Torso articulation in sign languages

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Abstract

Torso articulation in sign languages is mentioned variably in the linguistic analysis of sign languages but is often ignored. The prevailing idea seems to be that detailed study of movement of the parts of the torso will yield little insight into linguistic matters – so mentions can be general and brief. The result is that torso articulations are an unmined area – perhaps one that holds treasures, particularly regarding the appreciation of creative sign language. We draw together the findings of other research regarding torso articulation, then give an inventory of possible torso articulations, exemplified with signs from dozens of the world's named sign languages, and a brief overview of how annotation systems have approached torso movement in signs. We end with suggestions for how the study of torso articulation can open new avenues of sign language research.

Keywords: sign languages, torso articulation, nonmanual articulation, annotation systems, data collection and inclusion.

1. Introduction and background

What are the articulators of sign languages? Research over the last 60 years has established that sign languages are natural human languages that are not sound-based but visual-spatial-kinetic, produced by "visible bodily action" (Kendon 2004, 2017) enacted mostly above the waist and perceived visually. At the very least, all signers have at their disposal the hands, arms, torso, neck-head (where articulations of the neck muscles move the head), face as a whole, as well as parts of the face (eyebrows, eyes, nose, cheeks, and mouth). In this article, we investigate the role of the largest of these articulators and yet the least researched and understood in sign languages – the torso – looking at movement of parts of the torso.

Our experience in studying creative sign language in poetry, storytelling, and jokes (e.g. Napoli 2022; Napoli & Liapis 2019; Sutton-Spence 2004, 2016; Sutton-Spence & Kaneko 2016; Sutton-Spence & Napoli 2009, 2010, 2013), augmented by an ongoing study we are involved in (comparing torso articulation in three contexts: everyday sign language discourse, creative sign language, and dance) convince us that torso articulation plays a far more robust role in sign languages than previously recognized, particularly in creative sign language. In that ongoing study, we show that torso articulations can be lexical – which should not really be surprising. Nonmanual articulations of many sorts have been shown to become conventionalized to carry their own meaning (Johnston et al. 2016) and to stand alone as lexical items (Pendzich 2020; Tomaszewski & Farris 2010); why shouldn't torso articulations do the same? [INSTEAD PUT there is no principled reason why torse articulations should not.] In order to appreciate and evaluate this claim or others one might make about torso activity in sign languages, linguists need an appropriate way to talk about torso articulations. The present article aims to contribute toward that goal.

The structural linguistic approach that has been followed in most sign-linguistics research adopts duality of patterning and a parameter structure, especially in the articulating hands. With this assumed foundation, we understand that there are discrete handshapes, locations, movements and orientations of the hands that create units which act as phonemes within sign languages (starting with Stokoe 1960, through more recent foundational works, such as Brentari 1998, 2019; for a history and comparison of different phonological models, see Fenlon et al. 2017). Changing a handshape, for example, while maintaining the other parameters results in a different sign with a distinct meaning. Beyond the manual parameters, the nonmanual articulators (those typically discussed being the neck-head and parts of the face, but see Nyst 2007 for leg articulation in a village sign language) are understood to carry communicative meaning (starting with Baker & Padden 1978) and are receiving increasing attention (e.g., Herrmann & Steinbach 2013), but evidence of their phonemic status is scarce, as there are relatively few minimal pairs in which the articulation distinction is nonmanual. Attention to the spatial, temporal, and velocity components of both manual and nonmanual movement can help in understanding the alignment of phonological articulations (e.g. Woll & Sieratzki 1998; Loos & Napoli 2021) and the suprasegmental level of phonology (Nespor & Sandler 1999), as well as help in understanding morphological (Reilly 2006), syntactic (Benitez-Quiroz et al. 2014; Neidle et al. 2000; Zeshan 2004), and discourse phenomena (Herrmann 2013). That is, certain nonmanual elements fulfill grammatical functions – such as changes in head or eyebrow position in negations and interrogatives. Recognition and production systems for sign languages are improving steadily, as they take into consideration the roles of nonmanuals in phenomena such as sentence segmentation (Brock et al. 2020). In accord with this is the fact that nonmanual articulations turn out to be critical for the comprehensibility of sign language avatars (e.g., Kipp et al. 2011), and humanoid robots that use embodiment in their signing with young children who are deaf or on the spectrum are more effective at communication than robots that do not (Köse et al. 2015).

It is undeniable, then, that nonmanuals play grammatical roles. Yet there is something more gradient than discretely categorical about the nonmanuals, and while there are apparently endless combinations of nonmanual movements that convey meaning, a linguistic theory that embraces only structuralist semiotics can be left metaphorically scratching its head and declaring these devices and their communicative results paralinguistic. Simply put, despite abundant scholarly activity, it remains unclear how nonmanual features are to be represented in an exclusively structuralist model of phonology (Fenlon et al. 2017). Nonmanual articulations that one signer employs but another does not can be attributed rather vaguely to the claim that some signers are more expressive than others. All this can result in setting aside torso articulation as, admittedly visible, but of limited interest regarding what it can teach us about language structure.

This is a mistake. It could hinder us from seeing potentially critical data for linguistic theory and make us miss out on understanding not just nuances but major tropes in the language artistry of deaf individuals and deaf communities. In sign utterances of all sorts (not just creative sign language, as in stories and poems), there is a continuum from unconventional, gradient, and recognizably depictive characteristics to conventional, discrete, more arbitrary characteristics, where the entire continuum may be considered language (Dotter 1999, 2018; Enfield 2009; Ferrara & Hodge 2018; Jantunen 2017; Jantunen et al. 2021; Kendon 2004; Wilcox & Lackner 2021). In daily language encounters, human signers enrich language by embodying metaphors of many types (to build on Nilsson's 2016 insights). Embodiment, then, deserves to be recognized linguistically.

Spoken language differs from sign language here, but in degree, not in type. While arbitrariness of the relationship between articulation and meaning predominates in spoken languages, as claimed by de Saussure (1916) and many since, others have pointed out that speech includes substantial iconicity, as recognized by Sapir (1929), and that iconicity has extensive effect on the lexicon (e.g., Waugh & Newfield 1995; Winter et al. 2017). Recent studies have shown a resemblance between the sound of a word and its meaning with regard to size of an object (Winter & Perlman 2021), shape of an object (Ćwiek et al. 2022), and roughness of an object (Winter et al. 2022). And this is just the tip of the iceberg in studies of nonarbitrariness in speech. Language users, whether signers or speakers, can embody objects they talk about. Often that embodiment is extremely partial and imprecise, obfuscating this semiotic strategy. Thus, the noun phrases *the bong of a bell* and *the chirp of a chick* each have more obvious onomatopoeia in the first noun, but still enough remnants of it in the second noun to allow one to sense the reverberations of that bell or the pitch of that chick's call throughout the full noun phrase. Likewise, a story in which the signer embodies an elevator (as in John Wilson's British Sign Language (BSL) haiku poem "Lift") can exploit fewer points of mapping from the physical object elevator onto the signer's body than one in which the signer embodies an insect (as in Ian Sanborn's American Sign Language (ASL) piece "Caterpillar"), but the more prolonged the embodiment is, as in these sign language narratives, the more likely it is that a clear, precise meaning of an embodied articulation can emerge.

Prevalent models of phonology, which do not admit the importance of iconicity, may be keeping linguists from exploring the full range of phonological interactions that occur in sign languages. For example, integration of nonarbitrary relationships between form and meaning into the grammar of sign languages has multiple advantages (regarding handshape, see Boyes Braem, 1981; regarding place of articulation, see Friedman 1976 and van der Kooij 2002), allowing us, for example, to uncover new types of evidence that phonological features interact at the sublexical level (Napoli & Ferrara 2021). Less dramatically but no less real, such integration regarding speech leads to a better understanding of spoken language grammar (Dingemanse et al.

2015; Monaghan et al. 2014; and much ongoing work). Such integrated models of the grammar will be messy, not just because of the challenges to formalization, but because the perception of iconicity is relative to an individual's sociocultural and language experience (Occhino et al. 2017; Pizzuto & Volterra 200; Taub 2001; Wilcox 2000). Yet we would be remiss to ignore the insights such models offer. Our hope is that examination of the torso will in the long term contribute to linguists' recognition that an adequate grammar must incorporate semiotic strategies.

With this understanding, investigations of torso articulations can consider data from the lexicon that have previously been treated as not meriting mention and data from creative sign language that have previously been treated as not germane to linguistic analysis in a strict sense. In order to recognize those data and be equipped to investigate their roles in sign language utterances, we will take a much-needed detailed look at articulations of parts of the torso.

In Section 2, we pull together the disparate observations on the torso in existing publications and present them in a structured way. In Section 3, we discuss our data base and our method of analysis. Section 4 gives an inventory of torso movements; Section 5, a discussion of annotation issues; and we end with questions for future research.

2. Relevant findings of others on torso articulation

2.1 The torso in the lexicon

Studies of the articulators in sign languages often give the impression that the lexicon calls for almost negligible torso movement, at most. In this regard, Tyrone and Mauk (2016) compare head and torso movement to the phonetic realization of a co-occurring manual articulation. They find that the head moves to a significant extent in facilitating manual contact, but torso movements are "generally quite small" (p. 133) in this regard. They conclude that the torso does not move to facilitate contact with the hand for torso-located signs and suggest that torso movement might occur in signing "primarily for grammatical or pragmatic purposes and not to facilitate contact with the hand" (p. 136). They attribute this restriction to the fact that the torso is simply too heavy and large to use phonetically.

Sanders and Napoli (2016a, 2016b) go so far as to argue that sign language lexicons in general disprefer two-handed signs that move in such a way as to induce a particular kind of torso articulation: rotation. This dispreference is strongest for signs that induce torque with respect to the vertical axis that goes up the center of the body (resulting in spinning), such as PIANO in many languages (contrast the entry in the online dictionary spreadthesign.com for PIANO in BSL, an entry that does not induce torque, to the ASL entry, one that does induce torque). But dispreference is also noted for signs that induce torque around the transverse axis that goes through the waist from side to side (resulting in rocking), such as WAY in many languages (we refer the reader again to spreadthesign.com); and around the horizontal axis through the waist from the belly to the back (resulting in swaying), as in CLIMB in many languages (again, and hereafter, see spreadthesign.com). Such lexical signs require the signer to spend reactive effort to fight that torque in order to remain facing forward and to maintain eye contact (regarding importance of eye contact see Emmorey et al. 2009). Thus, the drive for ease of articulation (which leads one to avoid exerting extra effort, such as reactive effort) is responsible for the significantly smaller frequency in the lexicon of such destablizing signs in contrast to stable signs (ones that do not induce torque).

Indeed, we know of no claims that a given sign is not grammatical or well-formed if articulated with a torso that is nearly entirely still. Thus, torso movements seem to lack phonological status; no torso position or articulation seems to be used as a contrastive feature in a lexical sign. Nevertheless, in the next section we will describe torso movements, and we will see that on the website spreadthesign.com we easily find lexical examples to demonstrate nearly all of the various torso movements in our inventory. Clearly, then, the torso is active in producing lexical signs. Further, it may be active in predictable ways. For example, some have noticed the tendency of a forward lean of the upper body to accompany signs related to eagerness/ involvement, and a backward one to accompany signs related to disgust/ rejection (van der Kooij et al. 2006 for Sign Language of the Netherlands; Wilbur & Patschke 1998 for ASL). This raises the question of whether torso articulations might play a role somewhat comparable to phonesthemes in spoken languages (e.g., Hutchins 1998). The paucity of such remarks in the literature, however, makes us suspect that torso movement in a given sign is not so much negligible as overlooked in a sign's articulatory description.

We suspect further that torso movement may even be inhibited by a particular method of data collection. In many data sets in sign-language studies the signers are seated as they are recorded. The very act of sitting leads one to expend less energy on a task (Roemmich 2016), which might be at least partially because articulations of the torso are hampered by a seated posture, particularly motions of the lumbar spinal region and lower. In the Wilbur and Patschke (1998) study that notes the importance of upper-body leans, there is no description of the position the signers are in and no photos of those signers. But the drawings of signers show only the upper part of the torso. In the van der Kooij and colleagues (2006) study that notes the importance of upper body leans, the signers are seated (at least in the photographs shown), plus they say they used "one camera on the face of the signer, one on the upper body and head, and one camera on the Deaf interlocutor" (p. 1602). Thus, it stands to reason that they didn't see/notice any possible mid-torso or lower torso articulation. In contrast, the signers on spreadthesign.com are standing – and torso articulations from the hips up through the shoulders are abundant and easy to notice.

2.2 The torso in discourse

Articulation of the torso to indicate grammatical or metaphorical information in discourse (as opposed to in isolated lexical signs) is, in contrast, quite commonly remarked upon, if in sometimes vague terms. This is not surprising: many have studied the discourse roles of other nonmanual articulations (as in questions, negation, role shift, topicalization, emphatic stress, and so on; see e.g., Pfau & Quer 2010; Quinto-Pozos & Mehta 2010; Sze 2013; Weast 2008; Wilbur 1999). Yet studies don't seem to be looking for whether certain nonmanual articulations tend to co-occur with specific manual phonological features, such as location or location/movement combinations. Rather the focus is on how these nonmanuals can work with one another and even cluster together to mark syntactic or intonational boundaries (e.g., Wilbur 2013). The same sorts of observations made about nonmanual articulations of the neck and above tend to be made regarding torso articulation.

For example, several publications have noted that the torso tilts forward in certain kinds of questions (e.g., Göksel & Kelepir 2013 for Turkish Sign Language; Baker-Shenk 1983 for ASL). Wilbur and Patschke (1998) describe how body leans are used to convey the concept of contrast (affirmation vs. denial) in ASL, and Crasborn and van der Kooij (2013) describe how sideways leans help mark contrastive focus in Sign Language of the Netherlands. Body leans have also been shown to express inclusion or exclusion (Crasborn & van der Kooij 2013; van der Kooij et al. 2006; Wilbur & Patschke 1998). Jantunen (2007) includes mention of how torso positions and movements indicate syntactic boundaries in equative sentences in Finnish Sign Language. Aarons (1994: 70, 122, 149) notes bodyshifting from side to side as a way of signaling topics in ASL. Engberg-Pedersen (1993) shows how body leans contribute to the meaningful use of space in Danish Sign Language discourse. Sutton-Spence and Woll (1998: 183ff.) mention a backward leaning movement of the body to refer to events in the past and a forward lean to refer to events in the future in BSL. In ASL the torso can be held in a given position to bind together elements of a discourse, in a similar way to a manual buoy (Liddell 2003). In Austrian Sign Language the torso can sway to indicate epistemic modality; that is, it is a marker of speculation (Lackner 2017). Kita (2003) points out that torso orientation can be aligned with pointing gestures and speech (he does not look at sign language, though he looks at gesture in Japan) but gives no details beyond that.

In contrast to these relatively imprecise mentions, a few investigations that focus closely on torso articulation are models of precision, such as Boyes Braem's (1999) study of temporal prosody markings in Swiss German Sign Language. Boyes Braem looks at rhythmic structure regarding lateral torso movements (where she measures amplitude and speed) with respect to syntactic breaks, specific kinds of lexical items (e.g., stressed signs), and types of discourse (recapitulations/ summaries, longer explanations, detailed descriptions, etc.). Along this same line, some have pointed out that the torso can move in a coordinated way with another body part, typically the head, in prosodic behavior (Jantunen et al. 2012). Jantunen (2016) shows that sideways movements of the head coordinate with sideways torso movement to mark the junctures of coordinated clauses in discourse in Finnish Sign Language.

Interestingly, these studies seem to resist attributing a discourse-level function solely to an articulation of a torso part. Rather, it would seem that torso articulations work with the lexical information and with other nonmanual articulations to help deliver discourse-level information. Thus, just as at the lexical level, they are not seen as the sole articulators to deliver any particular bit of information.

2.3 The torso in creative sign language

We turn now to torso articulations in stories and poems. Many have noted that torso movement is larger and more frequent in constructed action or embodiment than in narration which is without constructed action in a narrative context – often called regular narration. In constructed action, signers embody the characters they are referring to in discourse; that is, they map the characters' bodies onto their own. So, if we have a bear character, the front paws of the bear are mapped onto the signer's hands, the head of the bear is mapped onto the signer's head, the trunk of the bear is mapped onto the signer's trunk. The signers then use their bodies to depict the behavior of the characters (Ferrara & Johnston 2014; Goswell 2011; Hodge & Ferrara 2013; Janzen 2004; Liddell & Metzger 1998; Mather & Winston 1998; Padden 1986; Pizzuto et al. 2008; Rayman 1999; Russo 2004; Russo et al. 2001; Sallandre 2003). Such depiction calls for much more of what many call whole-body or whole-trunk movement. Cuxac (1999, 2000, 2003) argues that when signers tell a story they can decide to enhance it to varying amounts by imitating or mirroring real-world experiences, where the more enhancement signers use, the more the audience feels they are witnessing the events of the story. Thus, in role shift, one can shift just the eyes or the head, or the upper torso, as well (e.g. Bahan & Petitto 1980, and many). In these early studies of constructed action, mentions of torso position and movements are brief and usually imprecise (obvious in the term *whole body*). That is, they tend to consider constructed action as an articulatorily holistic phenomenon.

Recently, however, constructed action research has devoted more attention and precision to torso movement. Cormier and colleagues (2015), in a study of BSL, find that head and torso represent different characteristics of a referent and argue that the degree to which articulations of each are used can result in subtle, reduced, or overt messages about behavior, leading them to propose that there are different levels of constructed action, each calling for different ranges of articulators and degree of activation of those articulators (a proposal with a foundation in Metzger 1995).

Puupponen (2018) compares head and torso rotations and head and torso sagittal and lateral flexions and extensions, with regard to timing and direction as signers narrate stories in Finnish Sign Language, using constructed action to various degrees[1]. She finds that often the

[1] A note is pertinent here regarding the terms flexion and extension. When a joint moves in a direction to decrease the angle between the two bones that meet at the joint, it flexes; when a joint moves in a direction to increase the angle between the two bones, it extends. Full extension is straight (i.e., 180 degrees).

head direction simply follows the torso movement, but sometimes there is complexity, including simultaneous movements produced in different directions, and there are several differences in the functions of movements in different directions. Generally, though, she finds that co-occurring torso and head movement perform the same function. Importantly, the head is more active than the torso. We note, however, that the participants in her study were seated as they signed.

Jantunen and colleagues (2021) compare head and upper torso movements in Finnish Sign Language between regular narration and constructed action. For head and for torso separately, they measure the horizontal movement area, the speed of movement, and the acceleration of movement. They find a continuum of activation, proposing a division between strong and weak constructed action, where the horizontal movement area, speed, and acceleration of the head are greater in more extreme/overt constructed action – and, since the upper torso tends to move as a unit with the head, the same can be said of the upper torso.

2.4 What's missing

Torso movement has been treated as an extra at the lexical level – leading to near absence of study there. It has been treated as a semantic/functional contributor at the discourse level, thus, worthy of study there, but detailed and precise studies are few. And it has been noted as important in creative sign language, but exactly how the torso plays a role there is severely under-investigated.

Further, in these studies and others we have come across, there is limited (and sometimes no) discussion of two important matters. One is lower torso movement. Lackner (2021), in her summary of linguistic research on nonmanual articulations in sign languages (which includes a plea for more study of nonmanuals) mentions only upper body and shoulders with respect to the torso. The other missing discussion is of torso movement that supplies information entirely by itself. It seems clear that torso movement alone does not signal questions or contrast or topics. Yet, in our ongoing study of torso articulations in sign language literature, we find many instances in which information is conveyed by the torso alone.

Thus, in our next section we examine all possible articulations of the torso, with the goal of being helpful to those who want to examine articulation found in the full range of varieties of sign language usage.

3. Our data set and our method

In the following section we offer an inventory of torso articulations which we illustrate with examples taken from the online lexicon repository at spreadthesign.com. We chose it as the

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Flexion/extension can be in various directions (sagitally, it's forward or backward; laterally, it's to one side or the other).

source of our data because of its size, search functionality, ease of use, and inventory of signs from many understudied languages. These main entries do not reflect well-defined lexemes, a problem with most sign language databases (Johnston & Schembri 1999), but for our purposes it is as close to adequate as we can now manage. Torso (and, particularly, spinal) muscle activation, however, may differ between the production of isolated signs (as in a dictionary) and the production of signs in sequence (regardless of the genre of discourse). Once large corpora of authentic sign language data are openly accessible (where several projects in Europe are working toward this goal), a more adequate set of examples can be sought, particularly if the signers are standing.

Spreadthesign.com allows us to show that torso movement of various types occurs across sign languages, where we list a single example for each type of movement. We offer video clips of two deaf signers, both fluent users of Libras (the sign language of Brazil), reproducing these examples. The signers have experience with multiple sign languages and creative sign language genres and have studied linguistics and deaf studies; we trust them to reproduce faithfully. We illustrate with just these two signers so that the reader can see different torso articulations on the same bodies, allowing for easier comparison between examples.

Our method of collecting data was intuitive. Having listed possible torso articulations, we then thought about what kind of sign each torso movement was likely to occur in. That is, we were guided in seeking examples by our knowledge of how signs made on the body often involve embodiment (Meir et al. 2007). This was a highly successful method: we usually found appropriate examples within the first lexical entry we checked. We judged which joints were articulating based on the dictionary-entry videos, that is, on visual inspection, and without annotation. Our study is preliminary and we are aware that to fully understand the forms and functions of torso articulations clear data with detailed analysis are needed; that is, perception-based analysis of video data should be augmented appropriately. Ideally, one would study high quality, multi-camera video data, recorded using a motion sensing input device such as *Kinect*, with its accompanying software (Puupponen et al. 2014) or other technologies/techniques developed for experimental sign language phonetics, such as kinematic analysis (Wilbur & Malaia 2018).

Other cautions are in order. We need to distinguish torso movements that are intrinsically part of a sign or a sign sentence from those that are incidental. Research on other nonmanuals might help here, where nonmanuals that "belong" to a sign or a syntactic constituent generally, in the words of Wilbur (2009, p. 249; and see her references) regarding ASL "turn on and off with the constituents they modify", while others "turn on and off gradually and not necessarily at syntactic boundaries". Of particular importance to us, headshakes (which involve the cervical spine) that are negative in ASL follow Wilbur's general characterization, in contrast to negative headshakes used by non-signing speakers of English, which turn on and off gradually in a way that seems unconnected to syntactic structure (Boyes Braem & Sutton Spence 2001; Veinberg & Wilbur 1990). Thus, one must look at a signing stream, not just isolated signs, to determine if the movement is incidental or part of the sign. Further, movement of the arms, for example, might precipitate compensatory movement of the shoulder blades. We doubt one can get away from using as a criterion whether the same information is conveyed if the torso is held entirely still.

We also need to judge whether a given signer's articulation is aberrant. Fortunately, with spreadthesign.com we can view many signers in many languages articulating a given sense. Though the details differ, if there is torso articulation of a particular type on several of them, we can be relatively secure that that articulation was not an idiosyncrasy of the individual signer.

4. Toward an inventory of torso articulation

So far discussions of articulatory phonetics in sign languages haven't included extensive description of anatomical facts (muscles and joints) to the extent that articulatory phonetics in spoken languages has. We have found that in our own research, a clear understanding of torso articulation in sign languages has been considerably advanced by such attention. We have not studied anatomy formally, nor are we phoneticists; here we try to offer enough information, however, to give a useful start to any linguist considering studying torso articulations in sign languages, regardless of the reason, while not straining the patience of our readers with material that may seem extraneous or overly technical. For the latter reader, we hope the video clips will facilitate quick passage through the discussion.

In ordinary standing, shoulders and hips align. The torso (trunk) of the human body comprises everything apart from the arms, legs, neck, and head; it is the part from shoulders to hips. Some muscles in the back, chest, and abdomen are deep (or intrinsic) muscles, so-called because they fuse with the vertebral column; others are superficial. Figure 1[2] shows most major muscles of the back with their common anatomical name, for the sake of those who want to follow up on details of their movements in the literature on anatomy. Some important muscles for torso movement are not shown in Figure 1, however, because from this posterior view they are obscured by other muscles. Included here are the deep muscle **quadratus lumborum** and the **multifidus** muscles on either side of the spine. We mention such muscles when appropriate, but we don't dwell on them.

In our discussion we will be concerned with the movements of body parts visible to participants in a sign conversation or to an audience at a sign performance, since these are the movements that can play a role in both productive and receptive communication. What matters to us is not that a particular muscle (such as the supraspinatus, for example) contracts, but the result of this contraction (such as that the upper arm abducts from the torso). Thus, we refer to

[2] Figure 1 is a modified version of the figure at https://www.completepaincare.com/patient-education/back-spine-anatomy/spinal-muscles/, which is offered free on the Internet. We have blocked out muscles we do not refer to in the discussion.

movements of body parts, not to the muscles that effect them, and with only the minimal differentiation necessary for our discussion. Accordingly, the descriptions here are not comprehensive with regard to muscle involvement and largely unrefined with regard to body-part movements.

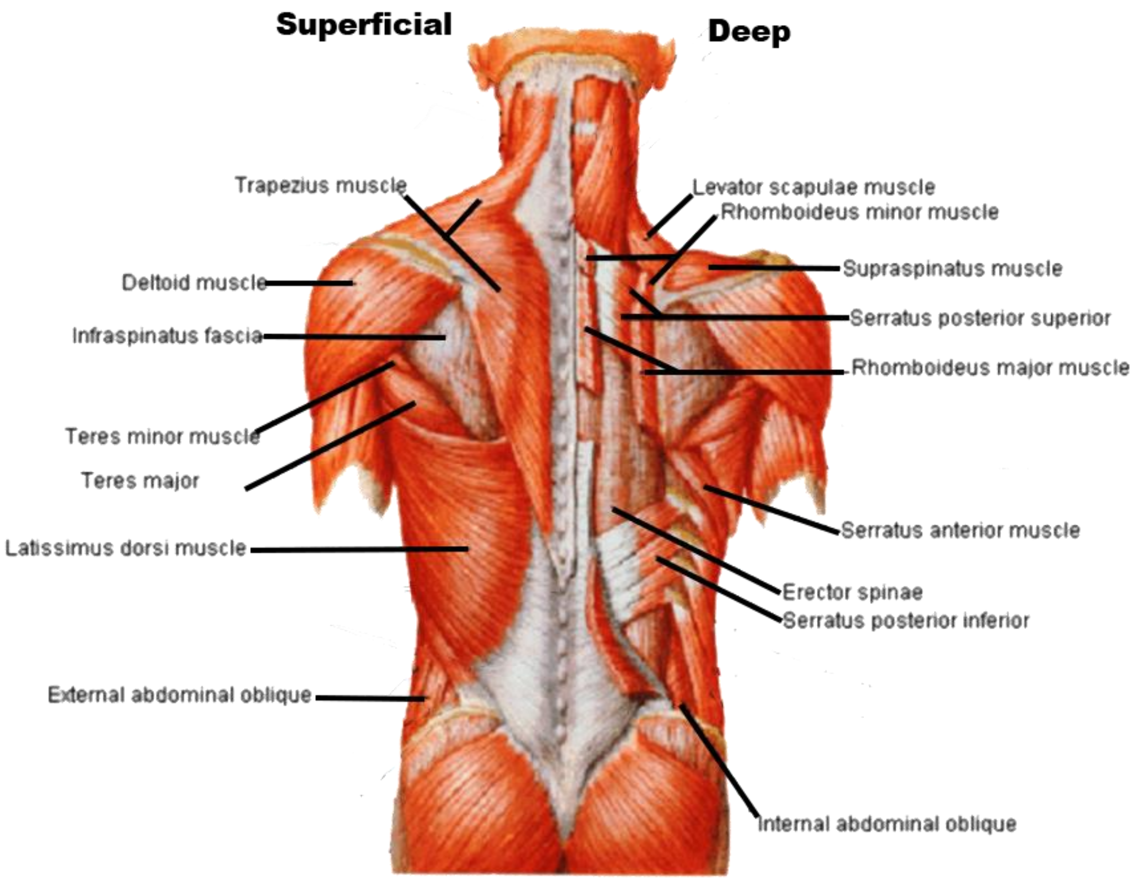

Figure 1: Muscles of the torso, posterior view

Muscles of the upper torso can move not just parts of the torso, but, in conjunction with muscles of the neck proper, they can move the neck/head. In Figure 1 muscles that are located primarily in the neck are not shown, and we will not mention them here. The muscles of the torso that effect head/neck movement include the **levator scapulae**[3], **trapezius, latissimus dorsi**, the **rhomboids** (**major** and **minor**), and in the front of the chest (not shown in Figure 1)

[3]Although the levator scapulae are anatomically superficial, they are marked on the "deep" side in Figure 1, because they function in conjunction with the three deep muscles: the rhomboids, the serratus anterior, and the serratus posterior.

the **pectoralis** (**major** and **minor**). Head/neck movements are common in sign language conversations. They are found in particular lexical items (often as part of echo phonology, e.g., Loos & Napoli 2021) and in particular types of utterances (such as questions, e.g., Kegl et al. 1999).

Five neck/head movements are given here, with a lexical entry in square parentheses from spreadthesign.com that exemplifies this movement in several of the sign languages listed there (although we indicate only one country for each, choosing a clear example; note that the website does not distinguish between different sign languages within a country, thus we do not either).

- neck sagittal displacement (moving forward or backward without tilt, also called "thrust" if forward and "head pull" if backward) [SURPRISE, Italy]
- neck lateral flexion or extension (tilt or bend to one side) [THINK, France]
- neck sagittal flexion or extension (tilt forward or backward, also called "nod" if forward and "raised chin" if backward) [TRUE, New Zealand]
- neck rotation (also called "head turn") [NOT, Denmark]
- neck lateral displacement (moving to one side without tilt, called "neck isolations" in street dance; common in Balinese dance) [WIND, the noun, Poland]

[Insert here links to clips 1-5 of signers demonstrating these five signs
Video example 1: SURPRISE, Italy
Video example 2: THINK, France
Video example 3: TRUE, New Zealand
Video example 4: NOT, Denmark
Video example 5: WIND, the noun, Poland]

These five neck/head movements can be considered simple, in that they involve movement of a particular type (flexion/extension, displacement, or rotation) along only one axis (lateral, sagittal, or, in the case of rotation, vertical). It is common for some of these movements to combine into complex movements. For example, we could laterally flex the neck and rotate it at the same time (see discussion of simple and complex neck/head movements in Loos & Napoli 2021). For all the of movements of parts of the torso in this section, we will make a distinction between simple and complex movements.

With regard to neck/head articulations, in a discussion of visible torso movements in sign languages, one need be concerned with neck/head movements only if torso movement accompanies them (regardless of which torso muscles contribute to effecting them).

Muscles of the upper torso can also move the upper arm: the **supraspinatus,** the **deltoid**, **teres (major** and **minor**) muscles and **infraspinatus**[4] muscles. These muscles are active in many (most?) lexical signs, where, again, we offer just one entry from spreadthesign.com, with a single country that exhibits an easily discernible example of the movement at hand although many other countries also exhibit it. The four simple upper arm movements are given here, where, again, of course, they can be combined into complex movements:

- upper arm abduction from the torso [SWIM, India]
- upper arm extension from the torso [OFFER, Iceland]
- upper arm swinging from the shoulder [SWING, Latvia]
- upper arm rotation at the shoulder [WHY, Slovakia]

[Insert here links to clips 6-9 of signers demonstrating these four signs
Video example 6: SWIM, India
Video example 7: OFFER, Iceland
Video example 8: SWING, Latvia
Video example 9: WHY, Slovakia]

Once more, a discussion of visible torso movements in sign languages need consider upper arm movements only if they induce torso movement (regardless of which torso muscles effect them). For example, arm movement can generate torque in such a way as to move the torso (twisting, swaying, or rocking, as noted in Section 2.1); however, in sign conversations, signers generally exert reactive effort to counteract such torso movement; the **deltoid** muscle effects shoulder stabilization in such instances.

Now that we have set aside the movement of the upper extremities (neck/head and upper arms), we are ready to consider activation of muscles that result in visible movements of parts of the torso proper, our major concern. We start with movement of bones at the top of the torso: the shoulder blades (scapulae). Movement of the shoulder blades is effected by the **levator scapulae**, the **rhomboids** (**major** and **minor**), the **trapezius**, the **serratus (anterior** and **posterior),** the **latissimus dorsi,** and in the front of the chest the **pectoralis** (**major** and **minor**) muscles. There are six major simple movements, where we offer a lexical item (with the same remarks as earlier), plus an example of a typical movement outside of language.

- shoulder blade rise (elevate, as in a shrug) [SHRUG, Mexico]
- shoulder blade drop (depress, as in standing at attention) [PRESS, Belarus]
- shoulder blade tilt (hunching forward or tilting backward, as happens in raising or lowering the arms) [BREATHE, Estonia]

[4] The infraspinatus fascia is a deep muscle, but it is shown on the "superficial" side in Figure 1 for reasons of spacing.

- shoulder blade rotation (down and in towards the spine, or up and away from the spine, as in rowing) [ROW, the verb, Portugal]
- shoulder blades adduction (retract – move toward the spine, as in a pushup) [PROUD, Turkey]
- shoulder blades abduction (protract – move away from the spine, as in throwing a punch) [WIDE, America/ASL]

[Insert here links to clips 10-15 of signers demonstrating these six signs
Video example 10: SHRUG, Mexico
Video example 11: PRESS, Belarus
Video example 12: BREATHE, Estonia
Video example 13: ROW, the verb, Portugal
Video example 14: PROUD, Turkey
Video example 15: WIDE, America/ASL]

All of these movements can be done with just one shoulder blade or both, in phase or out of phase (alternating). All these movements can also be combined to allow complex movements of the shoulder blades. For example, one could raise one shoulder then tilt it forward as it lowers, then tilt it backward as it raises again. That circular or wheel-like motion of a single shoulder could be replicated with the other, either in phase or out-of-phase, so the shoulders appear to be wheels rolling in the same direction, or one wheel could be rolling 180 degrees behind the other wheel, as though the shoulders are creeping along like a crouching cougar's. In our experience, this is a common articulation in creative sign language, thus it is useful to assign it a label and add it to the list:

- shoulder blade roll (raise-tilt-drop-tilt-raise) [CREEP, Russia]

[Insert here link to clip 16 of a signer demonstrating this sign
Video example 16: CREEP, Russia]

Next, let's consider movements of the spine/vertebral column, which is shown in Figure 2 (from https://visualsonline.cancer.gov/details.cfm?imageid=12201, copyright 2019, reproduced with the kind permission of Terese Winslow).

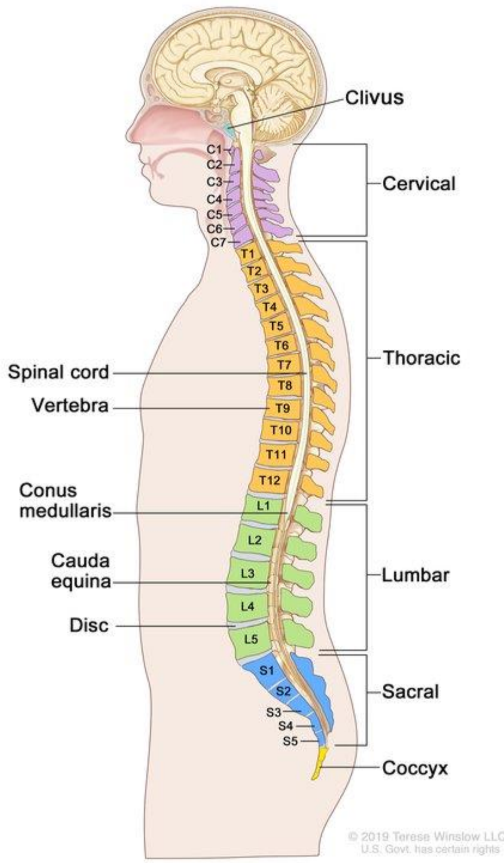

Figure 2: The five regions of the spinal column

Except when the torso is in a prone position, the spine as a whole needs to defy gravity. The major antigravity muscle groups of the back that people use to maintain an erect torso are the **spinalis thoracis, longissimus thoracis**, and **iliocostalis**, which together are known as the **erector spinae** in Figure 1. We rely on them also when lifting objects and when extending (straightening) after movements of the vertebral column. Five other muscles work together to stabilize the spine as a whole: the **levitor scapulae,** the **trapezius,** the **latissimus dorsi**, the **rhomboids**, and in the front of the chest the **pectoralis** (**major** and **minor**). In our discussion we will, again, point out only visible torso movement, so slight muscle contractions that effect stabilization will not be considered.

Movements of the cervical region of the spinal column result in neck/head movements, and we have already discussed those movements above.

Movements of the thoracic and lumbar regions of the spinal column are effected by the **longissimus thoracis**, the **internal oblique** muscle, and several muscles not shown in Figure 1, including the **multifidus** and **transverse abdominis** muscles and many muscles between and around the ribs. Lumbar movements are also effected by the **latissimus dorsi**, the **serratus posterior inferior**, the **oblique (internal** and **external)**, the **iliocostalis,** as well as the **serratus**

posterior superior, the **quadratus lumborum**, and the **rectus abdominus** not shown in Figure 1. The three most common simple movements are given here[5]:

- flexion/extension in the sagittal plane (bending forward or backward);
  [thoracic region: TIRED, Argentina (forward)]
  [lumbar region: CAROUSEL HORSE, Brazil (backward)]
- flexion/extension laterally (bending to one side)
  [thoracic region: TIRED, Australia]
  [lumbar region: DANCE, Romania]
- rotation (twisting the spine on its axis)
  [thoracic region: BASEBALL, UK]
  [lumbar region: ATTENTION, Germany]

Bilateral contraction of muscles effects sagittal flexion/extension of the part of the spine they are attached to. Unilateral contraction effects ipsilateral flexion/extension of that part of the spine.

[Insert here links to clips 17-22 of signers demonstrating these six signs
Video example 17: TIRED, Argentina
Video example 18: CAROUSEL HORSE, Brazil
Video example 19: TIRED, Australia
Video example 20: DANCE, Romania
Video example 21: BASEBALL, UK
Video example 22: ATTENTION, Germany]

All three common simple movements of the thoracic and lumbar regions of the spinal column bring about concomitant movements of the ribs/rib cage. However, there is a fourth type of thoracic and lumbar region movement, one that is uncommon, and generally calls for training in order to learn how to do it: displacement.

- sagittal displacement of the rib cage (as might happen after getting hit in the solar plexus)
- lateral displacement of the rib cage [DANCE, Spain]

[Insert here links to clips 23-24 of signers demonstrating sagittal displacement of rib cage and the one sign
Video example 23: blow to the solar plexus
Video example 24: DANCE, Spain]

[5] The thoracic spine also allows a fourth type of movement: nonaxial glides, which are small movements that the bones of the spinal column can make when moved by a force other than muscles around those bones – such as the hand of someone else or even of oneself. Such movement is not relevant to this study (but, rather, to joint therapies).

These displacements are effected by the **serratus posterior** (**superior** and **inferior**). We see these displacements in dancing traditions that are built around isolations, including jookin and popping of street dance/hip-hop, and belly dancing, where it is not uncommon to combine the two types of displacements into a complex movement, so that the ribcage goes in a circular path. The relevant region of the spine displaces – carrying with it the rib cage. We have not yet found examples of rib cage displacement in the sagittal plane listed in the lexicon of any sign language.

Additionally, there is a fifth type of simple movement of the lumbar spine that happens as a result of pelvis movement. If the rib cage is fixed in place, bilateral contraction of the **internal oblique** muscle will lift the anterior part of the pelvis, altering the degree of pelvic tilt. When the top of the pelvis tilts forward, it pulls the lumbar spine into hyper-lordosis (exaggerating the natural curve of the spine at that point); when the top of the pelvis tilts backward, it pulls the lumbar spine flat (so that the natural curve of the spine at that point is straightened out)

- pelvis tilt [BIRTH, Sweden]

Repeated bilateral contraction and relaxation results in a rippling lumbar spine.

- pelvis ripple [SWING, Czech Republic]

Many of the lexical entries on spreadthesign.com do not include the lower torso in the frame, so our examples indicate our judgment from what is shown. Another possible example for pelvis ripple is CAROUSEL HORSE (look particularly at the signs from UK and Spain).

[Insert here links to clips 25-26 of signers demonstrating these two signs
Video example 25: BIRTH, Sweden
Video example 26: SWING, Czech Republic]

Movement of the rib cage also occurs without spinal involvement (thus differing from displacement). When we breathe in, the diaphragm (a thin skeletal muscle running horizontally under the lungs; it separates the chest from the abdomen) contracts, enlarging the chest cavity and thus pulling the lungs down and expanding them. Pushing the air out of the lungs again is effected by the abdominal muscles, on the anterior side of the torso, located between the ribs and the pelvis – one type of which is shown in Figure 1, the **external obliques** (the others are the **internal obliques**, the **pyramidalis**, the **rectus abdominis**, and the **transversus abdominis)**. Movement of the lungs as they expand is accompanied by movement of the rib cage that encloses them, and this movement is externally visible if exaggerated, as in heavy exercise or panting.

- rib cage pant or heave [PANT, Greece]

Those same abdominal muscles can be used to distend the lower abdomen forward. This movement need not involve the spine (though backward lumbar flexion often cooccurs, as does shoulder blade tilt forward) and it need not coincide with respiration (though it often cooccurs with the release of breath).

- belly distension [FAT, adjective, Lithuania]

Further, the abdominal muscles can take turns contracting parts of the distended lower abdomen, resulting in an undulating belly.

- belly undulation [VOMIT, India]

[Insert here links to clips 27-29 of signers demonstrating these three signs
Video example 27: PANT, Greece
Video example 28: FAT, adjective, Lithuania
Video example 29: VOMIT, India]

Looking lower in the torso now, we find that, while the lumbar spine is highly movable, below the lumbar region spinal articulation is much more restricted. The sacral spine is the last four or five vertebrae, which, by adulthood, fuse to form the sacrum, a single triangular-shaped bone that constitutes the back wall of the pelvis. Its movement is minimal: under usual circumstances simply a slight forward or backward movement triggered by walking. The coccyx (tailbone) likewise has minimal movement. We have found no entries on spreadthesign.com that articulate the sacral spine or the coccyx in a visually accessible way.

Finally, the **psoas major** muscle and the **iliacus** muscle, together known as the **iliopsoas** muscle, are the main flexors of the hip joint (internal muscles, thus, not shown in Figure 1). When the iliopsoas contracts, because of its proximity to muscles of the back, it produces extension movement in the lumbar spine. The iliopsoas works with muscles in the thigh not just to walk, but to allow one to move the hips. This, along with lateral lumbar flexion/extension, will yield movement of the hips so that one is higher than the other, and, with knee flexion, movement of both hips to one side. Typically, these movements co-occur, yielding the complex movement of a wiggle.

- hip wiggle [DANCE, Cyprus]

[Insert here link to clip 30 of a signer demonstrating this sign
Video example 30: DANCE, Cyprus]

Alternating hip rise can be combined with lumbar rotation to give the complex movement of a hip roll (somewhat comparable to the shoulder blade roll, just lower in the torso):

- hip roll [WIGGLE, Croatia]

[Insert here link to clip 31 of a signer demonstrating this sign
Video example 31: WIGGLE, Croatia]

The remaining superficial muscles in Figure 1 are the **gluteus medius** and the **gluteus maximus**, which effect leg movement with respect to external rotation of the thigh bone in the hip socket and flexion/extension of the hip joint in walking, and so are not relevant to us -- but the gluteus medius does stabilize the pelvis while standing or walking.

Importantly, a movement initiated in one part of the torso often triggers a movement elsewhere in the torso. Thus, a hip wiggle generally calls for the opposite shoulder blade to rise and drop in contrasting direction (as hip goes up on one side, shoulder blade drops on that side). This tendency is so strong that dancers often need to be explicitly taught how to isolate the movements of just one part of the torso, particularly with regard to rib cage displacements (as in many African-origin dances [Gerstin 2004] as well as street dance/hip-hop and jazz [Durden 2019; Hebert 2016]). That means that when our readers look at the examples we cite in this section of a particular torso movement, they may well notice (slight or not) additional torso movements.

Additionally, many times various simple torso movements are combined into complex movements on purpose. For example, in DANCE in Chile (as well as Brazil, China, Portugal, and Romania) the shoulder blades raise and drop alternately, the rib cage displaces laterally, and the hips wiggle, resulting in a full torso ripple from shoulders to hips, with dynamics that vary from a smooth sway (or undulation) in some countries to something snappy and jerky in others.

We have demonstrated here that nearly all visually accessible movements of parts of the torso are attested in lexical items in sign languages. But that demonstration should not make us think that the lexicon is littered with the full range of torso movements: some of these torso movements are common and the sign language analysis literature mentions them, if only in passing and without much detail (such as thoracic sagittal leans), while others occur (extremely) rarely. Further, the sense of many of the relevant lexical items is a specific action that uses particular torso movements, thus the signs iconically represent the actions. As a result, these lexical items fall into a semantically-defined group.

5. Annotation of torso articulation

An agreed-upon annotation allows researchers to compare results of their studies (and see relevant remarks on annotation of constructed action in Norwegian Sign Language narratives in Bredeli [2022]), thus we need to discuss how to annotate torso movement.

In the early 1970's, Valerie Sutton, a ballerina training with the Royal Danish Ballet in Copenhagen, developed a system for writing dance, which, like Rudolf Laban's (1956) system, allowed recording of torso movement among other bodily movement. In Sutton's DanceWriting we find something that seems to us to resemble drawing body parts in motion. Figure 3 is a photo of a pose in a Burmese "ethnic" dance (as Sutton labels it) with its notation in DanceWriting (dancewriting.org/library/ethnic/Myanmar/Myanmar_Burma_dance_01.html). Figure 3 is "Burmese Traditional Dance", written in Sutton DanceWriting by Sutthikhun Pheangphongsai on 21 May 2021, reproduced via Creative Commons 3.0 License, but also with the kind permission of Valerie Sutton (p.c. 31 October 2022). The dancer in the photograph is Khaing Mar Lwin. The pose here will change from frame to frame in DanceWriting, and indicate movement. DanceWriting allows us to see on paper movement of the cervical, thoracic, and lumbar spine.

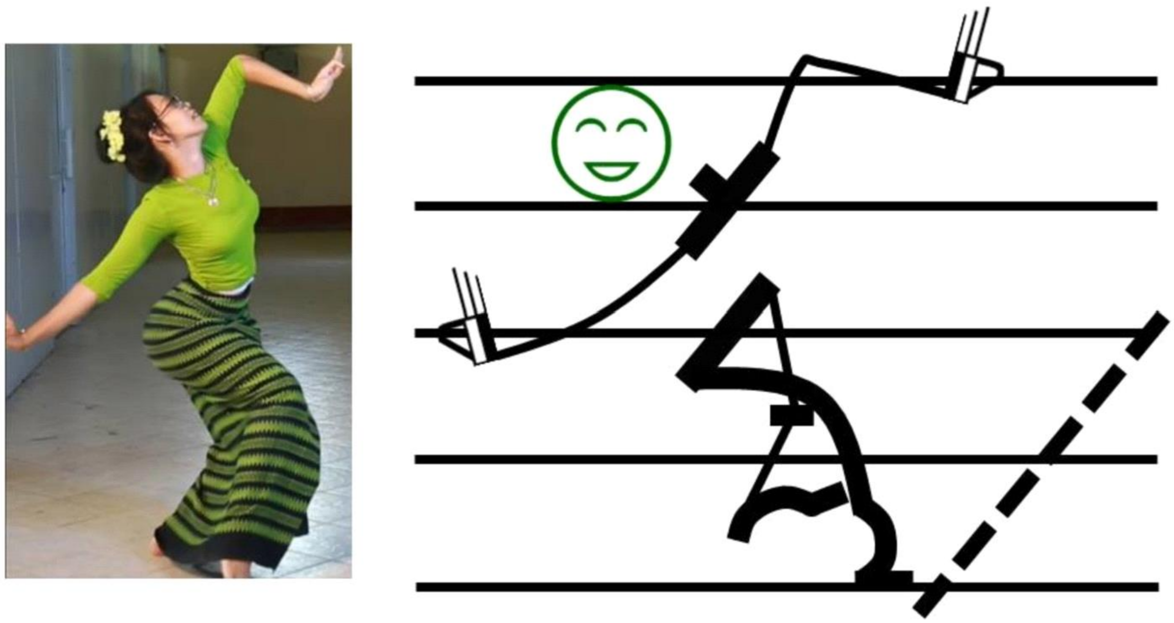

Figure 3: pose in a Burmese dance with DanceWriting notation (courtesy of DanceWriting.org).

Later in the 1970s, Sutton applied her DanceWriting system, with appropriate changes and augmentation, to writing signs used in sign languages, allowing accommodation for a wide range of movements of torso parts. Sutton and her colleagues went on to develop similar notation systems for articulation in mime, sports, and gesture, calling the whole system Movement Writing, and they included examples of English literature translated into written ASL using SignWriting (Sutton & Frost 2008). Original sign language literature is also written in SignWriting (visit signwriting.org/library/).

In SignWriting, Sutton again offers a visually iconic annotation, but she does not offer so elaborate an annotation regarding the signing torso as she does regarding the dancing torso. She divides sign articulation of the torso into three types. One type concerns shoulder position, as in Figure 4A (Sutton 2014: 179). One type concerns upper torso positions and movements, as in Figure 4B (Sutton 2014: 180). The third type concerns movement not within the torso, but of the torso as a whole unit. That is, the body from the hips up through the neck remains “straight”, while articulation of the hip joints “rock” that torso unit as a whole. Since we are concerned with intra-torso articulation, we do not reproduce the table for the third type here.

Figure 4: Intra-torso movement notation in SignWriting (courtesy of Valerie Sutton, p.c., 31 October 2022).

Sutton's system in Figure 4A concerns only shoulder movements. Her system in Figure 4B concerns movements of the cervical and thoracic spine. These torso bars allow for representation of articulation on one side or both, for movement upward and downward, for flexion/extension sagittally or laterally, and for rotation – which covers most simple movement types the upper torso can make (left out are rib cage displacements and rib cage lift and extension due to respiration). This system can be augmented in a variety of ways, including diacritics added to the torso bars (marking across the top as NW, N, and NE, for example) and showing articulation of two parts of the torso at once, as in Figure 5 (Thiessen 1993: 158, reproduced here with Stuart Thiesson's kind permission, p.c. 31 October 2022), allowing for representation of movement of the hips.

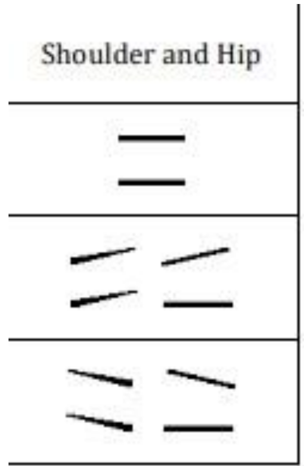

Figure 5: two torso bars representing shoulder in hip in various positions

The system continues to undergo refinement (https://www.signbank.org/iswa/36d_sg.html), and it seems no less nor more informative for shoulder and upper torso movement than for movement of other sign language articulators. That is, Sutton's system does not give short shrift to the torso. Other annotation/transcription systems for sign languages, in contrast, are far more informative about manual movement (typically breaking it down into the relevant phonological parameters) than about torso movement (for a comparison, see Garcia & Sallandre 2013), where some seem to assign torso movement to role shift in constructed action only and leave it at that (such as the Berkeley Transcription System; Slobin et al. 2001, 76-77). This may be a natural consequence of the fact noted earlier, that torso movements seem to lack phonological status in a structural approach to phonology.

Even the Hamburg Sign Language Notation System (Hanke 2004; Prillwitz et al. 1987), used by so many researchers, offers only minimal and relatively impressionistic guidance regarding torso movement. Schmaling and Hanke (2001), who give the torso more attention than most, separate torso movement into "shoulder movement" (including raising, hunching forward, and shrugging up and down), and "body movement", which they say is used mostly for role shifting where the upper body rotates right or left, tilts to a side or forward or backward, the chest can sigh or heave, and the back can straighten or round.

No system we know of other than Sutton's augmented one (as in Figure 5) includes notation for movements of the lumbar spine, and even Sutton's system did not address movements such as pelvic ripples, lumbar flexions/extensions, and belly distensions until recently (the system now accommodates chest puffing or sinking, stomach bloating or sucking in, and spinal undulations, as was posted on her SignWriting Listserv in November 2022).

That is, implicitly, notation systems seem to draw a horizontal line across the spine somewhere above waist level, where articulations below that line simply go unrecorded. We detect a circularity here: it seems people assume the articulations of sign languages happen in the upper torso and above, and that leads them not to record articulations of the lumber spine and lower. The lack of recording lumbar-spine and lower articulations feeds their original assumption that no such articulations occur, and so on.

In fact, though, even torso articulations above the waist level often go unrecorded. In a recent study using HamNoSys, Mocialov and colleagues (2022), for example, have reason to call upon many sub-types of the phonological parameters in annotating the data of interest to them. In Table 1 (from Mocialov et al. 2022, with the authors' kind permission, p.c. 31 October 2022) we see the approximate number for every HamNoSys sub-type in their annotated data. Torso articulations would fall under "many other special cases" (in the middle column).

TABLE 1: Approximate amount of notations for every phonological parameter in HamNoSys notation system. The amount is approximate because the notation system defines combinations of potential configurations or actions for each parameter

Phonological Parameter	**HamNoSys Phonological Parameter Sub-type**	**Approximate amount**
Handshape	Hand shapes	72
Orientation	Extended finger directions	18
	Palm orientations	8
Location	Hand locations	46
	Hand location sides	5
	Hand distances	5
Movement	Hand movements	7
	Other movements	1
	Movement directions	6
	Movement speeds	5
	Movement repetitions	7
Non-manuals	Eye gaze Facial expression Mouth gestures	12
	..and many other special cases	

With regard to this frequency distribution, they note (2022: 1 of draft):

> Annotation of the non-manuals is still limited as it potentially is much more complicated and subtle than other parameters. Despite the fact that the non-manual features, such as facial gestures, play an essential part in interpretation of the sign languages, HamNoSys has relatively poor notation system for them. Therefore, non-manuals will be left out for much later future work.

In other words, these researchers recognize the importance of nonmanual articulations, but due to the inadequacy of the annotation system, they set them aside.

Perhaps the lack of an agreed upon notation system for torso movement is generally responsible for the fact that movements of the torso are barely noted in linguistic analyses of sign languages. After all, our annotation system always risks limiting what we "see" in our analyses (a danger about which Hoiting & Slobin 2002 warned us). Another possibility, and one coherent with the first, is that torso movement in conversational signing is not so important to annotate since most torso movement in those settings cooccurs with facial nonmanuals to deliver the same discourse information. This possibility is particularly appealing given that the viewer generally looks at the center of the signer's face. The greater the distance an articulation is from the head, the more of a challenge it is to the visual acuity of the viewer (Siple1978). Accordingly, phonological distinctions between signs made on the head can be slight differences, while phonological distinctions between signs made elsewhere are typically grosser differences (Ferrara and Napoli submitted), and movements made on the head can be very small, whereas movements made further from foveal vision are larger (Caselli et al. 2022). In sum, regarding certain types of discourse information, the viewer can receive the message simply from the face, allowing linguists to annotate only the facial and head articulations and not the torso articulations.

However, in other situations, some lexical ones as well as creative narrative ones, torso movements can demand to be noticed in that they can provide critically different information from that of the other articulators. Hip wiggles and rolls, belly distensions and undulations – simple and complex torso movements of these types and others exploit the mechanism of embodiment and deliver a great amount of information in a highly efficient way. We therefore can benefit from an annotation system that allows description of such articulations.

We hope to have offered enough information in Section 4 to aid others in developing an annotation system for articulations of torso parts that has high usability in varying contexts. High usability requires that a system be easy to learn and remember, and be adequate and appropriate for the data (Keränen et al. 2016). Importantly, creative sign language data must be included as one develops such a system.

6. Conclusion and potential areas of future investigations

We have outlined what we see as the state of the art at this point, regarding the attention that articulations of the torso have received in the literature and attempts at annotating them. We have suggested that a contributing factor to the relative lack of attention is the habit of collecting data from seated participants (as opposed to standing ones, where torso articulation is not inhibited). We have also given as comprehensive an inventory of the simple movements of torso parts as we know how to give, and remarked on a few such complex movements. Many more complex movements are possible, of course. We have bulleted those simple movements and a few complex ones that we either see in sign language lexicons or we expect might occur in creative sign language. While we do not attempt to evaluate Sutton's annotation system nor develop a new annotation system, we hope to have given enough information for others to do so and, in the meantime, we hope that studies of torso articulation in sign languages can proceed using the terminology here – which, though clumsy, perhaps, is immediately accessible and accurate.

Our personal interest at this point is how articulations of parts of the torso contribute to the artistry of individual performers and of deaf communities. But many areas of inquiry present themselves.

Are some sign languages characterized by more or different articulations of the torso than others? Are torso articulations typically more obviously iconic than manual articulations, and if so, are those torso articulations that, instead, are more-nearly arbitrary a particularly reliable indication of historical relatedness when shared by sign languages? The answers to these two questions may benefit linguistic theory regarding typology and diachronic change.

Do torso movements differ with respect to the social and cultural identity of the signer? Do different kinds and frequencies of torso articulations help to define different registers of language – such as whether one is talking to a child, to a doctor, to an employer? The answers to these two questions may benefit not only sociolinguistic understanding of sign, but help to improve the effectiveness of interpreters. Along those lines, one could also ask whether interpreters who use the full range of torso articulations appropriately (to the genre, to the larger context, to the sign language, …) are better understood by a deaf audience.

Are different torso movements observed in signers of different ages and degrees of fluency in the language? Are any torso articulations typical of sign language conversation noticeably affected by injury or illness, such as Alzheimer's or Parkinson's? The answers to these two questions may benefit scholars of language acquisition, development, and pathologies.

Do caregivers who tell stories with a certain range of torso articulations capture the attention of deaf children more readily than those with a different range of torso articulations with, perhaps, more favorable results for literacy development? Given the amount of functional illiteracy among the deaf worldwide (including wealthy countries), the answer to this question could help in improving deaf education and, thus, contributing to social justice efforts for the deaf.

And on and on. The door is open.

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