Alignment mouth demonstrations in sign languages

Donna Jo Napoli, Swarthmore College, donnajonapoli@gmail.com Corresponding Author

Ronice Quadros, Universidade Federal de Santa Catarina, ronice.quadros@ufsc.br

Christian Rathmann, Humboldt-Universität zu Berlin, christian.rathmann@hu-berlin.de

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Abstract:

Non-manual articulations in sign languages range from being semantically impoverished to semantically rich, and from being independent of manual articulations to coordinated with them. But, while this range has been well noted, certain non-manuals remain understudied. Of particular interest to us are non-manual articulations coordinated with manual articulations, which, when considered in conjunction with those manual articulations, are semantically rich. In which ways can such different articulators coordinate and what is the linguistic effect or purpose of such coordination?

Of the non-manual articulators, the mouth is articulatorily the most versatile. We therefore examined mouth articulations in a single narrative told in the sign languages of America, Brazil, and Germany. We observed optional articulations of the corners of the lips that align with manual articulations spatially and temporally in classifier constructions. The lips, thus, enhance the message by giving redundant information, which should be particularly useful in narratives for children. Examination of a single children's narrative told in these same three sign languages plus six other sign languages yielded examples of one type of these optional alignment articulations, confirming our expectations. Our findings are coherent with linguistic findings regarding phonological enhancement and overspecification.

Keywords: sign languages, non-manual articulation, mouth articulation, hand-mouth coordination

Alignment mouth demonstration articulations in sign languages

1. Introduction

Depictive manual articulations can be accompanied by mouth articulations that are likewise depictive: for example, indicating the changing size of an opening, such as a narrowing drainpipe, simultaneously on the hands and the mouth via modulating the distance between finger(s) and thumb and the size of the mouth/lip opening (Sandler 2009). When the mouth articulation coordinates with the manual articulation (in this way and others specified below), we have what are called mouth demonstrations (Davidson 2015; Quadros et al. 2020).

That mouth demonstrations should occur is not surprising. There are more facial muscles that effect mouth/lip articulations and in a wider range of ways than there are muscles that effect articulations of other parts of the face (https://www.anatomynext.com/muscles-facial-muscles/). Importantly, while the two sides of the mouth can easily move independently of one another in a variety of ways, no other facial articulator shows such versatile independence. Thus, many people can raise only one eyebrow, but it's (nearly) impossible to furrow just one; people can squint one eye, but it's (nearly) impossible to direct one eye upward and the other eye elsewhere or to flare just one nostril. The mouth/lips, thus, offer multiple opportunities for coordination of articulation between mouth and hand and, in particular, between corner of the lips and ipsilateral hand.

With that in mind, we examined mouth articulations in the same narrative told in three sign languages, Libras (of Brazil), Deutsche Gebärdensprache (DGS, of Germany), and American Sign Language (ASL, of Canada and the United States).[1] We identified mouth demonstrations in which

[1] We use the terms *Libras, DGS,* and *ASL* throughout. For all other sign languages, we use the country adjective with *SL*. So *British Sign Language*, for example, will appear as *British SL*.

the lip corners coordinate with manual articulation with respect to spatial and temporal relations. In our data set, storytellers make use of these mouth demonstrations to varying degrees – that is, they are optional in the sense that they don't necessarily occur even when the opportunities for their appearance (as we understand them) arise. Thus, their frequency of use may be part of personal storyteller style.

Still, we suspect there is more at stake than aesthetics. Mouth demonstrations duplicate information given by the hands, underscoring parts of the narrative. The particular mouth demonstrations we examine underscore time and space relationships. Comprehending these relations is both complex and critical to the construction of a mental model of the logical organization of narrative information (for text narratives, see Woolley 2010; for visual narratives, see Cohn 2019). We predict, then, that these particular mouth demonstrations should be common in narratives where redundancy might be most useful: stories told to children (Morrow 1985, Trabasso and Sperry 1985; and for the comprehension of word-problem solving, see Blatto-Vallee et al. 2007 for deaf children, Boonen et al. 2014 for hearing children). Indeed, in a children's story told in these three languages, the opportunity for one of these mouth demonstrations arises, and the storytellers avail themselves of that opportunity. Our analysis has implications for the growing body of literature on narrative structure in sign languages, nonmanual articulations in sign languages, and mouth-hand coordinated articulation in general, as well as on phonological theory with respect to gradient phonotactics, overspecification, and enhancement.

While an enormous amount has been written about mouth articulations, for the sake of space limitations and ease of readability, we usually limit ourselves throughout to just one or two references for each point, where we encourage the reader to consider these as samples, only.

2. Background on mouth articulations

We assume familiarity with complexities of sign language lexicons and syntax, including the frozen lexicon and classifier constructions (see the pioneering works of Brennan 1990, Schick 1990, Supalla 1986, and many since). Our focus is on only one type of mouth articulation – demonstrations, which we elaborate on in Section 3. It is crucial that our readers understand how to distinguish demonstration mouth articulations from other mouth articulations. We, therefore, present a schematic of mouth articulations in Figure 1 that is organized to make this distinction clear and that readers can return to as they negotiate the rest of this paper. We refer the reader to Johnston and van Roekel (2014) for a different schematic, and to Boyes Braem and Sutton-Spence (2001) for a broad foundation in mouth articulations.

<FIGURE ONE GOES HERE>

Figure 1: Schematic of mouth articulations

Consider the semantically impoverished branch on the left. First, prosodic markers are semantically impoverished (Brentari et al. 2018, and references therein), are never sublexical components of a frozen sign, and can co-occur with any (string of) signs.

Second, articulations that signal grammatical functions have little meaning (Pfau and Quer 2010; although they might arise from lexical items, see Zucchi et al. 2010, as happens in spoken languages, see Traugott and Heine1991). For spoken languages the analogy has been made that lexical words are like the bricks of language, while function words are like the mortar (Jackson 1988, 15), though that mortar can affect how we interpret an overall utterance and thus bear on meaning at the sentential and discourse level (König 1991, Groom 2010). Mouth articulations that

signal grammatical functions are never sublexical components of a frozen sign, and can co-occur with any (string of) signs in the appropriate syntactic environment (Benitez-Quiroz et al. 2014).

Third, mouthing articulations arise as simulations of (part of) what the signer's mouth would do when voicing the word of the ambient spoken language that correlates to the sign being articulated (Johnston and van Roekel 2014, and see the references therein). Within a given language, mouthings bear little to no meaning independently; they are "inherently vague manifestations of spoken language words" (Ebbinghaus and Hessmann 2001, 137), where many signers don't realize they are borrowings and some have little knowledge of how sounds in the ambient spoken language are produced and, indeed, little knowledge of that spoken language. Mouthings are sublexical components of the sign, sometimes obligatory (MacSweeney et al. 2008, 436), often optional. They are variable in frequency of occurrence, form, and (socio-)linguistic context (for overview, see Bauer 2018). They can spread between many types of signs in many languages (Crasborn et al. 2008; Palfreyman 2013; Sandler 1999; Steinbach and Pfau 2007), with varying factors affecting spreading frequency (Mohr 2014; Pfau 2016).

Fourth, lexical mouth articulations are obligatory for the well-formedness of certain frozen signs (Pendzich 2018; Silva and Costa 2017). There is not much attention given to lexical mouth articulations in the literature other than to note that they exist and are obligatory (but see Leeson and Grehan 2004, 44). Among lexical mouth articulations is the small group called echoes. In echoes, mouth articulations copy/echo some aspects of hand articulation of frozen signs: "onset and offset, dynamic characteristics (speed and acceleration) and type of movement (e.g., opening or closing of the hand, wiggling of the fingers)" (Woll 2014, 4). The claim in the literature is that they are (somewhat) predictable from the articulatory actions of the hands but they are not iconic or meaningful (Woll 2009; Woll and Sieratzki 1998).

We turn now to the right branch of Figure 1: semantically rich mouth articulations. First, modifier mouth morphemes, often called mouth adverbials (although many can modify nominals), can be analyzed as signs themselves (Ebbinghaus and Hessmann 2001), but they gain their meaning only when they co-occur with signs that have a manual component, both frozen signs and classifier constructions (Sutton-Spence and Day 2001, and many since).

Second, whole-face affective gestures (showing disgust, surprise, delight, for example) are used in spoken as well as sign languages and generally involve larger facial areas than other nonmanual articulations (Baker-Shenk 1983; Crasborn 2006). They occur with any (string of) signs and are not part of the sublexical structure of the sign.[2] Whole-face affective gestures often involve mouth articulations and vary by signer and situation (Ruusuvuori 2013; Ruusuvuori and Peräkylä 2009).

Third, enactment mouth articulations mimic the sense of a sign (that is, how we interpret it to obtain the denotation) or an action involved in that sense. For example, the manual articulation of KISS can be accompanied by the mouth enactment of puckering the lips and kissing the air (as in Japanese SL), thus enacting the puckered lips involved in the sign sense, while the manual articulation of ICE CREAM can be accompanied by an extended tongue (as in Polish SL), thus enacting the licking action involved in the sign sense. These enactments seem to extend over the duration of manual articulation but need not coordinate with manual articulation in any other way (such as direction of movement). They can occur as a sublexical component of a frozen sign (Crasborn et al. 2008, among many), as well as with classifier constructions (Cormier, Smith, and

[2] So while a dictionary entry for an emotional state such as HAPPY might have a smiling face, in conversation asking if someone is happy or saying someone is not happy will not usually be signed with a smiling face.

Zwets, 2013; Johnston, van Roekel, and Schembri 2016; among many), often mimicking the mouth of the referent in constructed action/constructed dialogue, including biting, laughing, and licking.

In the rest of this paper, we discuss the fourth type of semantically rich mouth articulations: demonstrations.

3. Mouth demonstrations

Mouth demonstrations are mouth articulations in which the mouth coordinates with manual articulation, both being depictive. The first reference we have found to mouth demonstrations is in Sandler (2009, 241), who calls them iconic mouth gestures: "…signers create iconic gestures with the mouth, an articulator that acts symbiotically with the hands to complement the linguistic description of objects and events." Crucially, mouth demonstrations differ from enactments in that the mouth articulation does not mimic a mouth action involved in the action denoted by the sign utterance.

Earlier, we noted Sandler's example of hand(s) and mouth coordinating in "opening" size as they indicate changing size of a pipe. Another common use of mouth demonstrations is to indicate a narrow shape or a bulging shape. For narrow shapes, one sucks in the cheeks (effected by the movement of the oblicularis oris muscles of the mouth[3]) and for bulging shapes, one puffs out the cheeks (with air held in the oral cavity, calling for a closed mouth). We can see alternations of sucked in cheeks and puffed out cheeks when describing parts of a vase, for example (Lu and Goldin-Meadow 2018).

Often mouth demonstrations include a 'sound effect,' an example being [pfff] when doing an action such as throwing a cat out a window (Quadros et al. 2020), though the mouth articulations

[3]See https://www.anatomynext.com/muscles-facial-muscles/.

need not involve actual sound production (for example, they can show "the imagined sound of an object being punctured or penetrated, see Wulf and Dudis 2005, 329–330). Hogue (2011, 38), for example, notes that bilabial trills are iconically associated with movement even if no sounds are produced. Sound-effect demonstrations are to be distinguished from mappings of the facial expression of a character onto the face of the narrator. That is, a person might be so annoyed at a cat that she tosses it out the window – and her face, in this case, would probably show that annoyance. The [pfff], however, is not related to the actor's annoyance, but, instead, to the motion of tossing that cat and, perhaps, to the continued motion of the cat flying through the air. Likewise, when a signer shapes their mouth as in pronouncing 'boom' as they sign SHOOT-GUN, the mouth shape is not prototypical of what people do when they actually shoot, but, instead, indicates the noise of the gunshot (Dudis 2004, 62). Lu and Goldin-Meadow (2018) also note what they call the "ps" mouth shape, which can be reduplicated to correspond to spatial reduplications in the manual movement, for example, forming that mouth shape three times as the signer traces the three curves of a tree branch using the G-handshape (see discussion of their Figure 7).

4. Examples of mouth demonstrations in narration

Sign language narrative is highly depictive; as Napoli and Leeson (2020, 7) say, it is,

> …multifaceted in the extreme, including iconic mappings between articulations and size, shape, orientation, manner, extent, and other facets of referents in the message, as well as mappings between (parts of) the signer's body and (parts of) referents in the message, thus incorporating elements of mime and gesture including role playing…

To this we add tracing in the air and classifier constructions (and see Bauman et al. 2006; Metzger 1995; Rayman 1999; Sutton-Spence and Kaneko 2016; Taub 2001; Wilcox 2000; among others).

In role playing – also known as constructed action/constructed dialogue – the signer embodies a character and acts out what that character is doing. Cormier, Smith, and Sevcikova-

Sehyr (2015, 181) note role playing can use "squinted eyes and pursed mouth" to represent "small size or refined movement." We take this "pursed mouth" to be (close to) the same as what Sandler (2009) intends with "tightening of the mouth" and what Cuxac and Sallandre (2007) call "puckered lips" (which they also connect to "squinting eyes"), and we now use this repeated observation to initiate a list of demonstration mouth articulations for researchers to be on the alert for in narrative:

- puckered lips (perhaps with squint)

In a study of narrative in French SL and Italian SL, Petitta, Sallandre, and Rossini (2013) show that, with the exception of mouthing, mouth articulations are a fundamental aspect of sign languages. They offer a representative, but in no way exhaustive, list of mouth articulations that do not mime what the mouth does regarding the sense of the sign (and, so, are not enactments) but are, indeed, depictive, and occur in narrative. We now add these to the list we've initiated, noting that we take "vibrating lips" to be the same as Hogue's (2011) bilabial trills:

- expelling air in a "whistling" fashion, with stretched lips;
- vibrating lips while expelling air, with or without vibrating vocal cords;
- moving tongue sideways while signing;
- moving mouth in a downwards fashion.

Importantly, Petitta, Sallandre, and Rossini (2013) note that mouth articulations are frequent in what they call Highly Iconic Structures – so we should expect them in the classifier constructions typical of narratives.

Quadros and colleagues (2020) add sound-effect mouth articulations (and recall they do not necessarily indicate an audible articulation), noting the one we mentioned earlier, where we add in Lu and Goldin-Meadow's (2018) 'ps' mouth shape:

- [pfff]

- ps mouth shape

This list, we hope, can help others who want to pursue investigation of mouth demonstrations. Our focus in this paper, however, is narrowly on one kind of mouth demonstration: articulations that involve movement of the corners of the lips to align spatially and temporally with movement of manual articulators.

5. Our data set and findings

The stimulus. A national corpus of language data is presently being established for Libras. As part of it, several deaf signers were shown a video (duration 2 minutes and 54 seconds) of the Charlie Chaplin story "The Kid"[4] and asked to retell it in Libras. We selected three of these retellings at random for the present study. Then three deaf signers of DGS and three deaf signers of ASL were recruited through friendship with the authors, shown the Charlie Chaplin story, and asked to retell it. In sum, we have nine videos, three in each language. The consultants were not aware that we were looking specifically at mouth articulations prior or during their participation. The Libras videos were made in a professional studio. The ASL and DGS videos were self-recorded.

The consultants. The signers are fluent and signing is their preferred mode of communication. They are university graduates ranging in age from early 30s to early 50s. We had one female consultant each for Libras and ASL; all others were male.

We did not collect further information on the language backgrounds of our consultants – in particular, we did not ask questions typically meant to determine whether the consultants were native or near-native signers (i.e., L1 signers)– for two reasons. First, this is not the accepted protocol in some deaf communities (Napoli, Sutton-Spence, and Quadros 2017); asking it might

[4] Available at: https://www.youtube.com/watch?v=qNseEVlaCl4

have affected willingness to participate. Second, questions about at what age someone learned to sign, in what language they were educated in at school, whether or not family members are deaf – these questions might have "a negative effect on deaf communities by exalting the language of those who were privileged enough to acquire a firm foundation in signing during the sensitive period for language development and discounting the language of others" (Fisher, Mirus, and Napoli 2019, 152-3).

We have confidence in the data provided by our consultants. One of the authors of this paper is a L1 signer of Libras, and judges the signing in the Libras videos to be native. Another author is a L1 signer of DGS, and judges the signing in the DGS videos to be native or near-native. With respect to the signing of ASL consultants, we happen to know that one is the deaf child of deaf parents (deaf-of-deaf) and another was signing at least by early childhood. We know nothing about the linguistic history of the third. Importantly, the deaf-of-deaf signer's video did not differ with respect to mouth demonstrations from the other two ASL signers.

Coding. The resultant videos were annotated and analyzed with ELAN (ELAN 2008; Crasborn and Sloetjes 2008) by student researchers experienced with that software. The authors of the present article added a tier for coding mouth articulations.

The authors then coded all mouth articulations in all videos independently, and met to compare findings. First, we coded each in articulatory terms, then we labeled each mouth articulation as one of the eight types shown in Figure 1. All eight types in Figure 1 occurred in these narratives.[5] Coding according to these eight types is subjective, and places function above other considerations. This was a determined choice. We are not interested in relating mouth

[5] While lexical mouth articulations appeared, the subtype of them known as echo articulations did not appear. This is not surprising; echoes as defined by Woll (2009) are few in sign languages in general.

articulations to anything other than manual articulations, and then only in gross ways. In particular, we do not use the Facial Action Coding System (Ekman, Friesen, and Hager 2002), which notes all facial articulations, since we are not concerned with (in)consistencies between different facial articulations.

There was general agreement on author coding of mouth articulations. Initial disagreements were due to the failure to recognize mouthings by one or more of us unfamiliar with the relevant spoken language (and we note that mouthing is frequent in DGS [Ebbinghaus, Horst, and Hessmann 2001]). Important for us, there was 100% agreement on recognition of mouth demonstrations.

In our nine videos, there were multiple mouth articulations (most mouthings or part of whole-face gestures), where very few were mouth demonstrations. Our objective below is to establish the existence of demonstrations in which the corners of the lips align spatially and temporally with movement of manual articulators.

5.1 Lip articulations

While the lips articulate in multiple ways in sign languages (Bergman and Wallin 2001; Crasborn and Bank 2014), we are concerned only with lip corners, so our points are straightforward, non-technical, and not dependent upon measurements of degree of movement. Therefore, simple images suffice to describe the three types of articulations relevant to us.

The corners of the lips can be maximally distant from one another or move closer together, whether the mouth is open (Figure 2) or closed (Figure 3).

<FIGURE 2 GOES HERE>

Figure 2: open mouth

<FIGURE 3 GOES HERE>

Figure 3: closed mouth

Open or closed, the mouth puckers as the corners of the lips get closer to one another.

Additionally, we can screw one corner of the lips to the side, often moving it a little upward. In Figure 4 we see the right corner of the lips pulled rightward and slightly upward, where Figure 4a is a mild screw and Figure 4b is an exaggerated screw.

<FIGURE 4 GOES HERE>

Figure 4: screw mouth

Finally, we can protrude one or both lips, moving the corners of the lips forward while maintaining a fixed distance between them. This is executed either by activating muscles (in which case the mouth can be closed or open, but we show only closed mouth in Figure 5a because our data set used only closed protruded lips) or via air pressure trapped inside the oral cavity behind closed lips (Figure 5c).

<FIGURE 5 GOES HERE>

Figure 5: lip protrusion caused by muscle activation (a) or air pressure (b)

In the mouth demonstrations in our data set, other articulations of lip corners did not occur, and the articulations above differed by degree (from slight to exaggerated). In all examples below, our judgment that there is a lip corner articulation in progress is based on comparison with positions of the lip corners immediately preceding and following. Please note that the movement is rapid;

photos that show a mouth before, during, and after a mouth demonstration take place in fractions of a second.

5.2 Shrinking-size pucker

In our data set we find several instances of a classifier construction in which a hand moves away from the signer within the line of sight, with an initial L-handshape changing to a G-handshape, indicating that an object in motion goes so far away that it visually diminishes in size. A mouth pucker often coocurs in such a way that the distance between the corners of the mouth shrinks as the distance between the index finger and thumb shrinks – so we have spatial and temporal alignment of mouth and manual articulators. This particular classifier construction is common to narratives in all three languages, and all exhibit what we dub the **shrinking-size pucker** with it.

Often, the nondominant hand points toward the dominant hand, as ASL and Libras in Figure 6. Generally, the eyes squint.[6] Figure 6 shows the mouth configuration immediately preceding the manual movement (not a pucker), the mouth configuration during the manual movement (a pucker), and the mouth configuration instantly after the manual movement has reached the end of its path (in ASL a flattening of the mouth, in Libras a relaxation of the pucker, in DGS a new mouth articulation that is going to be part of a following whole-face gesture) when hands begin to relax and gaze often leaves the hands (as we see in Libras and DGS).

<FIGURE 6 GOES HERE>

Figure 6: Shrinking L-handshape with shrinking-size pucker in a classifier construction

[6] This squint in our data set appears to be iconic of difficulties in seeing something because it is far away and not evidence of coordination of eyelids with manual and/or mouth articulators; the eyes squint even when a 1-handshape classifier moves into the distance. In particular, it does not appear to serve other functions, such as marking relative clauses (as in Kubus 2016).

Various changes in handshape can be used to indicate gradience in size (Fuks 2014, and references there; and for drawing angles of triangles, see Emmorey, Nicodemus, and O'Grady forthcoming, their Table 2 and Fig. 4), where the shrinking L-handshape is just one of them. Likewise, puckers can be gestures which are iconic of small size (Cuxac and Sallandre 2007; Sandler 2009; Cormier, Smith, and Sehyr 2015). What is new here is the analysis of this pucker as a shrinking of the distance between the two lip corners in temporal and spatial alignment with the shrinking of the distance between the thumb and index finger in the shrinking-L handshape. This alignment is what classifies the pucker as a mouth demonstration in this classifier construction.

5.3 Alignment mouth demonstrations

Here we demonstrate four types of mouth demonstrations in our data set that involve spatial and temporal alignment of the corners of the mouth with the two hands in classifier constructions, and that occur in all three languages. None has been mentioned in the linguistic literature so far as we know. In these examples, the signers' eyes are typically directed toward their hands, as is generally the case with classifier constructions (Engberg-Pedersen 2003, 283).

In the first new type, which we dub **fixed flat mouth**, the lips are closed and tense, with the corners maintaining a substantial and, importantly, fixed distance between them throughout the manual movement, which, likewise, maintains a fixed distance between the hands. In Figure 7, we have examples where each hand separately is a classifier and they move ahead, side-by-side, along the sagittal axis. Each corner of the mouth aligns with the ipsilateral hand spatially and temporally.

<FIGURE 7 GOES HERE>

Figure 7: Fixed flat mouth accompanying classifier constructions

In the second type, which we dub **proximity pucker**, the lips move into a tight pucker. This happens a few times in our data set, and always when both hands are classifiers, and one or both hands move toward the other along a transverse axis. As the distance between the hands decreases, the distance between the corners of the lips decreases. The examples in Figures 8 through 10, depict different events within the narrative. In the DGS photos in Figure 8, the classifier on the signer's right hand moves toward the stationary classifier on the signer's left hand. In the first shot, we see the mouth before the right hand begins to move; in the second shot, during that movement; and, in the third shot, immediately after the right hand has stopped moving (note that the signer's gaze redirects toward the addressee as the classifier construction ends).

<FIGURE 8 GOES HERE>

Figure 8: Proximity pucker accompany ing classifier construction in DGS

In the ASL photos in Figure 9, we see a shot of the signer as he finishes signing WALK, in which he embodied a character. Then we see him hold his left hand in place as a classifier, if you will, of that character, while his right hand signs BOY and he mouths the English word. Next, he introduces another character represented by the 1-classifier on his right hand, and he starts to pucker his mouth. As that classifier nears the left-hand classifier, the pucker tightens. When the right-hand classifier comes as close as he's going to get to the left-hand classifier, the signer's gaze leaves that right hand and the mouth loses the pucker.

<FIGURE 9 GOES HERE>

Figure 9: Proximity pucker accompanying classifier construction in ASL

In Figure 10 we see photos from Libras, where both hands move. Again, our first shot shows the mouth immediately before the hands become classifiers. And here our final two shots show the mouth as the hands stop moving and then as the hands go on to the next sign. Once more the signer's gaze shifts away from the classifier hands as the movement of the classifiers stops.

<FIGURE 10 GOES HERE>

Figure 10: Proximity pucker accompanying classifier construction in Libras

In the third type, which we dub **forward mouth**, the mouth moves forward, either via lip protrusion (as in Figure 5a-b) or via air pressure trapped inside the lips making both lips move forward (as in Figure 5c). This can happen when both hands are classifiers that move along the sagittal axis, one behind the other. In Figures 11a-c we see lip protrusion in examples from Libras (bottom lip), ASL (both lips), and DGS (both lips), in which the right hand follows the left hand, both moving along the sagittal axis. In Figure 11d we see puffed-out lips in an example from ASL in which the right hand follows the left where the left hand is a classifier representing two people moving forward together (the same two people that were seen moving forward side-by-side in Figure 7a). Here the important manual spatial information is that the two hands are moving forward along the sagittal axis. The two corners of the lips repeat that spatial information by moving forward throughout the manual articulation.

<FIGURE 11 GOES HERE>

Figure 11: Forward mouth accompanying classifier constructions

In the fourth type, which we call **screw mouth**, the mouth screws (as in Figure 4). This can happen when both hands are classifiers, but only one hand moves, and that hand moves in any direction other than along the transverse axis toward the stationary hand (that is, not in the direction that can trigger the proximity pucker of Figures 8-10). The corner of the lip that screws is ipsilateral to the moving hand. In the Libras example in Figure 12 the right hand of the signer moves toward the left hand, but, importantly, from behind rather than from the side, while the left hand stays steady. Only the right corner of the lips articulates, as only the right hand articulates. The left corner of the lips stays fixed, as does the left hand. Here we show two initial shots to demonstrate that the right corner of the lip does not screw until the right hand begins to move. The final shot shows that the screw releases as the hand stops moving.

<FIGURE 12 GOES HERE>

Figure 12: Screw mouth accompanying classifier construction in Libras

In the DGS example in Figure 13, we see a similar situation. Throughout these images, the left hand is a classifier for a man. We first show the right hand moving toward the immobile left hand from behind (where the index and middle fingers represent the running legs of a boy). Then the right hand changes to the classifier for a person and continues moving toward the left hand. Immediately after, the lips tense and widen. Next, the right hand approaches the left and jiggles around, and the right side of the mouth screws. Now the right hand changes into the hand of the referent of the left hand classifier, shooing away the boy (who is no longer manually represented) and the mouth changes to be part of a whole-face gesture showing displeasure (where, importantly, the corners of the mouth return to being symmetrical).

<FIGURE 13 GOES HERE>

Figure 13: Screw mouth accompanying classifier construction in DGS

In the ASL example in Figure 14, the right hand of the signer moves randomly about while the left hand stays steady. Again, the right corner of the lips screws more tightly as the movement continues, coordinating with the asymmetry of manual movement.

<FIGURE 14 GOES HERE>

Figure 14: Screw mouth accompanying classifier construction in ASL

Figures 7 through 14 exemplify the only geometric configurations we found in our data set involving both hands being classifiers and in which the mouth articulated in a way other than the seven mouth articulations in Figure 1 that are not demonstrations. We account for these data by proposing that the corners of the mouth align with the hand on the ipsilateral side temporally and spatially. In this way, mouth articulations enhance manual articulations.

In summary:

- **Fixed flat mouth** maintains a fixed transverse spatial relationship between the lip corners, as the two hands maintain a fixed transverse spatial relationship.
- **Proximity pucker** brings the corners of the lips closer together along the transverse axis as the two classifier hands get closer to each other (whether by one or both moving) along a transverse axis. This is natural, since the resting mouth forms a transverse axis along which the corners of the mouth can move closer to each other. (Notice that the lips move forward

as the corners of the mouth come in closer proximity – but it is the movement of the corners of the mouth that causes this and that is our focus here.)

- **Forward mouth** moves the corners of the lips forward as the two classifier hands move forward along the sagittal axis, one behind the other. (In contrast to proximity pucker, the corners of the lips do not move closer to each other. Instead, they maintain a fixed distance between them.)
- **Screw mouth** tightens and raises one lip corner, leaving the other lip corner fixed, as one classifier hand moves about while the other hand stays fixed, with the caveat that the moving hand does not simply move closer to the fixed hand along the transverse axis.

Generally, mouth demonstrations of all types are most common in narrative. However, we might expect them to occur in a frozen lexical item, given that many frozen lexical items originate from classifier constructions (Johnston and Schembri 1999; Kegl and Schley 1986; Zwitserlood 2008, among many). This may be the case for at least three of our alignment mouth demonstrations. Fixed flat mouth seems to occur with some frozen lexical items indicating immobility via arrangement of the hands in a fixed position along the transverse axis (see, for example, STABLE in French SL and Chinese SL on the website spreadthesign.com). Proximity pucker seems to occur with some frozen lexical items that indicate closeness via manual movement along the transverse axis (see, for example, WITH in Croatian SL on spreadthesign.com).[7] **Forward mouth** seems to occur with some frozen lexical items that indicate movement forward of one referent behind the other (see for example CHASE in the sign languages of Austria, China, Poland, Portugal, Spain, on spreadthesign.com).

[7] We caution the reader to be alert for mouthings in all searches for demonstration mouth articulations in frozen signs, but particularly with regard to a pucker. Fortunately, the website spreadthesign.com gives the spoken language word for each sign, allowing one to check.

We thus have established the existence of **alignment mouth demonstrations** in which the articulation of the corners of the mouth aligns with the articulation of classifier hands with respect to spatial characteristics of the articulators, where mouth and manual articulations temporally coincide, something not noted in the literature before. In our small data set, the frequency of use of alignment mouth demonstrations varies by individual signer, but not by language.

5.4. The status of the shrinking-size pucker

An immediate question is whether the shrinking-size pucker of Section 5.2 might be a special instance of the proximity pucker of Section 5.3. Both puckers occur in classifier constructions and coordinate with an increasing proximity in the manual articulators – where with the first, the manual articulators are hand-internal (the thumb and index finger of the shrinking-L handshape) and with the second, the manual articulators are both hands moving along the transverse axis. The shrinking L-handshape has been analyzed in various constructions as a one-handed perimeter classifier (Collins-Ahlgren, 1990; Corazza, 1990; Liddell & Johnson, 1987). That is, the two selected fingers behave in similar ways to two separate hands drawing a shape. As Nyst (2016, 90) points out, the aperture between a finger (here the index finger) and the opposing thumb can indicate a stretch of space between two edges or lines in the same way that distance between the two hands can. Napoli and Ferrara (forthcoming), likewise, observe that when signers trace shapes in the air using changing handshapes, including shrinking L (as well as baby-C > baby O and C >O), "the thumb and the finger(s) act as separate articulators, almost like two mini-hands." With the shrinking-size pucker, the two "classifiers" (one indicating the top of a referent and one indicating the bottom of a referent, as that referent shrinks in the distance, perhaps?) end up closer together along the axis that cuts between thumb and index finger (regardless of the position of the whole

hand). Thus, the critical difference between the two puckers is that the lip movement in the shrinking-size pucker demonstration coordinates only with increasing proximity of classifiers, while the proximity pucker incorporates into that coordination the axis along which proximity is achieved. We suggest, then, reanalysis of the shrinking-size pucker as an alignment mouth demonstration, but we do not presently see a way to analyze it as a subtype of the proximity pucker. We thus go forward now with five alignment mouth demonstrations.

6. Discussion and prediction

Alignment mouth demonstrations appear to belong to the repertoire of mechanisms that signers can use in narratives and thus should be included in discussions of the structure of narrative. In particular, the spatial relationships between characters in the narrative, as expressed through the use of classifiers, were likewise expressed through alignment mouth demonstrations. And the appearance of size shrinking as a character moved into the distance, as expressed manually through the use of the shrinking-L-handshape was likewise expressed through an alignment mouth demonstration. However, in our data set, alignment mouth demonstrations did not occur independently of manual articulation. That is, we never found a signer using a proximity pucker, for example, to indicate that the distance between two characters lessened without also having classifiers indicating that information. Thus, mouth articulation is coordinated with manual articulation in alignment mouth demonstrations, thus they are not gestural and they give redundant information. We here discuss the grammatical status of alignment mouth demonstrations and their value in narrative, then offer a prediction and the results of a preliminary test of that prediction on a second data set.

6.1 Grammatical status

While all our signers used all these alignment mouth demonstrations at least once, none of them used them every time a conditioning manual articulation occurred. Given the brevity of the videos and the paucity of situations in the narrative that called for the manual articulations that can trigger alignment mouth demonstrations, we gleaned no information on what factors might favor the occurrence of an alignment mouth demonstration.

Importantly, though, the variability of the appearance of mouth demonstrations in no way detracts from their status as being part of the grammar. Gradient phonotactics are often the source of variation in spoken language (Alderete and Finley 2016; Coetzee and Pater 2005; Frisch, Pierrehumbert, and Broe 2004; Gallagher 2016; among many), and, as Hodge and Cormier (2019) argue, reported speech, which involves role playing, is a common type of depiction in sign languages (typical of narrative, but also appearing in ordinary conversation; see Quinto-Pozos 2007), and is conventionalized, but this conventionality is manifested as "a gradient property of different communicative acts" rather than identically across language ecologies (p. 194). Alignment mouth demonstrations are, then, another gradient feature of sign language narrative.

Likewise, the depictive nature of alignment mouth demonstrations does not compromise their status as being grammatical units; our understanding of human communication and language use should not be hampered by apriori ideas of what qualifies as 'language', but, rather, be enriched by recognition of the wide range of semiotic repertoires humans avail themselves of in both spoken and sign conversations and narratives (Dingemanse et al. 2015; Ferrara and Hodge 2018; Kendon 2014; Kusters et al. 2017; Stec et al. 2016; and the many works these sources cite).

6.2 Purpose of alignment mouth demonstrations and a prediction

Why should signers choose to use alignment mouth demonstrations? They are not instances of obligatory and unconscious motor coordination of articulators (in contrast to claims about echo phonology). And they give no new information, in contrast to co-speech gestures (McNeill 1992; Kendon 2004); instead, they repeat (part of) the information delivered by the manual articulators.

Their very redundancy suggests an answer. In spoken languages, there is a growing literature on overspecification, that is, the occurrence of features that are redundant in the sense that they are dispensable with respect to communication (Szmrecsanyi and Kortmann 2012). Familiar examples include 'extra' morphological distinctions for number, such as dual and paucal, and for person, such as inclusivity in the first person plural. Less familiar examples include distinctions in copular constructions as a function of the meaning of the predicates, which happens in Saramaccan, a creole language of Suriname (McWhorter 2012). While overspecification is not critical to communication, it has the benefit of reducing the error of reception of complex information (Campbell 1982, 73; and see Hunnicutt 1985, 53), and resolving ambiguity (Wit and Gillette 1999). The task of identifying a single referent within a discourse is highly complex (Epstein 2002), so the task of identifying two referents interacting with each other is enormously complex – supplying motivation for the overspecification we see in alignment mouth demonstrations. (And we note overspecification occurs in sign languages in another complex task: drawing shapes in the air, see Ferarra and Napoli 2019.)

Given that children appear to master the difficult task of identifying reference to person, to space, and to time in discourse over the entire course of childhood (Hickmann 2017; Schwab and Lew-Williams 2017), if our account is on the right track, we might expect narrative aimed at children to try to help them keep track of these relationships, and, thus, to make frequent use of alignment mouth demonstrations. Further, the mouth corners in alignment mouth demonstrations

reinforce the manual articulators in classifier constructions, where those articulators relate to each other iconically spatially and temporally, and there is evidence that iconicity, at least with regard to lexical signs, aids in learning a sign language both as L1 and L2 (for overview, see Ortega 2017), a factor that good sign storytellers might instinctively take into account when they deliver narrative (Sutton-Spence and Kaneko 2016, 60 ff). This might be one reason why sign narrative helps to develop sign language proficiency and literacy in deaf children (Rathmann, Mann, and Morgan 2007). And one- versus two-handedness of a sign turns out to be an important iconic factor cross-linguistically (Östling, Börstell, and Courtaux 2018) – so mouth actions that reinforce the distinction between one moving classifier versus two and how two classifiers relate to each other spatially and temporally might also be particularly helpful to the child.

7. Testing the prediction on a second data set

As an initial testing of the prediction that narrative aimed at children should use alignment mouth demonstrations, we examined mouth articulations in deaf signers' renderings of a story that appears on the RISE website of eBooks and YouTube videos for deaf children[8]: *Rocky the Cat who Barks*. This story is told in multiple languages, which, simply by chance, include ASL, DGS, and Libras. It is also told in six other sign languages: those of Fiji, Ireland, Italy, Japan, Korea, and Nepal. All signers on this website are deaf and signing is their preferred mode of communication. All signers in these nine videos were in their early 20s and students at Gallaudet University at the time they were recorded. Six are male; three are female. They are signing in their home country's sign language.

[8] Found at https://riseebooks.wixsite.com/access.

Role playing, where the story-teller embodies a character, is a common method of showing characters' actions in these story renderings, reducing the use of classifiers (Ferrara and Halvorsen 2017). Further, mouth articulations that are part of whole-face affective gestures are prevalent, reducing the potential for appearance of mouth demonstrations. Nevertheless, we did find relevant classifier constructions. At various points in the story, a dog moves toward another character (a woman or a cat), and at another point in the story, the dog and a whole group of cats move toward each other. In our data set, sometimes these instances are rendered via two classifiers, one on each hand, where additionally the mouth happens not to be coopted by other types of mouth articulations, so it is available for a mouth demonstration. We find in these instances that when movement is along the transverse axis in front of the signer (whether one or both hands move), the proximity pucker occurs (in varying degrees). Figure 15 (reproduced with the kind permission of riseebooks.wixsite.com – as are Figures 16-18 below) offers examples for ASL, DGS, and Libras.

<FIGURE 15 GOES HERE>

Figure 15: Proximity pucker accompanying a classifier construction in a children's story in ASL, DGS, and Libras

In ASL and DGS the classifiers on both hands are the same. In Libras, the classifier on the right hand is for a bowl of cat food, and is metonymically the cat who eats from that bowl (Wilcox and Wilcox 2012); the classifier on the right hand is a dog coming near the cat who is eating.

We find the proximity pucker in this story told in the sign languages of five other countries, and, we suggest, in the sixth, as well. For Ireland, Italy, and Japan, the mouth pucker is easy to see, hence we give only a single snapshot of each in Figure 16.

<FIGURE 16 GOES HERE>

Figure 16: Proximity pucker accompanying a classifier construction in the same children's story in the sign languages of Ireland, Italy, and Japan

For Fiji and Nepal, the mouth pucker is slight and most easily recognized in comparison to the mouth articulations immediately before and after the pucker, so we give multiple snapshots each in Figure 17, where the center one is the culminating moment of classifier movement, after which the hands begin to ready for the next sign, as does the facial articulation, including the mouth.

<FIGURE 17 GOES HERE>

Figure 17: Proximity pucker accompanying a classifier construction in the same children's story in the sign languages of Fiji and Nepal

For Korea, it is a stretch to call the mouth articulation here a pucker, but it could be reasonable to make that stretch. By comparing the mouth at the beginning of the manual movement, at one point during the movement, at the instant the two hands have come as close to each other as they will get, and in the moment after the movement has finished when the signer's hands and mouth begin to relax, all shown in Figure 18, we can see increased tension in the corners of the mouth (reflected also in the cheeks) and ever so slightly raised peaks of the top lip. This signer used this mouth articulation consistently when others used a more clearly-defined proximity pucker.

<FIGURE 18 GOES HERE>

Figure 18: Proximity pucker in the same children's story in the sign language of Korea

The renderings of this children's story, then, offer initial confirmation of our expectations.

8. Conclusion

That the mouth may move in coordination with the hands during language production is not a new claim (it occurs at least from Paget 1930 on; for a brief history, see Woll 2009). Many types of studies have confirmed mouth-hand coordinated articulation in several motor domains (Calvert, Spence, and Stein 2004), including first-language acquisition (Iverson and Fagan 2004) and, especially, neurobiology (Corballis 2002; Gentilucci 2003; Gentilucci and Campione 2011; among many), where often the focus is on the issue of how speech evolved. What we have focused on here, instead, is meaningful such hand-mouth coordination: alignment mouth demonstrations repeat information given by manual articulators, supporting the message of the narrative.

The shrinking-size pucker mouth demonstration involves coordinated movement to bring about the shrinking of the distance between the corners of the lips to match the shrinking of the distance between the selected fingers in the L-handshape. The other alignment mouth demonstrations involve aligning the corners of the lips with classifier handshapes and moving those corners in a systematic way with respect to the movement of the classifiers and their spatial relationships to each other. This alignment is optional, occurs naturally in narrative, and its frequency of use is variable based on individual signers, all of which factors mean that this phenomenon does not lend itself to statistical analysis across a large corpus.

But these findings are suggestive, and beg for systematic testing. The primary study here is of just three signers each in only three sign languages, delivering a single narrative, where Libras and ASL are in the same family, and all three sign languages have a European history. However, our findings with respect to the proximity pucker in Section 5.3 are supported by findings in Section 7 on a separate narrative with different signers in these same three sign languages plus six other signers in six other sign languages, including ones without a European history. Given what we know about classifiers cross-linguistically, this fact supports our analysis that alignment mouth demonstrations are based on coordination of human physiology (of the mouth and hand), not on culture.

A bold prediction now presents itself. While sign languages differ with respect to the inventory of handshapes they use as classifiers and with respect to the types of classifiers they exhibit, classifiers which indicate the movement or location of an entity appear in all sign languages studied in this regard thus far (Emmorey 2003; Sandler and Lillo-Martin 2006; Zwitserlood 2012; among many). The manual movement in these classifier predicates traces a path in the air that indicates changing spatial relationships of entities in the world. We therefore expect those movement paths to have strong similarities when signers of different languages express a given proposition. If the corners of the lips in alignment mouth demonstrations coordinate with the movement of the classifiers, we likewise expect them to have strong similarities. Thus, we predict further study to show that our results hold generally cross-linguistically.

One could devise ways to test our preliminary study – time-costly ways, which is why we decided not to delay in disseminating our preliminary findings. For instance, one might design a preference task in which deaf signers judge the naturalness of the signing in short video clips that show classifier constructions. Such a study must include clips in which the mouth does not

articulate, clips in which the four alignment mouth demonstrations studied here occur (puckered lips, lips protruding forward, flat and tense lips, and lips screwed to one side), and clips in which mouth articulations not studied here occur (such as one side of the mouth going down, or a tense mouth with top teeth showing). The clips must match these various mouth articulations with the different kinds of spatial relationships noted here between the two manual articulators, as well as with other spatial relationships (such as the two hands conjoined, or both moving downward, one above the other). Indeed, one might expect that if the proximity pucker is a true example of a mouth demonstration, we might also find a widening and tensing of the lips when two classifier hands move apart from each other along the transverse axis, for example. And if the forward mouth is a true example of a mouth demonstration, we might also find a pressing inward of the lips when two classifier hands moved along the sagittal axis toward the signer with one behind the other. Although we saw no language differences in our preliminary study, ideally in this new study the sign actors will match consultants with respect to the sign languages each normally uses. A hefty undertaking, this.

Should such a test largely confirm our study here, we have further predictions one could test on the resulting data set, involving matters of perception. Optionality in articulations in spoken language is sometimes the result of a process of enhancement to features that are in jeopardy of losing their perceptual salience (Keyser and Stevens 2006; Stevens and Keyser 1989). Therefore, if alignment mouth demonstrations are enhancers (as we have suggested), we might expect them to occur more frequently when vision is somehow challenged. Manual movement along the midsagittal axis is the most difficult one for the eyes to perceive (Regan, Erkelens, and Collewijn 1986; Regan and Kaushal 1994; Sanders 2018). We might therefore expect the forward mouth demonstration and the fixed flat mouth demonstration, both of which accompany manual movement

along the sagittal axis, to occur percentagewise more frequently when the conditions for them are met than the other alignment mouth demonstrations.

Finally, in the wake of confirmation of our study here, one might propose that alignment mouth demonstrations would occur much more frequently in adult signing than in juvenile signing. In fact, proper use of alignment mouth demonstrations should be mastered quite late, around the same time the task of identifying reference to person, to space, and to time in discourse is mastered by both deaf and hearing children.

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