognition-by-components theory, which explains how objects in our environment are recognised. According to Biederman (1987), objects are composed of distinctive parts or components, known as geons (e.g., cylinder, cone, block). The theory suggests that approximately 36 geons can account for all objects in the world. Biederman (1987) supported this theory by drawing an analogy with spoken language linguistics, stating that "we only need about 44 phonemes to code all the words in English, 15 in Hawaiian, and 55 to represent virtually all the words in all the languages spoken around the world" (p. 115). Just as a linguist can describe a language with a limited set of known phonemes, objects can be described and perceived with a limited set of geons. Interestingly, studies have shown that children as young as four months old can recognize geons and their structure cognitively, similar to phoneme acquisition occurring at an early stage of child development (Haaf et al., 2003). However, Koch and Abbey (1999) found that "perceptual strategies available for object recognition increase as children mature" (p. 990) when using the geons theory in experimental research.

For the purpose of stimulus development in this study, geon stimuli were identified as suitable. According to Eysenck and Keane (2015), "the identification of any given visual object is determined by whichever stored representation fits best with the component- or-geon-based information obtained from the visual object" (p. 92). They also noted that the recognition-by-components theory provides an answer to the puzzle of how we identify objects despite substantial differences in shape, size, and orientation among members of a category (Eysenck & Keane, 2015:94ff).

However, Biederman's recognition-by-components theory is not without its critics (see Eysenck & Keane 2015:95). Despite criticisms, the underlying concept of the geons theory has proven effective for certain objectives, and similar theories have been proposed by Dickinson et al. (1997; 1992), and Wu and Levine (1993).

Biederman (1987) proposed four properties to distinguish the 36 set of geons: Edge (curved or straight), Axis (curved or straight), Size (constant, expand, or expand-and-contract), and Symmetry (asymmetrical, reflection, or rotation-and-reflection). Figure 41 below presents a clear diagram of Biederman's (1987:122) illustration of the properties of a geon, specifically a cylinder, taken from Wu and Levine (1993). Figure 42 depicts an image illustrating all 36 geons.

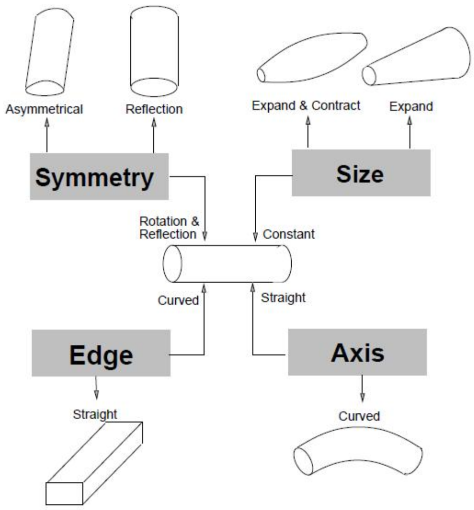


Figure 41: Wu and Levine (1993: 4)

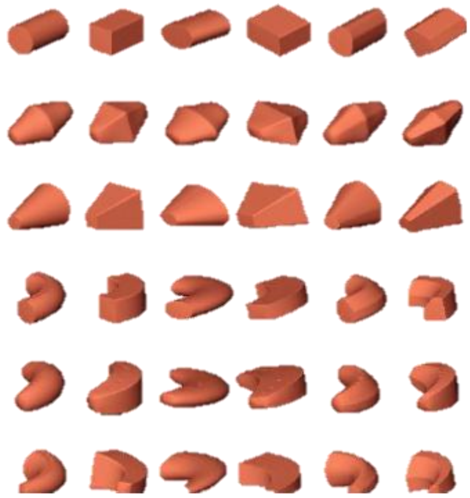


Figure 42: Zhou and Kambhamettu (2002:15)

However, Wu and Levine (1993, 1995) expanded on Biederman's essential properties and proposed a simplified set of seven basic geons, known as parametric geons. This simplification was motivated by the economy of representation, taking into account the tendencies of human cognitive perception (Wu and Levine, 1993).). Reducing the number of geons to seven makes the representation more efficient and easier to work with. The simplification is possible because, as Wu and Levine (1993) highlighted, some of these parametric geons can be combined or compounded to yield some of Biederman's original set of 36 geons. This means that the seven parametric geons encompass the essential properties needed to describe a wide range of objects while maintaining flexibility and adaptability.

These parametric geons have been widely used in research and have demonstrated their effectiveness in various domains related to object perception and analysis. Figure 43 visually illustrates the seven parametric geons proposed by Wu and Levine (1993, 1995), showcasing their simplified and distinctive shapes.

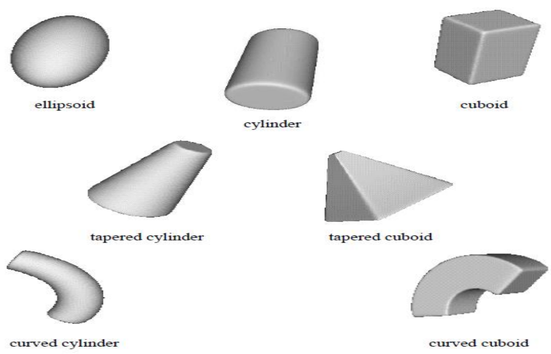


Figure 43: The seven parametric geons (Wu and Levine 1993: 9)

In order to elicit SASS that accurately depicts real-life objects, the study employed the theory of the seven parametric geons to design the elicitation materials for gesture and sign language linguistic studies. This selection was based on the fact that the geons proposed by Wu and Levine (1993) represent simplified and commonly encountered geometric objects such as pyramids, cuboids, cylinders, cones, and ellipsoids. The validity of geons for object description has been established through psychological experiments, making them suitable for this study (Biederman & Cooper, 1991; Biederman & Gerhardstein, 1993; Wu & Levine, 1993).

Cognitive research has revealed that familiarity with object size and effective interaction can significantly influence the depiction of object size (Eysenck & Keane, 2015). Size depiction is crucial in object identification as it is cognitively stored and can be reproduced independently of visual stimulation (Haber & Levin, 2001; Bolles & Bailey, 1956). Moreover, perceived environmental visual cues related to size are essential for accurate size depiction, particularly when there are variations in sensory cues (Haber & Levin, 2001). Considering these cognitive findings, the study modified the seven parametric geons by creating a diverse range of objects in 2D, 3D, and 3D-like organic shapes for stimulus development. Additionally, the study generated multiple sizes of tokens representing the 3D parametric geons. This decision aligns with the understanding that size is a fundamental criterion for classifying objects in our world and a key aspect of perceiving and understanding them (Bolles & Bailey, 1956: 225). As a result, tokens of different sizes were created for the cuboid and ellipsoid. To introduce variety, some objects such as the cylinder and pyramid were duplicated in a hollow form.

Using a diverse set of object stimuli, the study aimed to identify how participants depicted different token objects based on their appearance, encompassing size and shape variations. For a comprehensive view of the complete set of twenty-two haptic task objects developed for the study, please see Appendix E.

Personal Narrative: Animal Encounter

The data collection method employed in this study involved capturing personal narratives from participants. Specifically, participants were asked to spontaneously narrate their encounters with animal attacks or exciting animal encounters. This genre of storytelling was selected for several reasons. Firstly, it was considered a neutral topic that did not raise any ethical concerns associated with the narration process. Secondly, this genre allowed participants to emotionally engage with the story they were recounting, thereby minimising the potential influence of the observer's paradox.

By focusing on personal narratives, the study aimed to capture individual experiences within a culture-specific context, using the participant's own language. This approach facilitated a deeper understanding of how SASS were employed within the participant's linguistic and cultural framework.

During the narration of these personal stories, an addressee, who was present during the storytelling session, had the opportunity to interrupt and ask critical questions. These questions were designed to prompt participants to use SASS while describing the encountered animal or the incident. By incorporating these interruptions and inquiries, the study aimed to elicit more detailed and precise descriptions of the animals involved, enhancing the richness and accuracy of the collected data.

4.2.2 Data Collection Procedures

The results of this study were primarily based on primary data collected during fieldwork conducted over a period of six months, from September to December in 2018, with subsequent follow-up studies conducted in the following years. Approximately ten hours[97] of confirmed data were obtained from both signers and gesturers. Before the fieldwork visitation, a pilot testing of the method and

[97] Animal Encounter videos = 3 hours 36min (107.2 min for signers & 94.27 min for gesturers)
Haptic Task videos = 6 hours 22min (172.28 min for signers & 201.2 min for gesturers)

associated instruments was conducted with volunteers in Leiden, Holland. The pilot testing validated the adequacy of the instruments for eliciting SASS.

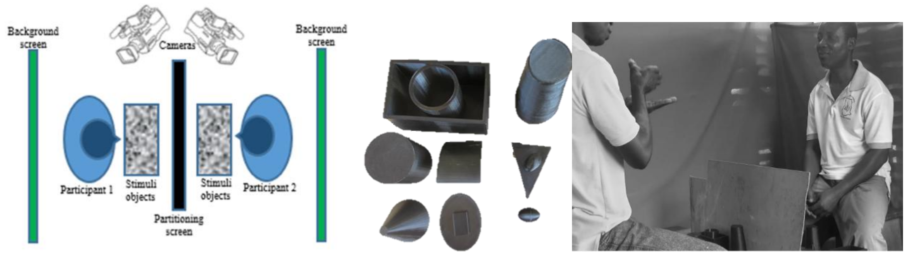
Data collection was carried out separately for deaf participants and gesturers, with data collection from the deaf participants preceding the engagement of gesturers. The timeframe for each task varied among participants, as none of the tasks were time-bound. The sequence of data collection, however, was based on availability. Before the elicitation tasks began, selected participants were introduced to the study and provided with research information forms and informed consent forms. Sufficient time was given to participants to read the documents, ask questions for clarity, and provide their informed consent by endorsing the consent form with their signature. The endorsed consent forms were collected, while the research information forms were left with the participants for reference.

The consent session was followed by a survey on participants' demographic background information, which was conducted using questionnaires. Two questionnaires were designed for demographic information collection, one for the signers and the other for gesturers. The questions focused on personal information, family, education, and occupation. The main difference between the questionnaires was the inclusion of questions about language acquisition in the personal information section. Participants had the option to fill out the questionnaires themselves or request assistance. Some participants preferred an interview-style approach, where they could articulate their responses through speech or sign language, while my research assistants aided in data collection. During these situations, I carefully observed the interaction. Research assistants received training from me prior to their engagement with participants. Where hearing participants were involved, I collected the demographic information myself and acted as an interlocutor.

After collecting consent and demographic information from participants on the first day, the remaining elicitation tasks took place randomly. The selection of the next task was generally based on the setting and availability of participants throughout the day. Some participants completed all tasks in one day, while others required multiple sessions due to other appointments or fatigue. Additionally, tasks that required participants to be paired served as a control for determining the order of tasks, as they could only be undertaken when two participants were available. Pairing was based on participants' familiarity with each other, such as siblings or couples. Participants often suggested and came with their preferred co-partner to participate in the study. Matching tasks specifically required all participants to be paired.

Before each task, participants received a brief explanation, intermittently provided before the task began with the recording. Video recordings played a crucial role in this sign language and gesture study, as they allowed for the systematic study of visual modality in communication. During fieldwork, I used two HD cameras, a laptop, a writing notepad, and two 2TB hard drives for data backup. One camera was used to record all the data elicitation tasks, while during the matching task, two cameras were involved to capture focused footage of each participant during the interaction.

In the 3D matching task, paired participants engaged in a spatial interaction experiment where one participant instructed the other to arrange a set of objects in a particular pattern. The task acquired the name "matching task" due to the activity of creating an identical pattern with the 3D objects. Figure 44 below illustrates a pattern object and interaction phrase used in the 3D matching task.



Blueprint of setup Stimuli objects Sample of actual setup

Figure 44: Matching task setting

While efforts were made to ensure ideal conditions, some challenges were encountered during the tasks. For instance, the seating arrangements were not always perfect since the tasks were not conducted in a prearranged laboratory room. In some cases, participants stood instead of sitting, and the green background screen used to cover the entire background of the signers was not always fixed correctly. The open space nature of the venue made it difficult to find a secure clutch for the screen, and some participants expressed discomfort when attempts were made to fix it. To alleviate their discomfort, the background screen was occasionally ignored.

Participants instructed each other to arrange objects in a specific pattern for the matching task. The task was introduced as a competitive game to encourage teamwork and engagement. The participants were seated and ready at the prescribed location for the task, and the objects were arranged in front of the lead participant to prevent them from seeing the pattern beforehand.

The personal narrative task focused on participants recounting a personal story of an animal attack, particularly a snake story. If participants had difficulty recalling a story, the addressee would inquire if they knew a similar story involving a friend or neighbour. The addressee could also share their own animal attack story to inspire participants. Key questions were introduced during the narration to incite the use of SASS, such as asking about the animal's size.

In conclusion, the data collection procedures employed encompassed a range of techniques and tasks that complemented each other to elicit and capture the desired information effectively. Dialogue and monologue tasks provided diverse opportunities for participants to express themselves and showcase their language abilities. The tasks were designed to stimulate natural language production and encourage detailed communication. Video recordings were invaluable in reviewing and validating the transcriptions, enhancing the overall data quality. By employing these data collection procedures, this study sought to capture a rich and nuanced understanding of the participants' use of languages.

4.2.3 Transcription and Annotation

In this section, I discuss the process of transcribing and annotating the data collected for this study. As mentioned earlier, most of the data was in video format, which required translation and annotation using ELAN software (source: http://tla.mpi.nl/tools/tla-tools/elan/). ELAN (multimedia linguistic annotation software) was developed at the Max Planck Institute for Psycholinguistics in the Netherlands and is widely recognised in sign language research.

ELAN proved to be a suitable tool for analysing signed languages, spoken languages, and gesture data, making it an ideal choice for this study. The video data was translated and annotated using ELAN, allowing for detailed analysis and identification of all the SASS present in the data. See Figure 45 below, which provides a screenshot of the annotation process with ELAN software. The annotations included coding for various features, such as gloss, handedness, handshape, handshape change, location, size, shape, iconic movement, movement direction, movement shape, repeated movement, mouth movements, eye gaze, and oral words.

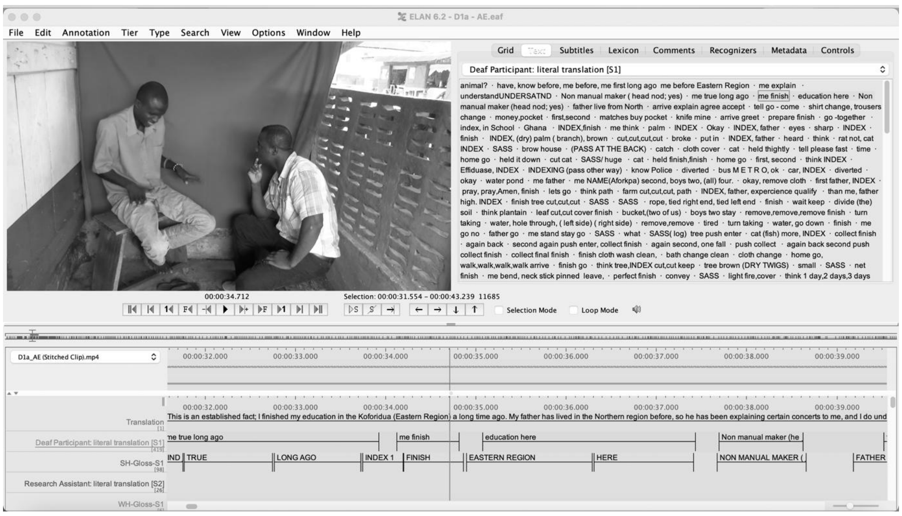


Figure 45: Screenshot of annotation done with ELAN.

When identifying SASS, the focus was on productive rather than lexical signs. However, iconic lexical signs depicting size and shape were coded separately but not considered SASS. Productive signs conveying size and/or shape through movement were considered SASS for coding. For size depiction, two definable points (one point potentially being a natural boundary) were used to indicate measurement. Size could be denoted in space or on the body, with different categories assigned to each (see Table 23 below). Similarly, handshapes were coded to represent an entity, handling an object, tracing an object, or the hand without handling an object.

Table 23: Sample of coding used for SASS annotation.
Sample of coding used for SASS annotation.

	CODING FOR SIZE: SPACE-BASED
S2	Size is denoted with two hands
SI	Size is denoted hand internal
SG	Size is denoted with hand and ground
SB	Size is denoted with hand and body
	CODING FOR SIZE: BODY-BASED
BS	Size is denoted with two hands
B1	Size is denoted hand internal
BN	Size is denoted with one hand and an inherent delimitation
NS	No size denotation
	CODING FOR SHAPE
E	Hand denote entity
H	Hand denote Handling
T	Hand denote tracing
N	Hand denotes non-handling

While a large collection of the Akan speech was also transcribed, the presence of environmental noise hindered the use of automated speech recognition software for transcription. Due to time restrictions, only a minor part of the Akan dataset could be transcribed. However, this limitation did not affect the identification and annotation of all the gestures depicting size and shape. Transcribing the Akan data involved the collaboration of Miracle Oppong Peprah[98], and the glosses for GSL were done in collaboration with my deaf assistant, Alexander Okyere.

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[98] A native speaker of Akan and a graduate student at the University of Ghana, Department of Linguistics, at the time of the study.

In summary, the transcription and annotation process involved the use of ELAN software for translating and annotating the video data. The coding system for SASS annotation allowed for detailed analysis of various linguistic features. Despite the challenges in transcribing the Akan speech, the identification and annotation of gestures representing size and shape were successfully accomplished. The collaboration with domain experts and research assistants contributed to the accuracy and quality of the transcriptions and annotations.

4.3 Comparison of Size and Shape Gestures and SASS Productions

In this findings section, I analyse size and shape gestures and signs in two distinct tasks: the animal encounter and haptic tasks. By examining the data, I explore how these expressive forms are used by gesturers and signers and the relationship between them. The results reveal that both groups employed comparable strategies for size and shape within their linguistic repertoire, with signers exhibiting more consistent parameters than gesturers. Disparities emerged in the frequency and distribution of these gestures and signs, as gesturers used fewer gestures for size and shape compared to signers. Subsequent subsections reveal the frequency and structure of size and shape gestures, as well as SASS usage among the participants during the animal encounter and haptic tasks.

As shown in Table 24, the number of size and shape gestures and SASS productions were compared between the animal encounter and haptic tasks. During the animal encounter, 79 size and shape gestures were identified from the 20 gesturers in 94 minutes of recording, while the 20 signers produced 285 SASS in 107.2 minutes. While, during the haptic task, 147 size and shape gestures were identified from the 20 gesturers within approximately 201.2 minutes of recording, and the signers produced 535 SASS in 172 minutes of recording.

Table 24: Summary of size and shape gestures and signs productions in animal encounter and haptic tasks.

Task	Size & Shape markers identified	Participants	Recording Duration(minutes)
Animal Encounter	79 gestures	20 Gesturers	94.27
	285 signs	20 Signers	107.2
Haptic Task	147 gestures	20 Gesturers	201.2
	535 signs	20 Signers	172

In the following subsections, I present a detailed exploration of the size and shape gestures and SASS data, categorising them based on their forms and the language users involved. By closely examining each aspect separately, I aim to unravel nuanced insights into these expressions' distinctive patterns and characteristics. Through this systematic approach, I seek to uncover the similarities of how gesturers and signers in the Ghanaian context use these communicative forms. Consequently, it offers a comparative understanding of their communicative strategies and preferences.

4.3.1 Signs and gestures for shape depiction

This section presents the signs and gestures in which the articulation depicts the shape (of a referent). Three main types of SASS are known to fall under this category. They are entity hand shape (Subsection 4.3.1.1), tracing (Subsection 4.3.1.2) and handling hand (Subsection 4.3.1.3). These shape depictions usually employ movement to depict the extension of the shape. In a situation where the movement was for other purposes, they are identified in the section. Movement may seem mandatory for tracing hands but not always for categories like entity hand shape. In the following, I describe the linguistic parameters of the data gathered under each categorisation.

Handshape depicts a non-hand entity: Entity Handshape

This type of SASS involves using hand(s) to represent the shape of an entity. The following subheadings provide the result of the various entity handshapes found in the data.

Sign: Entity Handshape Signs in the Animal Encounter Narrative and Haptic Task

Table 25 below reveals that the data from the animal encounter narrative comprised only seven entity SASS. These SASSes served as (non-hand) entity handshapes for various objects encountered during the narratives. One index finger was used in space to represent a rod (see Figure 46), while a double articulation of the index on the foreheads to depicted cow horns. Additionally, another double articulation of the index finger in space was employed to convey the presence of a chameleon (see Figure 47). Furthermore, the data included a double articulation of the bent index on the mouth, symbolising the teeth of a snake (see Figure 48), and a craw handshape placed on the mouth representing the teeth of a crocodile (see Figure 49). Moreover, a combination of the bent index and middle finger portrayed a fishing hook and a fist in space to describe an orange. Among the seven entities SASS identified, Figures 46 and 49 (out of the seven) incorporated movement, specifically to depict extension.

Table 25: Entity handshape signs in the animal encounter narrative with illustration of phonology and depicted referent.

Categorization of hand	Type	Loc.	Freq.	Depicted entity
1. Index finger 2. Double articulation of index 3. Double articulation of index		Space Space Forehead	3	Rod Chameleon Horns of a cow
4. Double articulation of bent index		Mouth	1	Teeth of a snake
5. A claw handshape		Mouth	1	Teeth of a crocodile
6. Bent index and middle finger		Space	1	Fishing hook
7. A fist		Space	1	Orange

Figure 46: Handshape for rod

Figure 47: Handshape for chameleon.

Figure 48: Handshape for snake's teeth

Figure 49: Handshape for crocodile teeth

In the context of the haptic task, a total of 69 tokens of entity handshape signs were elicited, using eight different handshapes, including fingertips (n=1), flat hand (n=1), fist (n=1), index (n=1), pyramid hand (n=2) and curved hand (n=2). Table 26 overviews these handshapes/signs and their corresponding frequencies and referents. Notably, 37 SASS tokens observed during the haptic task incorporated movements, each serving different functions.

The identified movements served various purposes within the haptic task. Some movements were employed to extend the shape (e.g., as seen in Figure 50A), while others were used for focus marking (e.g., as depicted in Figure 50B). Additionally, certain movements indicated a change in shape (e.g., exemplified in Figure 50C); in other instances, they were used to delimit the upper limb (as illustrated in Figure 50D).

In Figure 50D, the entity hand shape adopts an articulated fist  in the non-dominant hand, while the dominant hand  employs a straight trajectory movement to delimit the boundaries of the entity handshape on the arm, specifically at the apex and base of the fist. It is important to note that the movement observed in this particular SASS does not involve the extension of the entity hands; rather, it focuses on delimiting the boundaries of the shape. Additionally, this movement can also be interpreted as indicating the boundaries for size.

A (curved cylinder) B (Small elipsoid) C (Tapered cylinder)

D (Cylinder)

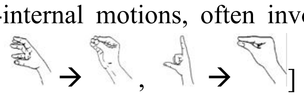
E

F

Figure 50: The different movements associated with entity handshape in the haptic task.

An intriguing observation in the data pertained to the representation of 2-dimensional flat objects, such as squares, triangles and elipsoids, which were represented using the flat hand []. The entity handshape, in context exhibited various forms, including static positioning in space (n=1) and slight straight trajectory motion either in space (n=1) or on the palm (n=4). Notably, when articulating the flat hand on the palm for 2-dimensional objects, participants employed a rub motion and a slap motion. Figure 50E and Figure 50F illustrate the slap motion, where the signers articulated the sign with a downward directional movement from space onto the palm.

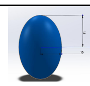
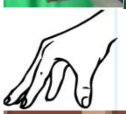
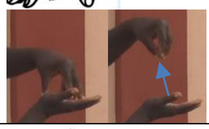
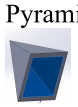
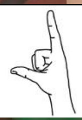
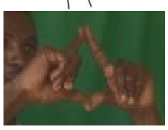
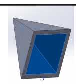
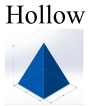
This change in hand shape indicated that the referent possessed a pointed apex at another end-point, which could also signify different sizes at the end-point. Figure 50C provides an illustration of this concept, showing the changes in hand shape for referents such as tapered cylinders, pyramids, hollow pyramids, and 2-dimensional triangles.

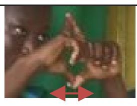
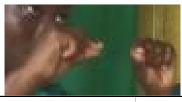
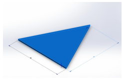
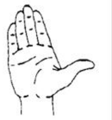
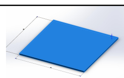
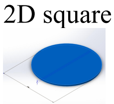
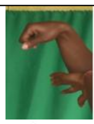
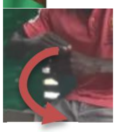
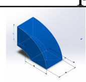
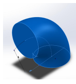
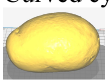
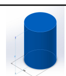
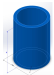
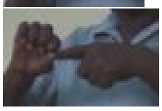
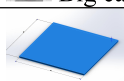
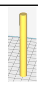
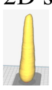
Furthermore, Figure 50B illustrate a brief right and left directional movement with the bundle fingertips . Although this movement may seem inconsequential, different signers consistently used it to mark focus on the SASS employed. Another distinct movement identified in the data involved a change in shape. This movement predominantly entailed hand-internal motions, often involving a reduction in the aperture within the hand [i.e., ] or a change in handshape.

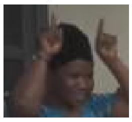
This change in hand shape indicated that the referent possessed a pointed apex at another end-point, which could also signify different sizes at the end-point. Figure 50C provides an illustration of this concept, showing the changes in hand shape [i.e.,  → ,  → ] for referents such as tapered cylinders, pyramids, hollow pyramids, and 2-dimensional triangles as found in the haptic task.

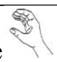
Among the 69 tokens of signs analysed, it was observed that 32 of them did not involve any movements. These static signs were assumed to represent the referents iconically in an adequate manner, thereby eliminating the need for movement to convey aspects like extension, delimitation, or changes in shape during their production.

Table 26: Entity handshape signs in the haptic task with illustration of phonology and depicted referent.

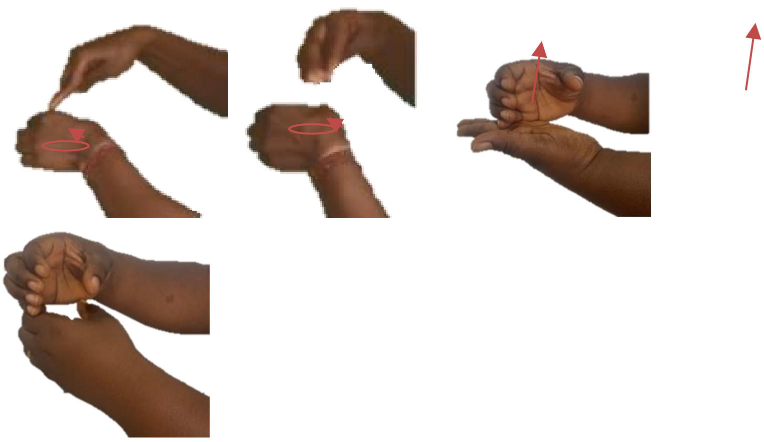
Categorization of hand	**Type**	**Loc.**	**Freq.**	**Depicted entity**
1. Fingertips		Space	2	 Small elipsoid
2. 1-hand Pyramid Handshape	   	Space & Head	12	 Tapered cylinder  Pyramid  Hollow pyramid
3. 2-hands Pyramid Handshape	 	Space	15	 Hollow pyramid  Pyramid  Tapered cylinder

	 			 2D Triangle
4. Flat hand		Space	6	 2D square  2D Elipsoid
5. Curved hands	     	Space	10	 Curved cuboid  Curved cylinder  Big Potato
6. Fist	 	Space	14	 Cylinder  Hollow cylinder  Tapered cylinder  Big carrot
7. Index Finger	 	Space Head	10	 2D square  Rod  Small carrot

One particular hand shape  not included in the table above (Table 26), exhibited a dynamic and multifaceted role. This particular hand shape  exhibits the potential for analysis as an entity hand, representing internal hand size and potentially for handling handshape. However, in the context of this specific situation (i.e., haptic task) and the manner in which the sign was articulated, the option of a handling hand is not considered. Below, examples of these hand shapes are provided to illustrate their complexities further. Among this particular SASS, two signs (Figure 51C & D) incorporated an upward movement that could be considered an entity extension. Conversely, three other signs (Figure 51A, B & F) demonstrated the movement of the non-entity hand [ & ] moving in a circular trajectory on the apex of the entity handshape. In Figure 51A and Figure 51B, the circular movement of the dominant hand likely indicated that the referent is circular. In contrast, in Figure 51F, the movement emphasised both the circular shape and hollowness, as indicated by the small insertion of the fingertip into the aperture of the entity's handshape.

A similar kind of insertion also occurred in the data; this time, the non-entity hand was the bundle of four fingers  without a circular movement (see Figure 51E). This articulation in 4.8E also depicts that the referent is hollow. In the dataset, signs using this hand shape  to refer to the hollow cylinder were observed in entries 6A (n=2), 6B (n=4), 6C (n=1), 6D (n=1), 6E (n=1) and 6F (n=1). On the other hand, the solid cylinder in the haptic task was also represented using this hand shape in entries 6B (n=4), 6C (n=5) and 6D (n=1). Notably, in Figure 51, the entity handshape  already exhibits some hollowness explaining its representation of the hollow cylinder without the need to emphasise its hollowness (see Figure 51E and Figure 51F).



A B C D

E F

Figure 51: Entity handshape for cylindrical entity

It is essential to acknowledge that signers did not consistently employ SASS for all objects in the haptic task. In certain instances, they associated the objects with real-life entities in the surrounding environment. For example, a hollow cylindrical object was likened to a telescope, while a spherical object was referred to as a handball.

One unusual situation was noted during the haptic task with a signer. The signer laughed and expressed shyness while using her body, particularly her head, in conjunction with her hand to represent an entity for a specific referent (tapered cylinder). This sign can be found in Figure 52B below, and it was articulated following Figure 52A, which was articulated with two hands. Both signs (Figure 52A & B) perfectly depicted the tapered cylinder  iconically. It is probable that the signer became self-aware after signing Figure 52B and realised that the embodiment used was not conventional. However, this realisation did not deter her from using the sign, as she repeated it multiple times to another deaf interlocutor.

A B

Figure 52: The entity handshape for the tapered cylinder

Gesture: Entity Handshape Gestures in the Animal Encounter Narrative and Haptic Task

Under the narrative of the animal encounter, a total of six gesture tokens were observed, employing three distinct entity handshapes. One of the entity handshapes was a curved, non-spread four fingers handshape [], used iconically to refer to a snake (Figure 53). The second entity, hand shape, involved the use of the fingers (i.e., index and middle finger) to represent a snake (Figure 54). Lastly, a fist [] was used as the third handshape to depict circular referents (Figure 55). Notably, in Figure 55A, the hand shape  was articulated on a nearby wall without any movement, symbolising an ant nest. Conversely, in Figure 55B, the same handshape was employed to signify a mouse.

In the animal encounter narrative context, only one gesture token used an entity handshape with movement. However, this movement did not indicate an extension of the shape; instead, it was employed to mark the boundary of the shape on the upper limb. Specifically, the entity handshape in this instance was a fist with flexion and wrist extension (see Figure 55B). The gesturers use of the upper limb to depict size and shape was a common practice. The flexion and extension of the wrist served to delimit the size and shape of the referent, focusing on the hand as the key articulator. To further clarify this boundary, the gesturer quickly followed up with another gesture, using the other hand to physically hold the wrist, thereby reinforcing the delineation of the shape's boundary.

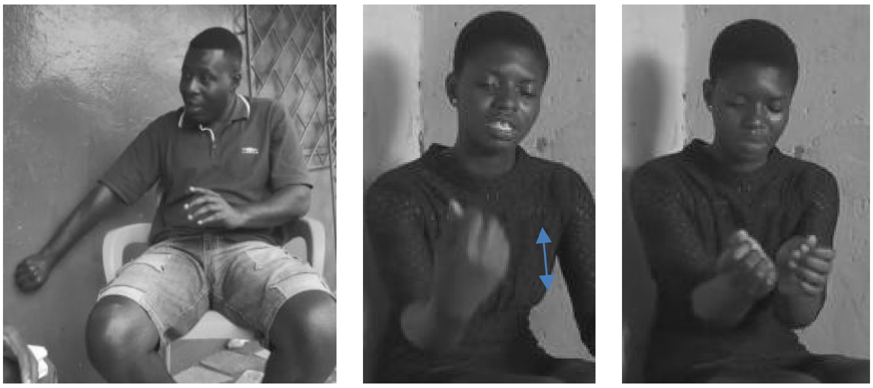
Regarding the size of the referent with an entity handshape, it was noted that they sometimes occurred without any movement. For instance, in Figure 55B, the movement signified the inherent delimiting points, with a flexion and extension movement of the wrist emphasising only the fist as the gesture representing the size of a mouse. In addition, within the sentence, the co-speech gesture (Figure 55B) was used, and the gesturer followed up with a gripping hand to delimit one boundary (the wrist) of the inherent points on the fist. As described in Subsection 4.3.2.2.3, this gripping hand gesture provided further clarity to the interlocutor when the movement alone may not have sufficiently defined the boundary.

Moreover, it was observed that the boundary of the referent could also be inherently present without any movement. For instance, in Figure 54, the gesture (handshape) was formed with the index and middle fingers  . In these gestures, without explicitly indicating the boundaries, it was inferred that the diameter between the extension of the index and middle finger was the marker of the snake's size and shape. Additionally, in Figure 55C, the gesturer conveyed a larger snake by joining the wrists of both hands, indicating that the snake's size and shape were equivalent to the diameter of both wrists joined together.

Figure 53: The use of the curved hand for entity handshape_ Snake's head

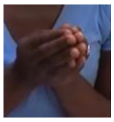
 or 

Figure 54: The use of the fingers for entity handshape_ snake



A: Ant nest B: Mouse C: Snake

Figure 55: The use of the fist for entity handshape

Five distinct entity handshapes were observed in the haptic task, producing approximately 47 gesture tokens. Notably, some of these handshapes exhibited different variants, which could be considered allophones. For instance, the fist handshape had two forms based on the thumb position:  and . Similarly, the four fingers extended handshape also displayed multiple variants: , , .Additionally, the curved bundle hands  had variations influenced by the size of the referent, as shown in Table 27. The Table 27) presents the entity handshapes that occurred during the haptic task among gesturers. Examples 4 (under Table 27) illustrate the usage of the four fingers extended handshape (, , ) with a straight part movement to represent 2-dimensional flat objects such as square, triangle and elipsoid. Notably, similar to the signers' gestures for 2-dimensional entities, these gestures also incorporated movement and were articulated on the palm, on a nearby surface, or in space. However, it is worth noting that, unlike gesturers, signers never articulated the sign on a nearby surface. The gesture was occasionally used as a stand-alone gesture or as part of a compound gesture.

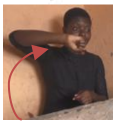
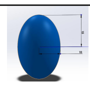
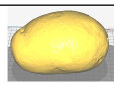
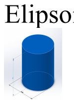
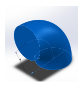
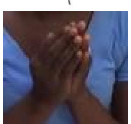
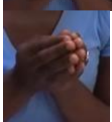
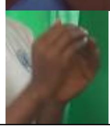
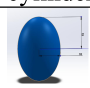
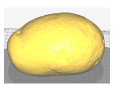
In Figure 56, an illustration is provided to demonstrate how gesturers used the 2-dimensional depiction gesture as a compound gesture. In Figure 56A, the gesturer traced the perimeter of the elipsoid with an index finger and then transitioned the handshape to a flat hand  with a slight path movement (see

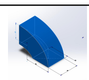
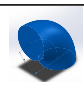
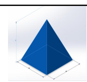
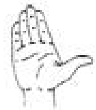
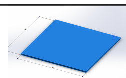
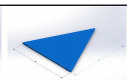
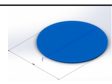
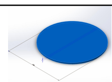
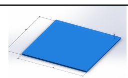
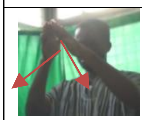
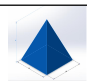
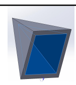
Figure 56A). This compound gesture effectively conveyed that the circular referent was a 2-dimensional flat object.

A B

Figure 56: Entity handshape with movement depicting BALL3.

Table 27: Entity handshape gesturers in the haptic task with illustration of phonology and depicted referent.

Categorization of hand	Type	Loc.	Freq.	Depicted entity
1. Fist	 	Space	11	  Big & medium Elipsoid; Big potato   Cylinder cylinder; Curved
2. Curved hands	   	Space	7	 Big & medium elipsoid  Medium potato

		Space	17	 Curved cuboid  Curved cylinder
3. 2-hands Pyramid Handshape		Space	2	 Pyramid
4. Flat hand	 	Head	2	 Tapered cylinder
		Table	2	 2D square  2D Triangle
		Space	2	 **2D** Elipsoid
		Palm	2	 **2D** Elipsoid  2D square
		Space	2	 Pyramid  Hollow pyramid

During the haptic task, all the observed movement exhibited by gesturers was employed to indicate an extension of the shape. In example 2 (under Table 27 section for Curved hands), the handshape  predominantly used movement to depict the extension of the referent. Out of 12 tokens of gestures involving the curved handshape , eight tokens were used to represent the curved cuboid, while for the curved cylinder, four out of the five tokens of gestures employed movement. Notably, two distinct types of directional movement were identified in the gesture articulation for these two entities (curved cuboid BOX3 and curved cylinder CLY3). The hands were either moved towards the plane of the fingertips (Figure 57A) or towards the plane of the ulnar side of the hand (Figure 57B).

Among the signs produced, eight (8) gestures used the ulnar plane for the curved cuboid, while two employed the same directional plane of movement for the curved cylinder. Signers also used these two directions of movement for the curved cuboid and curved cylinder.

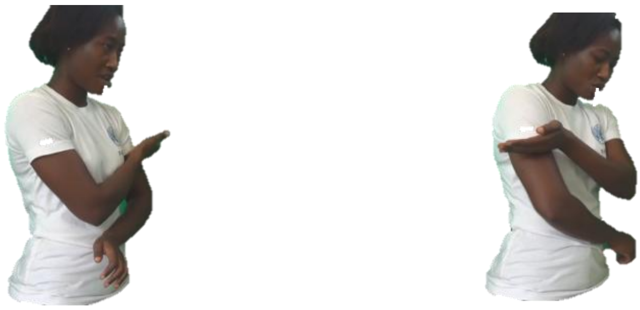
A B

Figure 57: Different directions of movement for both the curved cuboid and curved cylinder

In the haptic task, gesturers also demonstrated two (2) distinctive types of entity depiction for four tokens of gestures. This involved the use of the shoulder to depict an arc-like referent. In Figure 58 and Figure 59, the bent handshape  was employed to demarcate an outline the edge of the shoulder through ulnar plane movement, effectively indicating the shape of the entity. The movement of the hands over the perimeter of the shoulder served to draw attention to the shoulder's shape, resembling the intended referent. However, in Figure 60A and Figure 60B, no such outlining movement was observed; instead, the gesturer simply delimited the upper limb to mark the shoulder as the entity for the referent. Interestingly, in Akan, the gesturer noted to the interlocutor that the shape of the referent had been cut in a manner similar to her gestural depiction. Notably, the gesturer produced the gesture in Figure 60 after making a similar gesture with hand movement (in Figure 59) for the same referent within the same discourse. Furthermore, in Figure 60, the gesturer employed a dominant hand reversal to indicate the shape of the curved cylinder the curved cylinder.

Figure 58: Non-handling hand gesture for the curved cuboid with movement

Figure 59: Non-handling hand gesture for the curved cylinder with movement



A B

Figure 60: Non-handling hand gesture for the curved cylinder without movement

Not all the objects in the haptic tasks were depicted with gestures. In a co-speech gesture, gesturers sometimes mention something in the natural environment that shared similarities with the haptic task object's size and/or shape. For instance, when describing a large spherical object in the Akan language, a gesturer likened to a pawpaw, and for the smaller spherical object, it was compared to an orange in terms of size and shape. They employed other strategies like mentioning geometrical shapes or using literary devices like simile and metaphors to convey information about the entity.

An interesting observation is that none of the participants used numerical measurement values to describe the size or shape of any entity. Instead, they relied on visual comparisons and qualitative descriptors to express the attributes of the objects in question. This highlights the gesturers' preference for information through visual representations and gestures rather than numerical precision.

In the use of entity handshapes for depicting size and shape, both signers and gesturers have showcased a remarkable flexibility. They have illustrated that different segments of the entire upper limb, spanning from the shoulder down to various parts of the hand, can be effectively employed or delineated.

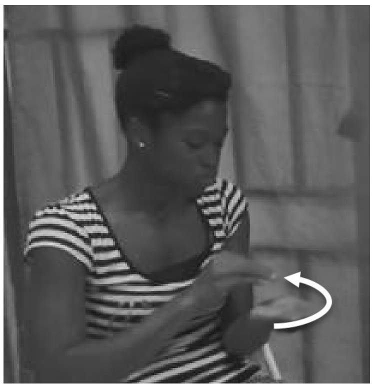
Tracing Handshape

This category of SASS involves using the hand(s) to trace the referent. The form of the trace usually varies yet is iconic to the shape of the referent.

Sign: Tracing Handshape Signs in the Animal Encounter Narrative and Haptic Task

In the animal encounter narrative, two tracing handshapes occurred for shape depiction producing four tokens of signs. All four tracing SASS had their location on the palm. Two of the signs used the index figure  for tracing the shape of a fishing float (see Figure 61A), and another traced a rubber ring used for playing a toss game. While the third tracing, SASS used the bundle fingers  to refer to the shape of a frog by making a circular trajectory movement around the palm (see Figure 61B). This sign used to indicate the shape of the frog was articulated as a compound after the size of the frog has been indicated in space with two hands.

A) Using the index finger

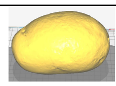
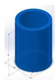
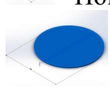
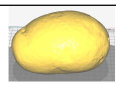
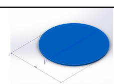
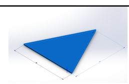
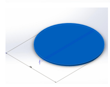


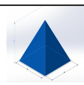
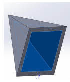
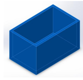
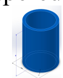
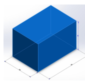
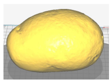
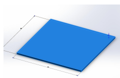
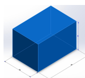
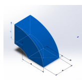
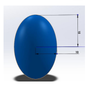
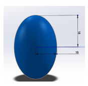
B) Using the bundle figures

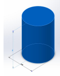
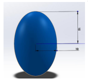
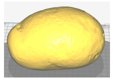
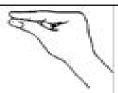
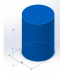
Figure 61: Illustrations of the tracing centred on the palm.

In the haptic task, two tracing handshapes (index finger & bundle fingers) in different variational forms were used for the SASS, occurring about 61 times in the dataset. The use of the index finger had the following variant , , ,  while the bundle fingers were , . In one instance, the index and middle finger  were used (for CLY1). Table 28 list the handshape and the objects. Several objects could either be traced on the palm or in space, with either the index figure or bundle fingers. The movements were all iconic in tracing the widest perimeter of the referent. For example, a circular object or an object with a circular perimeter would be articulated with a circular trajectory movement. The phonological location of the tracing was either on the palm or in space. It was observed not having any significant pattern or attribute of the object could account for the choice of tracing handshape or the location.

Table 28: Tracing handshapes signs in the haptic task with illustration of phonology and depicted referent.

Categorization of hand	**Type**	**Loc.**	**Freq.**	**Depicted entity**
Index Finger		Palm	13	 Small Potato  Tapered cylinder  Hollow cylinder  2D Elipsoid
		Space	2	 Small potato  2D Elipsoid
	 +	Space	34	 2D Triangle  2D Elipsoid

	 (2-handed)			 Pyramid  Hollow pyramid  Tapered cylinder   Hollow cuboid Hollow cylinder  Big cuboid  Big potato  Big & small carrot  2D square  Medium cuboid  Curved cuboid  Small elipsoid .
Fingertips		Palm	5	 Tapered cylinde  2D Elipsoid  Medium elipsoid

		Space	6	 Cylinder  Medium elipsoid  Small & Medium potato
		Space	1	 Cylinder

It appeared, however, that only entities whose size can fit within the palm had their tracing on the palm. In other words, a based hand was used as the location for these small entities. However, this did not mean smaller objects could not or were not traced in space. Signers used space to trace both smaller and bigger referents. Similarly, two hands were sometimes used to trace the perimeters of the entities. The movement was like a mirrored articulation with the same handshape; each hand traces the outside edge of the referent, as depicted in Figure 62. The index figure was only used for this type of mirrored tracing in the data. Some signers differentiated between 3-dimensional entities (e.g., BOXB1, BOX2, BALLB1) and 2-dimensional entities (e.g., BOX4, PYRA3 & BALL3) when indicating their shape through tracing. In the case of 3-dimensional entities, the distance between the hand and the body was consistently maintained during path movement or tracing in space to represent the horizontal and vertical sides of the entity (see Figure 62A). Conversely, for 2-dimensional entities, the direction of motion was towards the body when depicting the width or vertical side of the entity (see Figure 63). However, some signers who did not use the tracing direction to signify a 2-dimensional entity employed alternative strategies. For instance, they would affix the path for the shape sign with an entity handshape sign, as illustrated in Figure 62B.

A B

Figure 62: Tracing and hand entity for BOX4.

Figure 63: Tracing for BOX4.

A subtle kind of movement for extension of shape was also observed for all the triangular-like shaped entities. They are subtle because the movement is brief, and the whole arm is moved for the tracing as if the hand could also be considered an entity hand (see Figure 64A). In all the situations, the index finger was used, and they occurred one time for the 2D triangle, tapered cylinder and big carrot-like object.

A B

Figure 64: Subtle trace for tapered cylinder object[99]

Gesture: Tracing Handshape Gestures in the Animal Encounter Narrative and Haptic Task

With the gesture data, only one gesture was identified to trace the referent's shape during the narrative of the animal encounter. As illustrated in Figure 65, the gesturer used slightly flattened 2-handed spread fingers [] to outline the form of a pond in an arc trajectory movement in space.

[99] The addition of the sign in Figure 64B was rare for all triangular-like shaped entities that used the sign in Figure 64A.

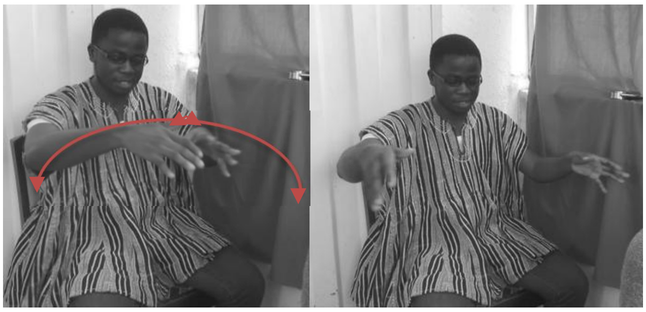


Figure 65: Tracing the outer edge of a pond.

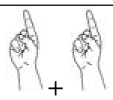
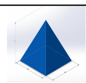
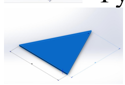
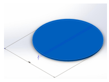
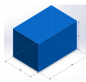
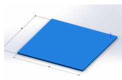
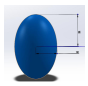
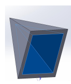
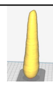
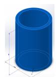
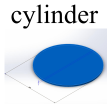
On the other hand, the haptic task produced several paths for shape. Twenty-one (21) paths for shape tracing gestures occurred in the data. Three main types of handshapes were used for the tracing. The first was the index figure with the following variant  ,  ,  . The second was the extended index and middle finger  . The third handshape gesture is closely related to the bundle finger handshape used by signers for tracing. It was a flattened finger with two variants;  (spread) and  (non-spread fingers). The index finger was the most frequently used handshape for tracing by gesturers. See Table 29 for the handshapes, frequency, and referent list.

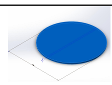
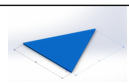
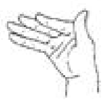
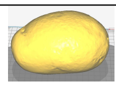
Tracing was mostly articulated in space; however, there were a few occasions in which it was produced with close proximation to the palm and sometimes on a nearby surface (table). But when the location was not in space, the index finger was not used. For example, in two instances, all four fingers were used in close approximation to the palm location to outline a spherical object (tapered cylinder & medium potato-like object). In another example, the gesturer used both the index and middle finger for tracing the shape of a triangular object on the table.

Some tracings were also 2-handed in mirrored articulation to outline the referent (see Figure 66). This type of mirrored articulation was used for triangular, spherical, and square referents. Figure 66 also illustrates an occasion where a gesturer laughed for consciously using her hands to describe the referent's shape. This was also an unusual situation in the gesture data.

Figure 66: Tracing BOX4 with 2-hands

Table 29: Tracing handshape gesturers in the haptic task with illustration of phonology and depicted referent.

Categorization of hand	Type	Loc.	Freq.	Depicted entity
1. Index finger	 + (2-handed)	Space	10	 Pyramid  2D Triangle  2D Elipsoid  Big cuboid  2D square  Medium elipsoid  Hollow pyramid
		Space	6	 Big & small carrot  Hollow cylinder  Tapered cylinder  2D Elipsoid

2. Two fingers (index & middle)		Space	1	 2D Elipsoid
		Table	1	 2D Triangle
3. Curved hand		Palm	1	 Tapered cylinder
		Palm	2	 Medium potato

It is crucial to highlight that, among signers and gesturers, the index finger stands out as one of the primary articulators for tracing. Nevertheless, a noteworthy distinction arises: while gestures may involve tracing on nearby surfaces, spatial environment or on palm, signers opt for tracing either in the neutral space or on the palm.

Handling hand: Hand = Hand

In this type of SASS, the hand represents the form of a hand. The hands are still considered the articulatory hands, manipulating or handling the referent to depict its shape.

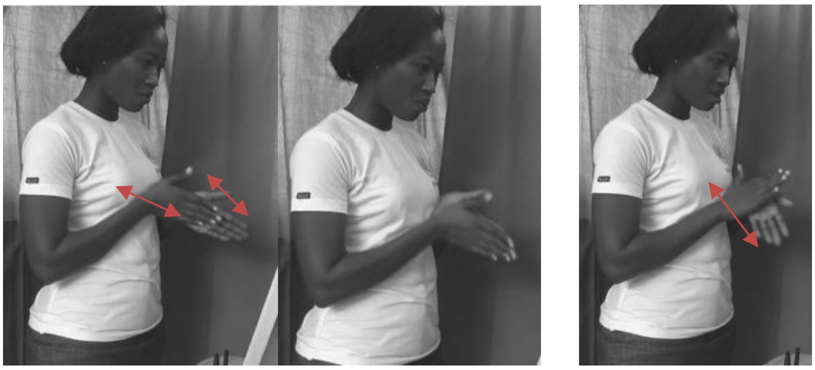
Sign: Handling Hand Signs in the Animal Encounter Narrative and Haptic Task

A single-handling hand SASS was observed in the animal encounter narrative, while none appeared in the haptic task. Figure 67 illustrates its use, where it was employed to represent the handle of a traditional push-walker used by children for fun. The sign was articulated in space, featuring a straight trajectory movement that depicted the extent of the referent (movement for extension).

Figure 67: Handling hand gesture for the control bar of a traditional push-walker[100].

Gesture: Handling Hand Gestures in the Animal Encounter Narrative and Haptic Task

No gesture for handling hands was produced in the narrative of the animal encounter. However, rubbing motions in 3 tokens (rod (n=1) & small potato-like object (n=2)) for handling hands were produced by two gesturers in the haptic task (see Figure 68). I believe the environment culturally influences this gesture. It considers some small spherical and cylindrical shaped local Ghanaian biscuits/snacks (e.g., Kuli kuli & Agbli krako; made with grated peanuts & cassava, respectively) are moulded with this kind of handling gesture during preparation. The gesturer using this gesture in co-speech quickly helped the interlocutor identify the referent to be something small, spherical, or cylindrical that can fit between both palms.



A **B**

Figure 68: Handling hand gesture for rod & small potato-like object

[100] The traditional push-walker, fondly known as a "car" by the children who use and craft it, is simply a long wooden cross with wheel carved out from flip-flops. The vertical part normally extends from the ground to the shoulder of the user, with smaller horizontal bars serving as steering wheels.

Summary of signs and gestures for shape depiction

This section explores the signs and gestures used to depict the shape of a referent. Three main types of size and shape markers fall under this category: Entity Handshape, Tracing Handshape, and Handling Hand. The following provides a breakdown of the comparison on signs and gestures for shape depiction gathered for each category.

Entity Handshape:

Entity handshapes serve as a means to represent the shapes of non-hand entities. This study observed the delimitation of upper limb components to convey shape. Predominantly, this delimitation involved segments of the hands, although variations were observed in how these segments were delimited. Signers and gesturers exhibited the ability to delimit: 1) solely the index finger and 2) both the index and middle finger. In addition, only signers were seen delimiting 3) the thumb and index, and 4) the tips of the fingers and thumb.

Another noteworthy distinction between signers and gesturers pertained to the extent of upper limb delimitation. While signers could delimit part of the forearm or the entire forearm, gesturers were observed delimiting the shoulder, a distinction not observed among signers. For visual representations of these delimitations of the upper limb, please see Figure 69 and Figure 70.

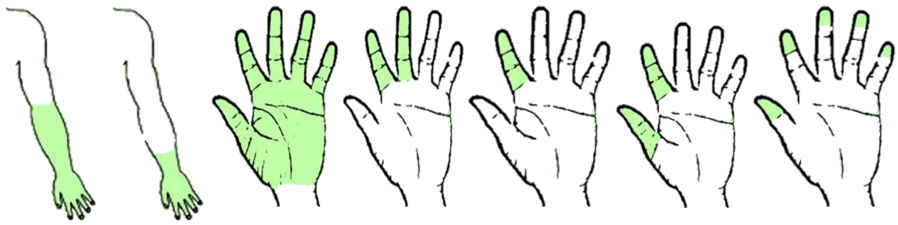


Figure 69: Delimitation of the upper limb by signers

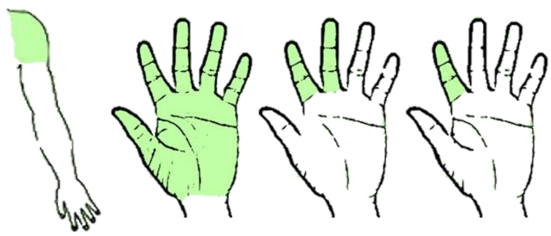


Figure 70: Delimitation of the upper limb by gesturers

Within both gestures and signs, movement played a vital role in conveying aspects such as extension, boundary delimitation, focus marking, and changes in shape. Nonetheless, some signs and gestures remained static in form. An intriguing contrast, however, was observed, as gestures displayed a greater degree of flexibility by using ad hoc locations for articulation. This included instances where gestures were articulated on nearby walls or tables, a departure from the relatively more constrained signing conventions.

Tracing Handshape:

Tracing handshapes involve using hand(s) to outline the shape of the referent. The act of tracing for shape was identified as a common practice among both signers and gesturers in the datasets. Within both datasets, we observed the use of three distinct handshapes for tracing purposes. In gestures, we observed (1) the whole fingers, (2) the index finger, or (3) the index finger in conjunction with the middle finger being employed for tracing (as depicted in Figure 71). In sign language, on the other hand, tracing typically involved the use of (1) the index finger, (2) the thumb in conjunction with the index finger, or (3) a bundle of fingers and the thumb (as illustrated in Figure 72).

Figure 71: Tracing handshapes by gesturers

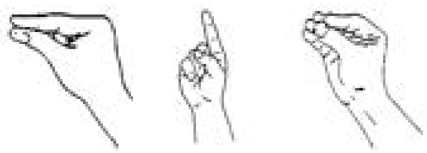


Figure 72: Tracing handshapes by signers

Notably, only the use of the index finger was found among signers and gesturers and was the most frequently used handshape. The way tracing movements were articulated demonstrated iconicity, with signers being able to differentiate between 2D and 3D entities based on the direction of their tracing movements. Signers and gesturers predominantly articulated their tracing movements in open space or on their palm. Additionally, gesturers were occasionally observed tracing on nearby surfaces, such as a table.

Handling Hand:

The handling hand SASS representing the form of a hand(s) manipulating or handling a referent to depict its shape had limited occurrence. A singular instance of a handling hand SASS involving two hands was identified in both the sign and gesture datasets. Despite variations in handshapes (a fist grip vs a flat hand) between the two datasets, it was evident that both were iconically inspired by the cultural context.

In summary, Subsection 4.3.1 explored the use of entity handshapes, tracing handshapes, and handling hand SASS in sign languages and gestures. Both signers and gesturers use various articulations to depict the shape of referents. Some similarities and differences were found within the handshapes, delimiting body parts and locations. The observed similarity suggests a connection, hinting at the shared cultural environment between signers and gesturers. While the observed differences can be attributed to the linguistic structure or the formalized system inherent in GSL. Notably, not all objects in the elicitation task for gesturers were depicted with gestures; they sometimes used visual comparisons and qualitative descriptors in Akan. The Subsection (4.3.1) also illustrated moments when signers and gesturers found amusement in using specific articulations to describe the shape of the referent.

4.3.2 Signs and gestures for size depiction

This category of SASS involves using articulators to indicate two referent points or apertures, which serves to convey the concept of size. The study revealed that creating two points to depict distance and size could be executed in relation to the body or the surrounding space. Consequently, the data is presented in these two subcategories; size depicted in space (Subsection 4.3.2.1) and size depicted on the body (Subsection 4.3.2.2).

Size depiction in space

In the realm of space, both signers and gesturers employ diverse strategies to depict size. This can be achieved by forming an aperture between the two hands or creating an internal aperture using the finger(s) and thumb. Additionally, size can be conveyed by indicating an aperture between the hand and the ground or, occasionally, between the hand and the body.

Distance delimited between two hands

Sign: Two Hands Space Signs in the Animal Encounter Narrative and Haptic Task

About 82 tokens of signs depicting size in space with two hands were identified in the animal encounter data. These signs involved two main handshapes: the index finger [e.g., , ] or all the fingers extended [e.g., , ]. It is worth noting that certain signs for expressing distance, represented by the aperture between two hands in GSL, have become lexicalised and can be found in GSL online dictionaries (e.g., by Mill Neck International[101] & by HANDS! Lab[102]) specifically for signs like BIG and SMALL.

Figure 73 illustrates some examples of lexicalised SASS signs for "BIG." However, it was observed that there were variations in handshape and movement used to convey the lexemes "big" or "small" in GSL. The size of the object being referred to often influenced the aperture's size and the movement used (e.g., as shown in Figure 73A or B), and sometimes these signs were repeated for emphasis. The handshapes are sometimes opened [], closed [] or bent [, ]. The thumb opposition could also vary [e.g., , ]. Some signers also preferred to use initialisation for the signs; in this case, they used the B-handshape []. When an L-handshape [] is used, it is considered as "large". However, in the GSL online dictionaries (by Mill Neck International & by HANDS! Lab), the sign with the L-handshape [] is translated as BIG or GREAT. One distinctive feature of the lexicalised BIG sign is that they all had their apertures aligned horizontally with their hands.

A B

Figure 73: Big

Out of the initial 82 tokens of signs after excluding suspected lexicalised SASS signs based on my knowledge of GSL as a user and information from secondary data such as online dictionaries, approximately 21 unlexicalised SASS signs remained. The selection of unlexicalised SASS signs was guided by the context of their usage and the nature of articulation. For instance, consider the SASS for a palm tree shown in Figure 74. Although the signer used the aperture between both hands to indicate size and employed movement to depict extent, the sign

[101] http://www.ayelefoundation.org/dictionary/

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

differed from what is found in GSL dictionaries, suggesting that it is not yet lexicalised, particularly regarding the function of movement for extent.

Among the 21 unlexicalised SASS signs, 9 used the index finger [ ,  & ] to represent distance delimited between two hands. As depicted in Figure 75, out of these nine signs, only one (Figure 75C) incorporated movement. Notably, the movement observed in Figure 75C was not a mere reduplication of the sign, as the aperture continued to increase with each motion. Instead, this movement indicated intensity, conveying the size or magnitude of the referent being discussed.

Figure 74: SASS for a palm tree

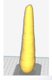
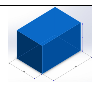
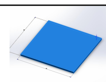
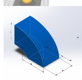
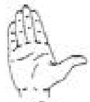
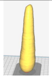
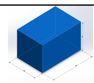
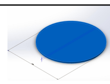
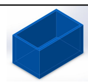
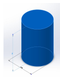
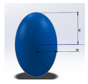
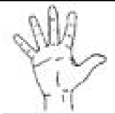
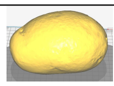
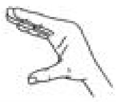
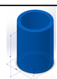
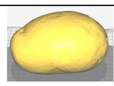
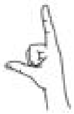
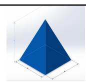
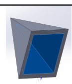
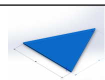
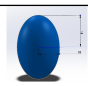
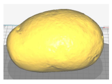
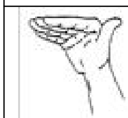
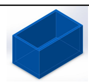
A: Chameleon B: Lion C: Snake

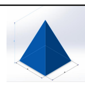
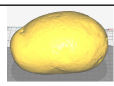
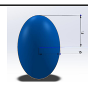
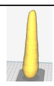
Figure 75: Distance delimited between two hands with the index finger.

In the haptic task, 81 tokens of signs occurred, delimiting the distance between the hands. Eight main types of handshapes were found among the tokens. See Table 30 for examples of the handshapes, their frequencies and referent.

Table 30: Two Hands Space Signs in the haptic task with illustration of phonology and depicted referent.

Categorization of hand	**Type**	**Freq.**	**Depicted entity**

Index finger		8	    Small Curved carrot Cuboid 2D square cuboid
Flat hand	  Four fingers nonspread	36	 Big carrot  Cuboid  2D Elipsoid  Hollow cuboid  Cylinder  Big elipsoid
	 Four fingers spread	1	 Big potato
C-Hand	 	2	 Hollow cylinder  Big potato
Pyramid Handshape		10	 Pyramid  Hollow pyramid  Tapered cylinder  2D. Triangle
Curved hand	 	11	 Big & Medium elipsoid  Medium potato
		3	 Hollow cuboid

Claw handshape		7	 Pyramid  Big potato  Medium elipsoid
		2	 Big carrot

Regarding movements, approximately 50 of the tokens analysed in the study incorporated some form of movement. Among these movements, 33 were driven by the shape of the referent, 8 were used to indicate the extension of the shape, and 5 served as focus markers. These movements added an iconic dimension to the articulation of the signs, further enhancing their visual representation. An exemplary illustration of iconic handshapes motivated by geometrical shapes can be observed in the static signs depicted in Figure 76. Each sign in this figure uses specific handshapes that closely resemble the geometric properties of the referent. For instance, in Figure 76A, the curved handshapes  mimic the circular sides of the spherical referent, while in 25D, the flat hands  are used to simulate the flat apex and base of a cylindrical referent. Similarly, Figure 77 and Figure 78 illustrate how the shape of the referent influences the 33 movements driven by the shape, further highlighting the iconicity of the signs.

A B C D

Medium ellipsoid Pyramid Big ellipsoid Cylinder

Figure 76: Examples of two-hand space signs to depict entities

Figure 77: Two hands space sign for the Medium ellipsoid or potato-like object

Figure 78: Two-hand space sign for the Big ellipsoid

Some handshapes employed for signs indicating the distance between the hands were subject to controversy during analysis, mainly due to internal apertures within the hands. This complexity is illustrated in Figure 79, where, in addition to the aperture (indicated by the line) between the two hands, each hand internally exhibits an aperture that could be interpreted as an internal size depiction. Interestingly, GSL includes a lexical sign for BOX, which involves an aperture within two hands (see Figure 79). During the haptic task, participants frequently used the lexical sign for BOX due to the involvement of various geometrical shapes. However, these signs were not classified as SASS in the data for this study.

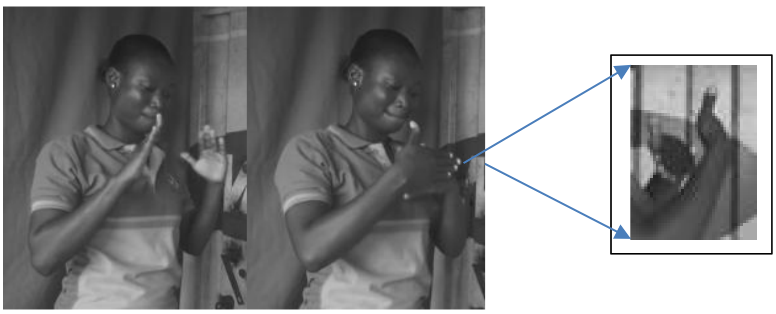
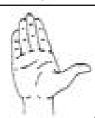
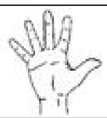


Figure 79: BOX

Gesture: Two Hands Space Gestures in the Animal Encounter Narrative and Haptic Task

Using both hands to denote size was the most frequently employed gesture to depict the size of various entities, occurring 21 times in the narrative on animal encounters. This expressive gesture was used to portray the size of different animals such as snakes (n=10), dogs (n=4), chickens (n=2), rodents (n=1), grasscutters (n=1), sheep (n=1), as well as inanimate entities like cassava (n=1) and a pond (n=1). The data revealed four main handshapes involved in these gestures, and their respective frequencies and referents are detailed in Table 31. Comparatively, some of the handshapes used by gesturers did not possess obvious iconic motivations, possibly because gesturers were not always consciously aware of their gestures, leading to variations such as using a fist handshape for both dogs and sheep.

Table 31: Two Hands Space gesture in the animal encounter narrative with illustration of phonology and depicted referent.

Categorization of hand	Type	Freq.	Depicted entity
Curved hand	 / 	9	Snake, chicken, dog, cassava & pond
Fist		3	Dog & sheep
flat hand	 / 	8	Snake, chicken, rodent & grasscutter
Index finger		1	Snake

It is also worth mentioning that except for two gestures with their apertures in their hands aligned vertically, all the other two-hand gestures depicting size in space were aligned horizontally (see Figure 80A). The two gestures with a vertical aperture were both bent hands (), with one depicting the size of a dog and the other a chicken (see Figure 80B). Out of the 21 two-hand gestures depicting size in space, three (3) gestures used movement to depict extent (see Figure 81A, Figure 81B & Figure 82).

A B

Figure 80: Gesture depicting the size of a chicken.

A **B**

Figure 81: Gesture depicting a snake with 2-hands.

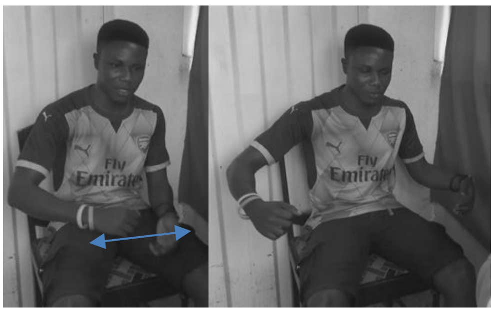


Figure 82: Gesture depicting the size of a dog.

Another movement was observed in the two-hand gesture depicting size in space data. This gesture used bent hands () to depict the size and shape (Figure 65, repeated here as Figure 83). I believe this time; the movement was not intended to express an extent in size but rather to indicate the shape of the referent.

Figure 83: Gesture depicting the size and shape of a pond.

Table 32 below summarises the two-hand gestures depicting size in space during the haptic task. About 44 token gestures were produced. In most cases, handshapes were also influenced by the shape of the referent. For example, 50% of the spherical referent tokens used a bent or C-handshape (e.g., , ). However, some spherical referents did not use the bent or C-handshape for depicting size; instead, they used a straight or flattened handshape (e.g., , ). It seems gesturers were just interested in using the aperture in the two hands to depict the size.

Regarding movement, 50% of the two-hand gestures depicting size in space did employ movement. The gesture associated with movement had 11 tokens for shape (see Figure 84), eight (8) movements for extent (see Figure 85), 2 for focus marking (see Figure 86) and one (1) movement for a change in size (see Figure 87). In Figure 84, the trajectory of the movements was semi-circular to depict the spherical nature of the referent. The hands' movement in Figure 85 widens the aperture between both hands to indicate the extent of the referent. Focus-making was also seen in Figure 86, where the gesturer kept repeating the gesture. In Figure 87, apart from the gesturer indicating the extent of the referent by moving the hands upward, she also reduces the aperture between both hands to show that the shape of the referent is narrowed at the apex.

We can also observe a handshape change in Figure 85B during the movement for extension (also in, e.g., 4 under Table 32). One could also consider the gesture initially an entity handshape, which applies movement for extension with a change in handshape from flat to curved [ ➔ ] to indicate that the referent is spherical.

A B

Figure 84: Movement to depict shape of BALLB2.

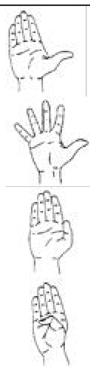
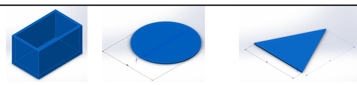
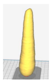
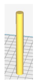
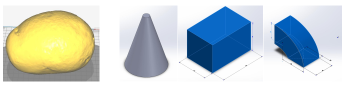
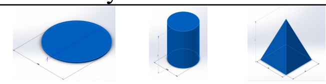
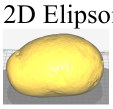
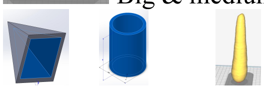
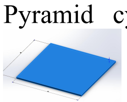
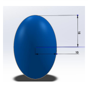
A: BALLB2 B. BALLM1

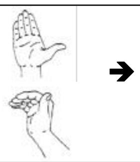
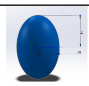
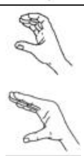
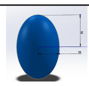
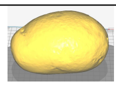
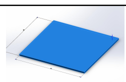
Figure 85: Movement to depict extent.

Figure 86: Movement to depict focus making for BALLB2.

Figure 87: Movement to depict the change in shape for the tapered cylinder.

Table 32: Two Hands Space gesture in the haptic task with illustration of phonology and depicted referent.

Categorization of hand	Type	Freq.	Depicted entity
1. Flat hand		**15**	 Hollow cuboid 2D Elipsoid 2D Triangle  Small carrot  Rod  Medium Potato Tapered cylinder Small cuboi Curved cuboid
2. Curved hand		**22**	 2D Elipsoid Cylinder Pyramid  Big & medium potato  Hollow Pyramid Hollow cylinder Big carrot  2D square  Big & Medium elipsoid

3. Flat → Curved hand		**1**	 Medium elipsoid
4. C- Hand		**5**	 Big elipsoid  Medium potato  Big carrot
5. Pyramid Handshape		**1**	 2D square

Distance delimited hand-internally

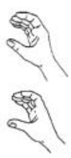
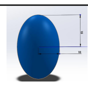
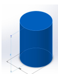
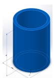
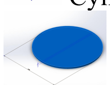
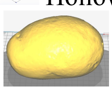
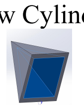
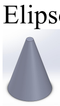
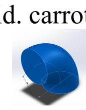
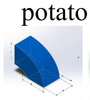
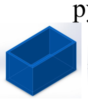
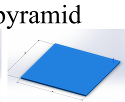
<u>Sign: One-Hand Space Signs in the Animal Encounter Narrative and Haptic Task</u>

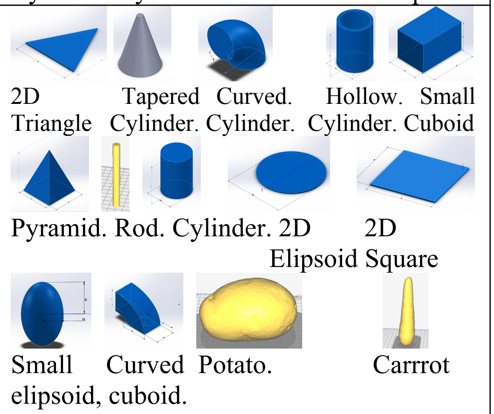
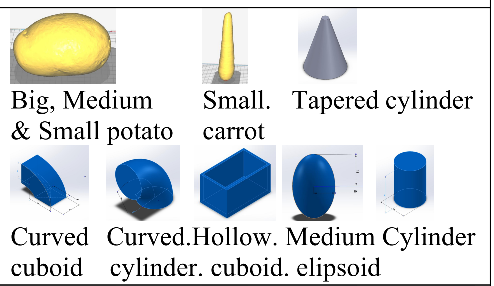
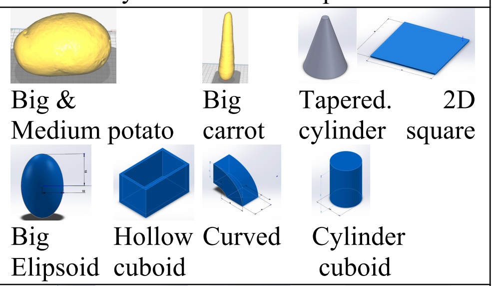
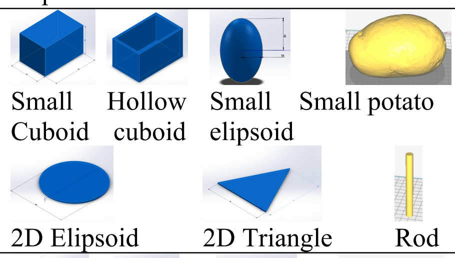
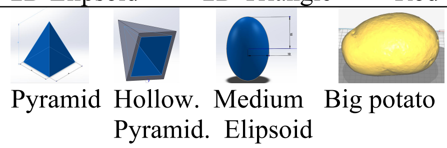
A total of 323 hand-internal signs, delimiting distance, were observed in the haptic task, making it the most frequently used type of SASS in the data. Table 33 provides an overview of the various handshapes and their respective frequencies. Among these signs, the curved hands with an aperture between the thumb and the four fingers  emerged as the most commonly employed handshape, accounting for 163 tokens. Within this set, six tokens raised suspicions of being a lexicalised sign for "CUP." Nevertheless, I classified them as SASS in the data due to slight parameter variations compared to the established lexicalised sign for "CUP" (Figure 88). For instance, while the lexicalised sign involves articulation from the mouth with a straight trajectory and a downward movement onto the palm, my six suspected SASS showed different movements, either from the palm into space (Figure 89A) or from space onto the palm (Figure 89B). These distinctions justified their categorisation as separate SASS in the analysis.

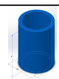
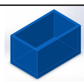
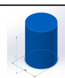
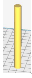
Figure 88: GSL sign for CUP.
A: http://www.ayelefoundation.org/dictionary/
B:https://play.google.com/store/apps/details?id=com.ljsharp.gsldictionary

Figure 89: SASS for hollow and solid cylinder object.

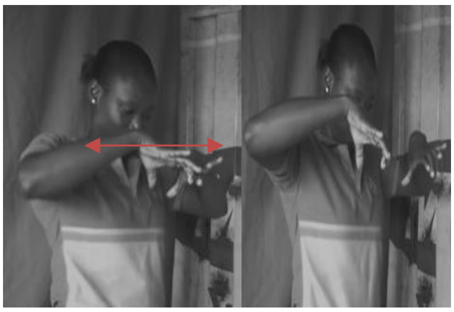
Table 33: One Hand Space Signs in the haptic task with illustration of phonology and depicted referent.

Categorization of hand	Type	Freq.	Depicted entity
C-Hand		163	 Big & medium ellipsoid.  Cylinder.  Hollow Cylinder     2D Elipsoid. Big. . carrot Medium potato Hollow. pyramid      Tapered. Curved. Curved.. Hollow 2D

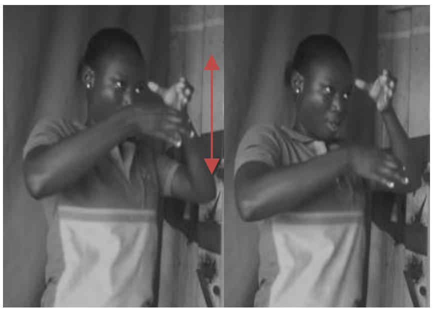
			Cylinder. Cylinder. Cuboid. cuboid square
Index and Thumb		69	 2D Triangle. Tapered Cylinder. Curved. Cylinder. Hollow. Cylinder. Small Cuboid. Pyramid. Rod. Cylinder. 2D Elipsoid. 2D Square. Small elipsoid, Curved cuboid. Potato. Carrrot
		16	 Big, Medium & Small potato. Small. carrot. Tapered cylinder. Curved cuboid. Curved. cylinder. Hollow. cuboid. Medium elipsoid. Cylinder
Four fingers and Thumb		32	 Big & Medium potato. Big carrot. Tapered. cylinder. 2D square. Big Elipsoid. Hollow cuboid. Curved cuboid. Cylinder
		27	 Small Cuboid. Hollow cuboid. Small elipsoid. Small potato. 2D Elipsoid. 2D Triangle. Rod
		13	 Pyramid. Hollow. Pyramid. Medium Elipsoid. Big potato

			 Tapered Cylinder.  Hollow Cylinder  Hollow cuboid  Cylinder
Middle finger and Thumb		1	 Rod

Within this category of SASS, a significant portion of the signs also incorporated movement. Specifically, around 279 of the SASS observed in the data used movement for various purposes. Among these movements, 105 were associated with depicting the extent or size of the shape (as illustrated in Figure 90), 88 were used to represent real-life movements of the referent, 59 were motivated by the shape of the referent (as shown in Figure 91), and 27 were employed to signify a change in the shape (as demonstrated in Figure 92). In the case of movements depicting a change in shape, this often involved either a change in handshape or an internal hand movement that reduced the aperture formed within the hand (e.g., Figure 92). The movements exhibited high iconicity, effectively conveying size or shape characteristics.



A: Hollow cuboid



B: Cylinder

C: 2D ellipsoid

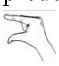
Figure 90: Movement for the extent of shape.


A: BOX3 B: BALLM1


C: BALLM1 D: BALL3

Figure 91: Movement for the shape.

Figure 92: Movement for a change in shape [tapered cylinder].

In animal encounters, 85 SASS were observed, specifically used to depict distance delimited hand-internally. The aperture employed to indicate size predominantly involved the area between the thumb and the index finger [e.g., , ] or between the thumb and the four fingers [e.g., , ]. However, it's worth noting that the aperture's size varied depending on the size of the described referent. Out of the 85 SASS tokens, 71 were observed with movement, while the remaining were static without any movement. The movements were primarily used to depict the extent of the referent's size (Figure 93A). In addition, I came across two instances where movement was used for focus marking, presumably to emphasise certain aspects of the size or shape (as illustrated in Figure 93B).

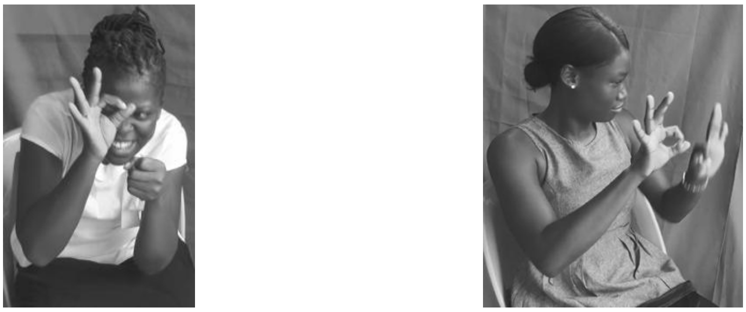
A B

Figure 93: Space Signs for Snake

The SASS in this category was primarily used to describe circular referents, such as snakes, rods, holes, horns, crocodile's tails, chameleons, and logs. However, there were a few exceptions where the referents were not elongated, including rats, fishes, dogs, and mice. Interestingly, approximately 90% of the signs with movement were specifically employed to depict the size of a snake. At the same time, entities without an elongated shape, like rats and mice, did not elicit the use of movement.

Within the data, four unique signs were captured, and they are presented below (Figure 94– Figure 96). Two of these signs stood out due to their unique handshape. In Figure 94A, the handshape  was articulated on the body, while in 4.47B, it was in space. Another example of size depicted on the body is in Figure 95, where the signer first articulated the sign on the body to localise the referent (see Figure 95A) and then in space for the interlocutor to view the size depicted with the hand clearly (see Figure 95B) and then in space to demonstrate the size depicted with the hand (Figure 95B).

The final unique sign, shown in Figure 96 (also presented as Figure 46 above), exemplifies a multifunctional SASS where two types of SASS (Entity handshape & distance delimited hand-internal) are combined in a single sign. In this instance, the dominant hand depicts the entity's shape with movement for extension. In contrast, the non-dominant hand simultaneously indicates the size of the referent with the aperture made between the thumb and index finger. This particular sign demonstrates the versatility and complexity of SASS in conveying information about both the shape and size of the entities being discussed.



A B

Figure 94: Size of a hole

A B

Figure 95: Size of a horn of a frog

Figure 96: Size of a rod

Gesture: One-Hand Space Gestures in the Animal Encounter Narrative and Haptic Task

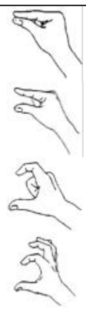
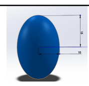
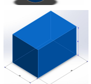
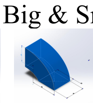
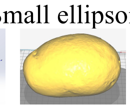
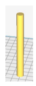
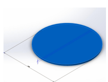
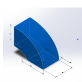
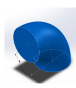
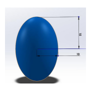
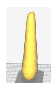
In the animal encounter narrative, only one gesture was elicited for hand-internal size depiction in space. This gesture featured an aperture between the thumb and the index finger  and, as depicted in Figure 97, involved movement to illustrate the extent of the referent.

Figure 97: Scorpion

Conversely, the haptic task yielded about 21 gestures for hand-internal size depiction in space. In this case, the aperture was primarily observed between the thumb and the four fingers, with occasional instances between the thumb and the index finger. Table 34 provides a summary of the different handshapes and their corresponding referents.

Interestingly, all but three gestures involved movement to depict the extent of the shape. These three exceptions were very brief in articulation, almost as if the gesturers were unaware of their hand movements while verbally describing the object. The use of movement in most gestures highlights their iconic nature, wherein the gesturers intuitively employed hand movements that conveyed the size and shape of the objects they were describing.

Table 34: One Hand Space gesture in the haptic task with illustration of phonology and depicted referent.

Categorization of hand	**Type**	**Freq.**	**Depicted entity**
Index and Thumb		10	 Big & Small ellipsoid  Small Cuboid  Curved cuboid  Medium & Small potato  Rod
Four fingers and Thumb		11	 2D  Curved.  Curved  Big  Big

			elipsoid. cuboid cylinder ellipsoid.carrot

Distance delimited between hand and ground

<u>Sign: Hand and Ground Space Signs in the Animal Encounter Narrative and Haptic Task.</u>

In the haptic task, no distance delimitation was observed between the hand and the ground. However, about 17 signs occurred for distance delimitation between the hand and the ground in the context of animal encounters. These signs were mainly articulated without the use of movement.

On some occasions (3 instances), signers were not entirely satisfied with the relative aperture and sought to clarify the delimitation in space by slightly moving their hands upward. It's important to note that this slight movement was not considered part of the SASS articulation. Three different handshapes were observed in these signs. The first handshape featured closed extended fingers  and was used for referents like dogs, goats, rabbits, lions, trees, and humans (n=14). The second handshape involved an opened extended finger  and was used to determine the size of the seal animal (n=1). The third handshape comprised a closed flattened finger  and was used for the size of a lion and a dog (n=2). In all these instances, the palms of the hands were oriented downward, except for one unique occurrence illustrated in Figure 98, where the palm orientation faced upward. The signer used this upward orientation when referring to the size of a cub.

A: Dog B: cub/young lion

Figure 98: Distance delimited between hand and ground by signers

Gesture: Hand and Ground Space Gestures in the Animal Encounter Narrative and Haptic Task

During the haptic task, no gestures were observed to depict size through distance delimitation between the hand and the ground. However, in the data from the animal encounter narrative, ten (10) gestures of this kind were recorded. These gestures were used to represent various referents, including a snake (n=1), dog (n=3), sheep (n=3), chicken (n=2), and monkey (n=1). All these gestures were articulated with extended fingers: Eight of them used closed fingers , while the remaining two involved opened fingers . Examples of these gestures can be seen in Figure 99, with Figure 99A showing the use of closed fingers for chickens and Figure 4.52B illustrating the use of open fingers for sheep.

A: Chicken B: sheep

Figure 99: Distance delimited between hand and ground by gesturers.

In all the gestures except one, the palm was facing downwards. The exception was the gesture depicting the size of a sheep (Figure 100), where the palm was oriented upward. Interestingly, the same gesturer who used an upward palm orientation for the size of the sheep also used a downward palm orientation for another size depiction within the same narrative.

Figure 100: Sheep

Another exceptional gesture depicted size through distance delimitation between the hand and the ground with a specific motion used to illustrate the length of a snake (Figure 101). This motion added an extra dimension to the gesture, effectively enhancing the snake's size.

Figure 101: Snake

Distance delimited between hand and body

Sign: Hand and Body Space Signs in the Animal Encounter Narrative and Haptic Task.

During the haptic task, only one SASS was observed where distance was delimited between the hand and the body. This SASS is illustrated in Figure 102, where the index finger and the thumb were used to hold the nose and then imaginarily pulled apart, creating an aperture between the hand and the nose to depict the extent.

Figure 102: Pointed apex of PYRA2.

On the other hand, in the animal encounter narrative, 14 SASS occurrences involved distance delimitation between the hand(s) and the head, torso, or leg (see Figure 103). Among these, five (5) tokens of SASS were focused on the mouth to refer to the snout of a crocodile and a catfish (e.g., Figure 103A), while two signs depicted the nose of a rhinoceros and a snake-like animal (e.g., Figure 104 & Figure 103B). Other variations included the entire face (for a seal animal and the head of a snake), the jaw (for a dog), the cheek (for the snake's head), and the whole head (for a lion's head).

Figure 105 represents an example of a lexicalised SASS with an aperture between the hand(s) and the head. The sign was commonly used to refer to animals like rats and birds, but signers also interpreted it to mean "fat," as found in the GSL dictionary (by Hands!Lab). However, this study did not consider it a SASS due to its lexicalised nature.

The articulation was iconic in form and used different handshapes (i.e., , , , , ,  , ). Except for one [] (see Figure 104), the entire handshapes were not necessarily iconic but functional for identifying the relevant part, imaginarily pulling it, or elongating it.

Figure 104 also illustrates an exceptional handshape that could be considered an entity hand for depicting the shape, with the aperture being made to indicate the size.

A: Snout of a crocodile B: Nose of a snake-like animal

C: Blotted body of snake/man D: Swollen legs

Figure 103: Various distance delimitations between the hand and the head

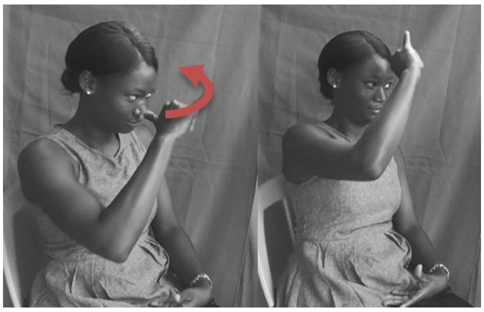


Figure 104: Rhinoceros' horn

Figure 105: Fat

In some instances, handshape changes were observed during the articulation of the signs. For example, while describing a seal animal with an aperture between the hands and the face, the initial handshape was opened with extended fingers  and ended with bent closed fingers  to depict the pointed face, and the aperture indicated the elongation of the face.

In most cases, the aperture between the hand and the head represents a relevant body part that is virtually held or touched. Then the distance was created to indicate its elongation. Some handshapes used for this purpose were not necessarily iconic but functional for identifying the relevant part and visually representing its elongation.

Gesture: Hand and Body Space Gestures in the Animal Encounter Narrative and Haptic Task

During the haptic task, gesturers produced no gestures falling under this category. However, during the animal encounter narrative, only one gesture was elicited, which involved using a two-handed fist articulated at the forehead region. This gesture, illustrated in Figure 106, depicts the size and shape of the horn of a wild sheep. The relative distance between the forehead and the hand conveyed the length of the horn, while the fist handshape  represented an entity handshape, symbolising the horn itself.

Figure 106: Horn of a bighorn sheep

Size depiction on the body

Within this category of SASS, three different types were identified: size denoted hand-internally (Subsection 4.3.2.2.1) and size depicted with two hands on the body (Subsection 4.3.2.2.2). Additionally, it was observed that one point could overtly be delimited with one hand, while the other point may be inherent (Subsection 4.3.2.2.3).

Size denoted hand-internally

Sign: Hand-internal Body-Based Signs in the Animal Encounter Narrative and Haptic Task

The haptic task data showed 15 instances of hand-internally SASS tokens. It was found that out of these 15 tokens, signers used 3 handshapes delimiting the hands internally. Table 10 presents the handshapes found in the data with their corresponding referents and frequencies.

Examples under the category of four fingers and index finger, as shown in Table 35: Hand-internal Body-Based Signs in the haptic task with illustration of the handshape and depicted referent., could potentially be considered as being lexicalised to connote the meaning "SMALL" in GSL.[103] However, I classified all of them as SASS since they did not appear to be fully conventionalised. Signers demonstrated variations of the same form to indicate the size as big or small for a given referent. They achieved this by demarcating various parts of the fingers to illustrate size. For instance, the distal interphalangeal part of the finger could be delimited by the thumb to refer to the size of a small entity (e.g., a small ellipsoid & a small potato-like object). On the other hand, the delimitation was done at the proximal interphalangeal part of the fingers for larger objects like medium ellipsoids. Generally, movement was not associated with this type of SASS. However, we did observe two occasions where the handshape was moved (see Figure 107). The movement found in Figure 107 was not iconic but rather served as a focus marking in these instances.

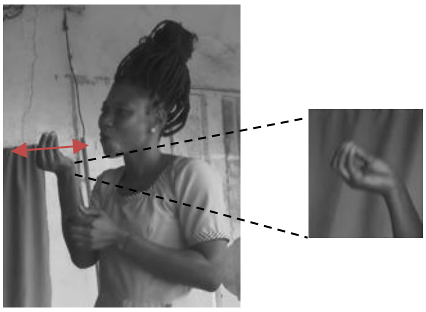
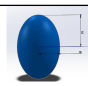
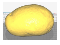
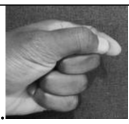
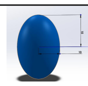
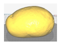
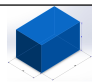
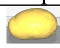


Figure 107: SASS for Small ellipsoid and small potato-like object under Hand-internal Body-Based Signs.

Table 35: Hand-internal Body-Based Signs in the haptic task with illustration of the handshape and depicted referent.

[103] Note: Example 2 can be found in the GSL dictionary by Hands!Lab.

Categorization of hand	Type	Freq.	Depicted entity
Four fingers	a. , b.  c. 	**8**	 Medium & Small ellipsoid  Small potato
Index finger	a. 	6	 Small ellipsoid  Small. potato  Small cuboid
Little finger	a 	1	 Small potato

Only two examples of hand-internal SASS were observed in the animal encounter narrative. These instances are illustrated in Figure 108 and Figure 109, where signers either demarcated the bundle of four (4) fingers or the thumb to indicate the size of the referent.

Figure 108: Mouse

Figure 109: Fishing hook

Gesture: Hand-internal Body-Based Gestures in the Animal Encounter Narrative and Haptic Task

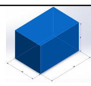
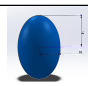
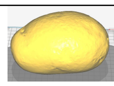
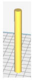
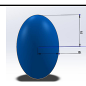
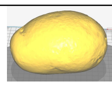
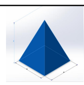
The hand-internal gesture, used to depict size on the body, occurred only two (2) times in the animal encounter narrative. These two gestures demonstrated two types of finger delimitation. One gesture involved delimiting the index finger (see Figure 110) to represent the size of a snake, while the other involved delimiting all four fingers (see Figure 111) to indicate the sizes of some small fishes. Notably, the hand-internal gesture in Figure 111 was produced during co-speech, specifically referring to the sizes of fishes in a particular pond witnessed by the participants. This observation raises the intriguing possibility of a potential relationship between the number of fingers delimited and the concept of plurality in gesturing. However, further data is needed to explore this idea fully in the context of Ghanaian gestures.

Figure 110: Snake

Figure 111: Fishers

In the haptic task data, the hand-internal gesture depicting the size on the body was observed nine times. These gestures exhibited three different handshapes. The most common involved using the thumb to delimit the bundle of four fingers at the distal interphalangeal region (e.g., for example, four fingers under Table 36). Additionally, other hand-internal gestures involved the delimitation at the distal interphalangeal region but with different fingers. For instance, in one gesture, the bundle of fingers delimited the thumb (e.g., example thumb under Table 36), while in another gesture, the thumb delimited the index finger (e.g., example index under Table 36). These variations in handshapes highlight the flexibility and adaptability of Ghanaian gestures in conveying different sizes and shapes.

Table 36: Hand-internal Body-Based gesture in the haptic task with illustration of the handshape and depicted referent.

Categorization of hand	Type	Freq.	Depicted entity
Four fingers	a. , b. , c. 	5	 Small Cuboid  Small ellipsoid  Small potato.  Small. carrot  Pointed apex of the pyramid  Rod
Thumb	a. 	2	 Small ellipsoid  Small potato
Index	a. , b. 	2	  Pointed apex of the pyramid & tapered cuboid

Size denoted with two hands on the body

Sign: Two Hands Body-Based Signs in the Animal Encounter Narrative and Haptic Task

During the haptic task, no SASS were found that denoted size with two hands on the body. However, three tokens of such SASS occurred in the animal encounter narrative. These signs were produced by two signers and were all articulated on the legs (see Figure 112). The handshapes used in these signs were the flat hands 

in two instances and the index finger  in one instance. Notably, no movement was observed in these SASS, indicating that the size was conveyed solely through the handshapes and their placement on the body.

A B

Figure 112: Snake

Gesture: Two Hands Body-Based Gestures in the Animal Encounter Narrative and Haptic Task

In the gestures section, we also observed that no gestures were produced during the haptic task. However, one gesturer made two gestures during the animal encounter narrative to denote the size of a snake in relation to the thigh. As illustrated in Figure 113, the gesturer used flat hands  to delimit the thigh, indicating that the referent had the same diameter as the thigh circumference. Similar to the gestures mentioned earlier, no movement was used in these SASS, suggesting that the gesturer relied on the static handshapes and their placement on the body to convey the size of the referent.

A B

Figure 113: Snake

Size denoted with one hand on the body.

This category of SASS involves delimiting boundaries on a limb, with most signs/gestures concentrated on the hands, followed by the upper limb/arm, and the least on the lower limb. In this chapter, I refer to the hand that delimits the boundary as "callipers" and sometimes as a "measuring line." The comparison to callipers stems from the observation that signers and gesturers use their hand in this type of SASS as if it were a measuring tool. Like the jaws of callipers used to measure an object's dimensions, the hand serves a similar purpose, determining length, diameter, or thickness. When the hand assumes an extended finger(s) instead of a grip (calliper jaw) to demarcate the boundary, I refer to it as a "measuring line."

Sign: One Hand Body-Based Signs in the Animal Encounter Narrative and Haptic Task

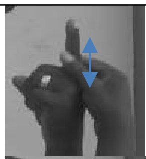
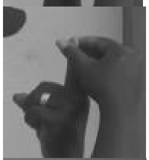
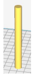
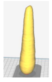
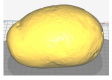
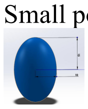
In the GSL signs section, we encountered 42 SASS during the haptic task. All of these SASS involved a calliper hand delimiting various part of the hand. Table 37 presents the list of SASS found and their frequency and referents.

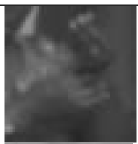
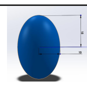
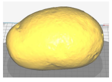
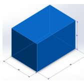
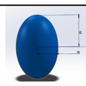
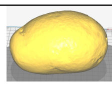
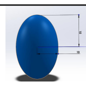
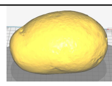
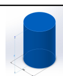
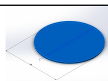
The most frequent delimitation occurred on the index finger, with 17 tokens (see, e.g., on the index under Table 37). The bundle fingers  were the second most used, with 11 tokens (e.g., 4 & 6), followed by the fist with five tokens (e.g., on fist under Table 37). The least frequent SASS involved using the calliper (i.e., little finger and thumb) to demarcate the boundary on the palm with one token (e.g., on the palm under Table 37).

The body part chosen for the SASS appears to be iconic for the referent, as the delimitation is based on the discretion of the signer. For instance, signers delimited the entire index finger with small cylindrical referents, creating a direct replica of the referent. Signers could delimit the distal interphalangeal part of the index finger (closest to the fingertip) for small spherical referents. With larger spherical referents, the bundle fingers  were delimited with a calliper hand. Depending on the size of the referent, signers could create the delimitation on the distal, intermediate, and proximal phalanges. In some instances, signers even made the delimitation on the wrist of the forearm.

The signs were mostly articulated without movement. However, one SASS (e.g., see index under Table 37) employed movement to demarcate the two boundaries on the index finger.

Table 37: One Hand Body-Based Signs in the haptic task with illustration of the handshape and depicted referent.

Categorization of hand	**Type**	**Freq.**	**Depicted entity**
Index	       	17	 Rod  Big & Small Carrot  Small potato  Small ellipsoid

Bundle fingers	  	11	 Medium & small ellipsoid  Small potato  Small cuboid
		8	 Medium ellipsoid  Medium potato
Fist		4	 Medium ellipsoid  Big potato
		1	 Cylinder
Palm		1	 2D Elipsoid

In the animal encounter, we observed a total of 13 SASS tokens. Of these, twelve were calliper hand signs, and one was a measuring line sign. Among the twelve calliper hand signs, seven were concentrated on the forearm, three on the four fingers, and two on the index finger. The single measuring line sign was also on the forearm.

It was noted that four of the calliper hand signs involved movement. Three of these signs used movement for focus marking or intensity (see Figure 114B), while one used movement to delimit the boundaries (tip & base of finger) for the size on the body (see Figure 114).

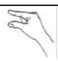
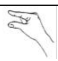
The movement associated with focus marking or intensity involved repeating the articulation of the calliper grip on the body. Another movement considered as focus marking was a slight rubbing of the calliper grip hand on the forearm, akin to a firm or strong grab of the forearm. With signs associated with focus marking or intensity, the signer emphasised that the referent (snake) was very big. [104] These movement variations added nuances to the meaning of the SASS and provided insights into the size or intensity of the depicted referent.

Table 38, below provides the 12 tokens of SASS with the calliper hands. Three body parts were used: the index finger, bundle fingers and the forearm. Examples of how signers used the forearm (see Figure 115A) and the bundle fingers (see Figure 115B) for the size of a referent are illustrated below.

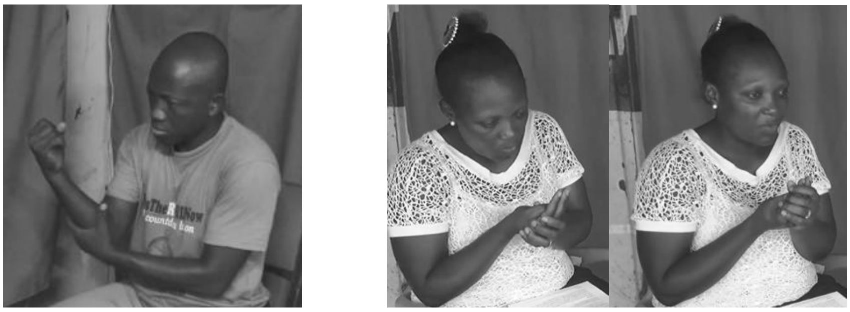
A: Size of a worn B: Size of a snake

Figure 114: Example of movement found with the calliper hands.

Table 38: Tokens of the calliper hand signs.

E.g. ,	Body part	Delimiting calliper hands	Freq.	Referent
1A.	Index finger (entire fingers)		1	Worm
1B.	Index finger (distal interphalangeal/ closest to the fingertip)		1	Worm
2.	Bundle fingers and thumb	 (N=2),  (N=1)	3	Fish, Bird
3.	Forearm	 (N=1),  (N=5),  (N=1)	7	Fish, rat, snake, tree stem

[104] Facial expressions could also be said to contribute to the focus marking or intensity as observed in figure 63B.



A: snake B: Bird

Figure 115: Example of the calliper hands sign.

Apart from the calliper hand signs, there was one notable measuring line sign (see Figure 116). In this sign, the signer used his extended fingers  to demarcate the boundaries on the forearm, indicating the size of a lion's body. The sign in Figure 116 specifically conveyed the length of the diameter observed in the lion the signer encountered. By using the extended fingers in a linear fashion, the signer effectively represented the lion's body size, providing a visual representation of the diameter. This measuring line sign added valuable detail to the description, giving a clearer sense of the lion's actual physical dimensions.

Figure 116: Lion's body.

Gesture: One Hand Body-Based Gestures in the Animal Encounter Narrative and Haptic Task

In the animal encounter data, a total of 34 gestures were used to depict size and shape. Among these, 29 gestures involved the use of calliper hands, while five gestures were measuring line gestures. The measuring line gestures demonstrated a variety of hand placements on the body to indicate size.

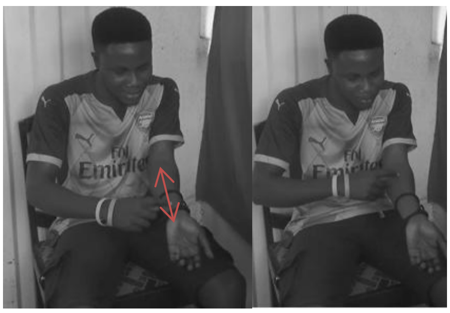
For the measuring line gestures, one had the measuring line hand concentrated on the forearm (see Figure 117A), one on the thumb (see Figure 117B), two on the palm (see Figure 117C), and the last one involved moving the measuring line back and forth between the palm and forearm. Table 39 summarises the features of the measuring line gestures found in the data.

Notably, all the measuring line gestures employed movement. The observed movements were associated with two different concepts of size depiction. In the first concept, by delimiting the target body, the gesture indicated the diameter of the referent. For instance, as shown in Figure 117A, the back-and-forth movement of the delimiting hand on the middle lane of the forearm was used to represent the diameter as half of the forearm, signifying the size of a snake. The gesturer further reinforced this representation through co-speech, mentioning that the snake was half of his hand and then gesturing.

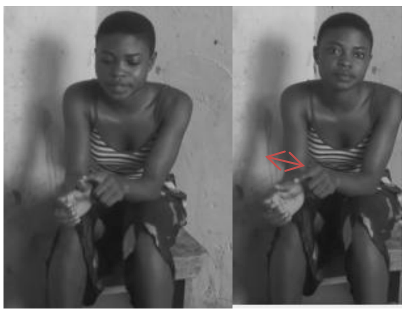
In the second concept of size depiction, the delimiting hands on specific body parts indicated the extent or length of the referent. This concept relied on the selected body part's iconic nature to reflect the target referent's size and shape. The movement made by the delimiting hands then conveyed the referent's diameter/width or length. As demonstrated in Figure 117B, the gesture involved delimiting the thumb to indicate the length of the referent (a millipede).

Similarly, in Figure 117C, the gesturer selected an open flat hand with a calliper hand as the base body part before demarcating a portion of the palm to depict the size of a scorpion she encountered. The movement in this gesture effectively conveyed the extent of the scorpion's body.

Overall, the measuring line gestures provided nuanced and detailed representations of the size and shape of the encountered entities, using the body as a measuring tool in a visually expressive manner.



A: Snake size on the forearm



B: Millipede size on the palm

C: Scorpion on the palm
Figure 117: Examples of measuring line gestures on the forearm

Table 39: Measuring line gestures; their frequency and referent.

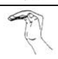
Body part	Delimiting measuring line HS	Freq.	Referent
Palm	 , 	2	Scorpion
Forearm		1	Snake
Thumb		1	Millipede
Palm + forearm		1	Scorpion

Table 39 also includes the different handshapes [i.e.,  ,  ,  , ] observed for the delimiting hand movement in the measuring line gesture. Although it was not identified if the type of handshape selected for the delimiting hands was iconic, it was evident that the tip of the finger(s) in the chosen hand was functionally used to trace an imaginary line on the body to demarcate it accurately.

Conversely, the 29 calliper hand gestures also exhibited functional delimiting handshapes.

Table 40 provides an overview of the body part, delimiting hand used, frequency, and corresponding referents for the calliper hand gestures found in the data. A range of body parts was employed: one (1) sign involved the index finger, one (1) the middle plus ring finger, one (1) the thumb, three (3) the entire hand (comprising 3 fists and 1 bundle fingers), five (5) the arm (of which 2 had movement), 16 the forearm (of which 5 had movement), and one (1) calliper hand on the palm (see Figure 118 for examples).

In both types of gestures, the handshapes chosen for delimiting the body parts appeared to serve functional purposes, aiding in the precise representation of the size and shape of the referent. The diversity of body parts used for delimiting suggests that gesturers effectively adapted their hand placements to match the specific dimensions and characteristics of the encountered entities.



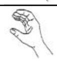
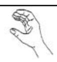
A: Index_Snake B: Thumb_Mouse C: Fist_ Snake' head



D: Fingers _ snake E: Forearm Snake F: Arm _ snake

Figure 118: Example of the calliper hand gesture on various body parts

Table 40: Calliper hand gestures; their frequencies and referent

Body part	Delimiting calliper HS	Freq.	Referent
Index finger (proximal interphalangeal/ middle of the finger)		1	Snake
Bundle middle and ring finger (distal interphalangeal/ closest to the fingertip)		1	knife
thumb		1	Mouse
Entire hand (fist)	 (N=2)  (N=1)	3	Mouse Lizard Snake's head
Bundle fingers and thumb (metacarpophalangeal/ the base of the fingers)		1	Snake's head
Arm		5	Snake
Forearm	 (N=13),  (N=1),  (N=2)	16	Snake (N=15) Scorpion (N=1)
Palm + forearm		1	Scorpion

During the data collection, gesturers provided insights into their selection of body parts for size and shape depiction. They emphasized that the choice of body part was determined by the size of the referent they encountered. In one instance, a gesturer recounted an encounter with a large snake and gestured that it was as big as their arm. They emphasized verbally that referring to the size as the forearm (gestured) would be different from saying it was like their arm (gestured). This implied that since the arm is generally larger than the forearm, the gesturer wanted to convey that the snake was very big. In another example, a gesturer pointed to their interlocutor's arm to indicate the size and shape of a snake. Since the gesturer had a larger upper limb than their interlocutor, they used the smaller appearance of the interlocutor's arm compared to theirs to represent the smaller size of the circular entity (snake) they wanted to refer to.

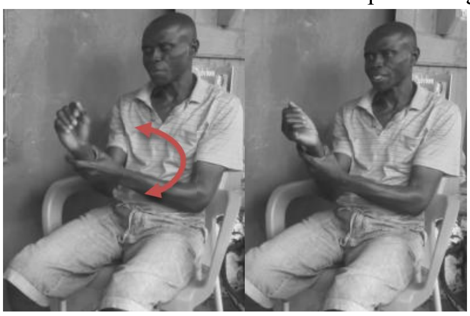
Among the gesturers, three (3) types of movement were associated with the calliper hand gestures (see Table 41). These were calliper tapping (e.g., Figure 119A), straight calliper line tracing (e.g., Figure 119B), and supination and pronation of the forearm within the calliper handshape (e.g., Figure 119C). In calliper tapping, the end-points were demarcated sequentially, providing a representation of the diameter of the referent. In the straight calliper line, the end-points were indicated simultaneously, indicating the extent or length of the referent. The supination and pronation motion of the forearm were used to convey the sphericalness or curvature of the referent. Table 41 provides a summary of the type of movement observed, their frequency, and their specific functions during the size and shape depictions using calliper hand gestures.

Table 41: Types of movements associated with the calliper hand gestures and their functions.

Movement	**Freq.**	**Function**
Calliper tapping	2	Marking end-points of diameter
Calliper straight line tracing	5	Marking end-points of diameter (n=1) Marking end-point of extension (n=4)
supination and pronation of the forearm inside the calliper handshape	1	Sphericalness

A: Tapping gesture for snake's size

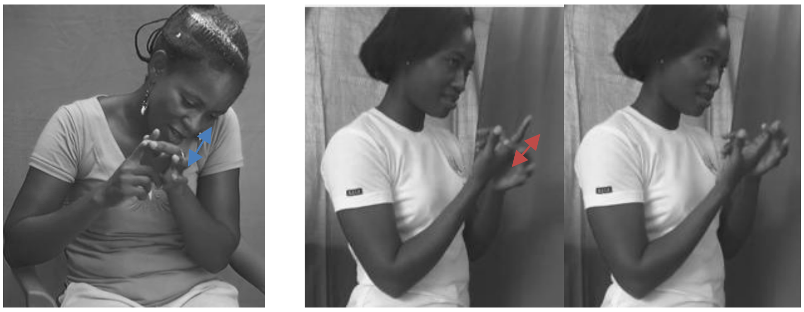
B: Calipers line gesture for scorpion



C: Circular motion of forearm for snake's size

Figure 119: Example of movements with the Calliper hand gesture for size.

Two (2) calliper hand gestures involving the index finger were produced during the haptic task. One of these gestures was performed without movement, while the other included movement. Figure 120 illustrates these two calliper hand gestures:



A: Apex of Pyramid B: Rod

Figure 120: Calliper's hand gesture during the haptic task.

In the first gesture (Figure 120A), the gesturer did not use any movement. While describing a pyramid with a pointed apex during her co-speech, she used a calliper grip  on the fingertip of her index finger to depict the size of the tapered part of the pyramid.

On the other hand, the second gesture (Figure 120B) involved movement. The gesturer was describing a small cylindrical referent, a rod, using her index finger. In this case, the movement of the calliper grip  was used to mark the delimiting boundaries for the size of the referent. During her co-speech, she mentioned that the referent was slim, resembling the size of her finger, and then gestured accordingly.

These examples demonstrate how gesturers used the calliper hand gestures with and without movement to depict the size and shape of different referents encountered during the haptic task. The choice of movement or the lack thereof seemed to be influenced by the specific characteristics of the described referent.

Summary of signs and gestures for size depiction

This section compares different strategies signers and gesturers use to depict size in space and on the body and the similarities and differences between their approaches. The gestures and signs are analysed in the context of the animal encounter narrative and the haptic task.

Size Depiction in Space:

Both signers and gesturers use various strategies to depict size in space, such as creating apertures between hands, fingers, the hand and the ground, and the hand and the body. They employ different handshapes and movements to convey the size of the referent.

- Distance Delimited Between Two Hands:

Signers and gesturers employed the same four distinct areas of the hands to convey information about size, using different hand configurations and movements based on the characteristics of the referent's size or shape. For instance, the entire hand could be curved when referring to a spherical entity. The four specific hand parts for distance delimited between two hands are depicted in Figure 121. Interestingly, it was observed that some of these size depicting gestures have become lexicalised in signs. Notably, the handshapes commonly known as the "L-handshape" and "B-handshape" in ASL alphabetical signs have also become lexicalised signs in GSL, denoting LARGE and BIG, respectively.

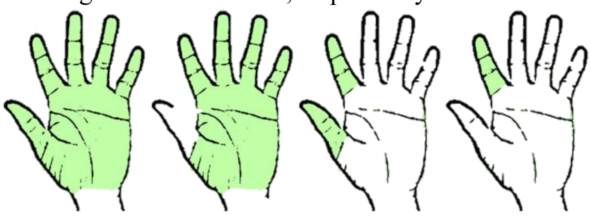


Figure 121: Articulatory hand parts for distance delimited between two hands by signers and gesturers.

- Distance Delimited Hand-Internally:

Two types of gestures featuring distance-delimited hand-internal articulations were observed among gesturers. They primarily used apertures between either 1) the fingers and the thumb or 2) the index and the thumb. In contrast, signers were also observed using these same two articulations employed by gesturers (as depicted in Figure 122). However, signers introduced two distinctive apertures not observed among gesturers, which involved 1) the use of the index and middle finger versus the thumb aperture and 2) the use of the index and middle finger aperture (illustrated in Figure 123). Notably, signers occasionally localized apertures created with the index and the thumb on specific body parts, such as the eyes or forehead, to convey characteristics of the referent. This kind of localisation was not observed among gesturers.

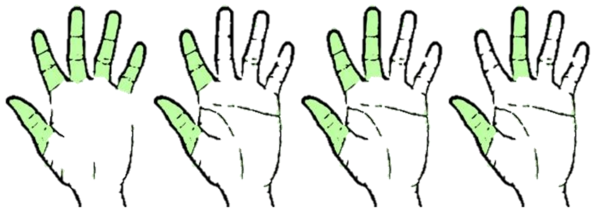


Figure 122: Hand parts for distance delimited hand-internally by signers.

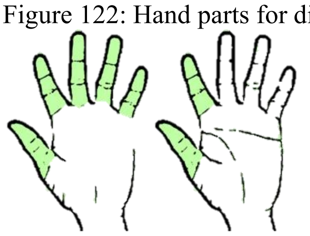


Figure 123: Hand parts for distance delimited hand-internally by gesturers

- <u>Distance Delimited Between Hand and Ground:</u>

Both signers and gesturers employed the same hand parts to indicate the distance between the hand and the ground, primarily using closed or open flat-hand fingers (as depicted in Figure 124). As observed, movements played a crucial role in clarifying the delimitation.

Figure 124:Hand parts for distance delimited between hand and ground by signers and gesturers.

- <u>Distance Delimited Between Hand and Body:</u>

Regarding the distance delimited between hand and body category, gesturers primarily employed one specific hand part. The same articulation used by gesturers (see Figure 126) was also observed among signers (see Figure 125). However, signers introduced two additional distinct hand parts not present in gestural communication. These two additional hand parts included 1) the thumb and index finger handshape and 2) the thumb and little finger handshape. While gestures typically created apertures between the hand and the head, signers employed various body parts (such as the nose, mouth, chest, thigh, and head) with diverse movements to convey information about size.

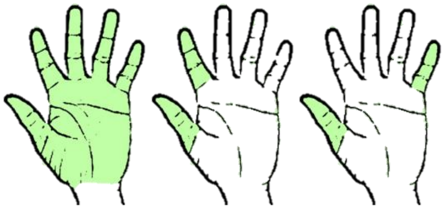


Figure 125: Hand parts for distance delimited hand and body by signers.

Figure 126: Hand parts for distance delimited hand and body by gesturers

Size Depiction on the Body:

This category involves using the body to depict size, either with distance delimited hand-internally or two hands on the body. Both signs and gestures are often iconic, reflecting the referent's size and sometimes with specific handshapes and movements reflecting the referent's size or diameter.

- Size denoted hand-internally:

In the context of indicating size through hand-internal gestures, gesturers used four distinct delimited hand parts, including the delimitation of 1) all four fingers, 2) the tips of the fingers, 3) the tip of the index finger, and 4) the tip of the thumb (see Figure 128). As depicted in Figure 127, signers employed the same articulators as gesturers, along with the addition of a fifth hand part, which involved the use of the tip of the little finger. It's worth noting that among both signers and gesturers, the delimitation of the tip of the index finger was observed to be a lexicalized form connoting the meaning "small."

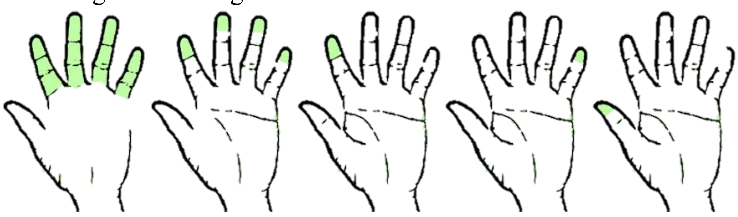


Figure 127: Delimited hand parts for size denoted hand-internally by signers

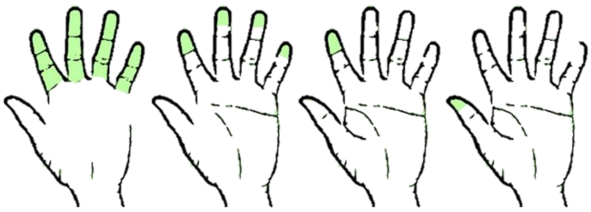


Figure 128: Delimited hand parts for size denoted hand-internally by gesturers.

- Size Denoted with Two Hands on the Body:

This specific type of articulation was relatively limited in both datasets, primarily occurring when signers and gesturers used the thigh as the sole body part for reference. Interestingly, there was no accompanying movement in either the gesture or sign when this articulation was employed. While both gesturers and signers used flat or curved hands for this SASS, signers were occasionally observed using the index finger, a variation not found among gesturers.

- Size Denoted with One Hand on the Body:

Both signers and gesturers employed various parts of the hands, including the entire hand, four fingers, and finger tips, to convey size. However, distinctive selections were made by each group. Gesturers used the delimitation of the thumb and the combination of the thumb and index finger, while signers did not employ these specific hand selections. Conversely, signers made use of delimiting the tip of the index finger, a distinction not found among gesturers. In addition Both signers and gesturers appeared to use the forearm, but gesturers also employed the upper arm, a choice not observed among signers. The figures below provide visual representations of the upper limb segments delimited by signers (Figure 129) and gesturers (Figure 130) for size reference.

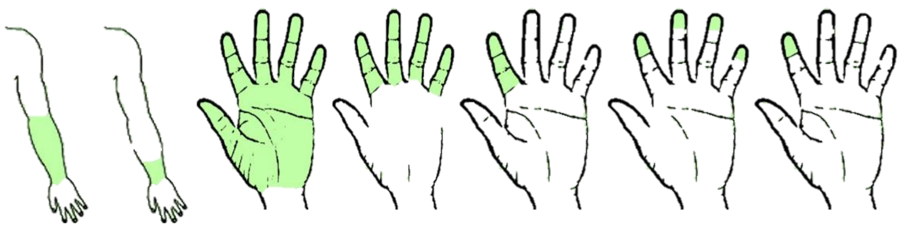


Figure 129: Parts of upper limb selected for size depiction with One Hand by signers.

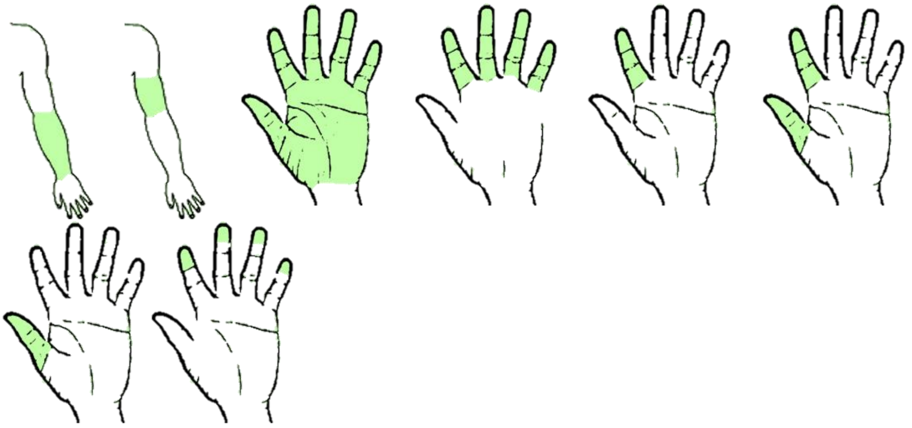


Figure 130: Parts of upper limb selected for size depiction with One Hand by gesturers

Movement played a significant role in conveying size-related aspects, serving to mark intensity or to delimit boundaries indicating diameter, width, or length of the referent. When movement was employed to delimit boundaries resembling a measuring line, gesturers used specific handshapes such as the flat hand, the index finger, or the index and middle finger for this purpose. In contrast, signers exclusively used the flat hand for movement-based boundary delimitation. Beyond the measuring line movement, the active hand sometimes grasped part of the upper limb, acting as callipers to indicate boundaries. The handshapes for this calliper-like action were consistent between sign and gesture, involving either the fingers and thumb or the index and thumb. Various movements, such as calliper tapping, tracing a straight calliper line, and supination and pronation of the forearm within the calliper handshape, were employed for this purpose.

Overall, both signers and gesturers use a variety of handshapes, movements, and body parts to depict size in space and on the body. However, there are some differences in the specific body parts and handshapes used and the frequency of occurrence. Additionally, while both signers and gesturers sometimes use movement in size depiction, the reasons and functions for movement differ between them. Movements are often used by gesturers to provide emphasis, focus marking, or to convey the extent of the referent.

4.4 Discussion

In this discussion section, I will compare some essential features of signs and gestures related to SASS while drawing attention to the striking similarities that emerge among these distinct modes of communication. Especially noteworthy is the use of body-based SASS by both signers and gesturers. I will also integrate insights from the literature on ASL and AdaSL.

One prominent feature from this study is the diverse range of delimitation techniques observed in both signers and gesturers. They employ various articulators, including the index finger, middle finger, thumb, and even the tips of the fingers and thumb. However, signers place more emphasis on using the fingertips for delimitation. It's worth noting that among gesturers, only fingertip articulations are typically lexicalised. An intriguing aspect is the lexicalisation of specific SASS elements, particularly using the tip of the index finger to convey "small." This lexicalisation feature is common to signs and gestures and extends to other locally developed sign languages in Ghana, such as AdaSL (Morgado and Nyst, 2022; Nyst, 2007; Nyst and Tano, 2018).

A significant distinction arises concerning the extent to which arm segments are involved. Signers demonstrate the capacity to delimit the forearm and the hands, while gesturers typically confine their articulations to the shoulder region, the forearm, and the hands. This discrepancy implies that gesturers possess a broader range of upper limb segments to choose from when representing object shapes. Signers' preference for the hand could be attributed to established sign language conventions mirrored in AdaSL (Nyst & Tano, 2018).

A crucial discovery from this study is the prominence of distalization process among signers, directing their focus toward the fingertips. Distalization refers to the shift in sign language articulation from proximal joints closer to the body to distal joints, like the fingers. This shift effectively reduces the energy required for articulation, a phenomenon well-documented in sign language literature (Crasborn, 2001; Crasborn & van der Kooij, 2003; Napoli et al., 2011). The same principle is observed among fluent ASL singers in general, where moving individual fingers is notably less demanding than relocating the entire hand from the wrist, elbow, or shoulder, attributed to the reduced mass and effort involved (Crasborn & van der Kooij, 2003; Napoli et al., 2011). In our study, signers predominantly used fingertip articulations to convey size and shape, distinguishing them from gesturers. However, the root cause of this distalization effect among signers remains a subject of intrigue. While it may be influenced by signing style, as a marker of competence in sign language and a means of economising articulatory effort, it need not be a direct result of the previous state of the articulator, as Crasborn (2001) pointed out. Notably, compelling evidence for distalization in SASS signs by signers in this study is based on the remarkable similarities found with the use of the body (see section 4.3.1.4 & 4.3.2.3) between signs and gestures in a shared linguistic environment.

In contrast to distalization, AdaSL literature suggests a case for concentrating on the hand (Nyst & Tano, 2018). This observation implies that body-part SASS in AdaSL tends to converge toward the hands. In our study, both the concentration on the hands and distalization emerged as recurring themes across various parameters, including location, handshapes, and movement, serving as key distinguishing factors between SASS used by gesturers and signers. SASS exhibits common ground between AdaSL and the GSL, aligning with Nyst and Tano's (2018) implicational hierarchy, which links the use of SASS for body parts to arm parts and subsequently to hand parts, underscoring shared linguistic elements.

Another noteworthy point of comparison pertains to the unconventional locations used by gesturers, which includes instances where gestures are articulated on nearby walls or tables, deviating from the relatively more constrained signing conventions. For example, in the case of tracing, it is interesting to note that the index finger is the most frequently used handshape in both groups. Signers typically trace in space or palm, while gesturers often resort to nearby surfaces, like tables, indicating their more flexible approach to articulation. This difference, characterized by the absence of unconventional locations among signers, further highlights their concentration on the hands and use of distalization for SASS production.

Additionally, a unique feature among signers is the localization of body part SASS, which involves object handshape placement on the body. This localization was predominantly found in one or two-handed signs, typically on various parts of the head region, such as the mouth or forehead. While this localization is evident in AdaSL, it was only observed in gesturers on the forehead with two-handed signs (Nyst 2007; Nyst & Tano 2018).

Closely related to localization is the internal modification of existing signs, as described by Nyst (2007:151). In this context, certain signs emphasizing the size or shape of specific body parts are modified by virtually holding the relevant body part and pulling it. For example, AdaSL signers might hold their nose or ears and then virtually pull it away from the face. This form of internal modification, which was not previously identified in other sign languages, such as ASL (Nyst, 2007:151), is now identified in this study among signers using GSL. However, this internal modification was not found among gesturers or in the literature on ASL SASS.

Another unique feature among gesturers is the occurrence of hesitation, often preceding the articulation of delimited body part gestures. This hesitation arises as gesturers search for the most suitable body part to represent the desired size and shape accurately. Interestingly, this hesitancy, common among gesturers, is largely absent among signers in AdaSL (Nyst & Tano 2018) and was not identified in signers in my study.

The occurrence of Handling Hand SASS is limited in both sign and gesture datasets. Variations in handshapes exist between these two groups, influenced by cultural context. Moreover, both signers and gesturers use apertures between hands, fingers, the hand and the ground, and the hand and the body for SASS, employing similar configurations and movements to match the size or shape of the referent.

Notably, the body-base SASS found among signers and gesturers in Ghana was not identified in the ASL literature.

The literature on AdaSL SASS suggests that the signers in this study exhibit commonalities in body base and space base SASS, which contrasts with ASL practices. Furthermore, a noteworthy distinction between SASS in the GSL and AdaSL is the presence of body-base SASS on the thigh among gesturers and signers in Ghana, a feature conspicuously absent in ASL. While Morgado and Nyst's work in 2022 indicates the potential for SASS production on the thigh in AdaSL, it is essential to acknowledge that this feature is not prevalent or prominently observed in the dataset.

In examining the use of Size and Shape Specifiers in signs and gestures, this discussion has shed light on the diverse strategies and conventions employed by both signers and gesturers. It underscores the shared features and emphasises the differences in their methods of expressing size and shape information. As Nyst and Tano (2018) argue for a concentration on the hands in AdaSL, this study presents a compelling case for the simultaneous emphasis on both hand concentration and distalization in the GSL, potentially influenced by the observed influence of ASL conventions.

4.5 Conclusion

This chapter delved into the examination of gestures and signs used by Ghanaians, focusing on 226 tokens of gestures (79 elicited from animal encounters & 147 from the haptic task) and 820 signs (285 elicited from animal encounters & 535 from the haptic task) corresponding to productive size and shape markers. The data was annotated for phonological features, emphasising handshape, location, and movement parameters.

Throughout the study, hearing participants were instructed to communicate solely in Akan, to encourage the production of natural gestures. This approach, although reasonable for naturalistic expression, resulted in a lower number of gestures compared to the signs produced by signers. Nonetheless, gesturers exhibited a considerable amount of gesturing, aligning with the theories of some researchers that highlight gestures as enriching communication tools (Bavelas et al., 2008; Goldin-Meadow & Brentari, 2017; Iverson & Goldin-Meadow, 2001; Kendon, 2017; Pouw et al., 2019).

Examining similarities in the gestures and signs, it was found that both SASS signs and gestures displayed variations, but SASS signs demonstrated a more consistent form. In contrast, gestures exhibited irregular forms, particularly in handshape. However, gestures became more regular when produced in isolation. Signers were observed to limit themselves to specific phonological parameters, with a heightened awareness of these limitations compared to gesturers. Despite this, both groups used similar strategies for size and shape within their linguistic repertoire, although signers' parameters were more consistent than those of gesturers.

The findings also indicated that some SASS elements may become lexicalised and conventionalised in sign language, integrating and nativising within the signing community's language system (Pfau & Steinbach, 2006; Nyst & Tano, 2018).

In conclusion, this chapter contributes to our understanding of SASS among Ghanaians, highlighting the similarities and differences in using gestures and signs in AdaSL and GSL. The study highlights the shared use of Size and Shape markers and similar strategies employed by both groups, suggesting a common communication repertoire. Particularly with the use of body-based SASS by both signers and gesturers. At the same time, signers demonstrate more restraint due to their phonological awareness. Differences exist in the frequency and distribution of these gestures and signs, with gesturers employing fewer gestures, likely influenced by the communication context and the absence of specific instruction. However, exploring size and shape gestures and signs reveals intriguing parallels between signs and gestures, both employing body-based representations and movements to convey entities and dimensions. Notably, a distinction was seen among signers in the GSL community adopting hand concentration and distalization for SASS. Overall, this research provides a valuable inventory of both groups' handshapes, locations, and movements, making a substantial contribution to the knowledge of sign language and gesture studies.