The Phonetic basis of sonority in American Sign Language

Tatiana Luchkina[1] , Elena Koulidobrova[1], & Jeffrey Palmer[2]
[1]*Central Connecticut State University*
[2] *Gallaudet University*

Background: Research demonstrates that phonological and visual learning problems are resolved in similar ways [1] and with the use of the same cognitive processes. This 'unification account' makes two predictions: (i) that both native and hearing L2 signers, as well as non-signers are responsive to articulatory features of sign languages and that (ii) both spoken and sign languages (SLs) deliver perceptual cues which exhibit various degrees of perceptual validity in categorization (e.g., see Figs 1a,b). In spoken languages, listeners develop perceptual biases when integrating multiple acoustic dimensions [2]. We should then also expect differential perceptual validity for dynamic gestural units produced by manual articulators in SLs. [3] demonstrate (i) to be true for articulatory sign features HANDSHAPE, MOVEMENT, ORIENTATION, and LOCATION. In line with (ii), the responsiveness of both signers and non-signers to these articulatory features must be more readily available for the perceptually salient features.

According to Brenrary's model of SL phonology[4], physical size of the active articulator contributes to its relative visual salience and may serve as a correlate of sonority in sign modality. Larger scale articulators (shoulder >> elbow >> wrist joints) deliver more perceptually salient phonemic contrasts than smaller scale articulators (e.g. finger joints). In contrast, [5] predicts the sign feature MOVEMENT, suprasegmental in nature, to be the most salient, as it can be purposefully enhanced by the signer to relay focus or emphasis.

In this study, we evaluate the perceptual saliency of the gestural components of signs in American Sign Language for naïve signers vis-à-vis deaf L2 learners of ASL proficient in another SL, to **reveal which of these features are likely to present the phonetic basis for sonority in sign modality and relay phonemic contrasts perceptible for even naïve signers.**

Participants: 25 deaf L2 signers (mean age:19;03; mean length of sign exposure: 193.8m., mean length of ASL exposure: 15.2m) and 28 hearing English speakers with no experience in any sign language (naïve signers, mean age: 27;09).

Method: In a closed-set Sentence Discrimination Task [5] with 96 video test trials, relative perceptual salience of articulatory sign features was proxied by the rate of discrimination of ASL sentence pairs which differed in terms of one aspect of the visuo-spatial configuration of the sentence-initial/medial/final word: HANDSHAPE, ORIENTATION, MOVEMENT, and LOCATION (see Fig.1). Each test trial contained test sentence presented by a native signer and sequentially reproduced by two different native signers. Participants judged each sentence pair as SAME or DIFFERENT. Responses were modeled using a mixed-effects binary logistic regression.

Findings: Contrasts based on functional morphology were identified less accurately than lexical contrasts, but only by experienced signers. Naïve signers, who did not process stimuli for meaning, were accurate on 69.9% of the trials. The difference in accuracy (ΔACCURACY, see Fig.2) between experienced and naïve signers, except when localized to HANDSHAPE, fell within a narrow range of 9-17%. For *both participant groups*, contrasts in ORIENTATION and LOCATION, involving larger scale articulators, substantiated robust categorical discrimination (see Table 1). Results reveal a dissociation in the perceptual saliency of HANDSHAPE, which facilitated discrimination for experienced signers (as well as native signers [5]), but not for naïve signers, possibly due to its configurational complexity and smaller-scale spatial resolution.

Main conclusion: Despite the difference in language modality, phonological processing is anchored in the relative perceptual saliency of the features marking phonemic contrasts [2]. Consistent with the Sonority Hierarchy in SL [4], in ASL, phonemic contrasts based on HANDSHAPE, configurationally complex but spatially compressed, and therefore low in sonority, present a likely area of maximal difficulty in phonological development, unlike contrasts based on LOCATION and ORIENTATION, high in sonority, and perceptible even for first-time signers.

Figure 1a: "mother" (ASL)

Figure 1b: "father" (ASL)

Phonemically contrastive feature: LOCATION of the sign relative to the signer's body.

Figure 2: *Results of the Sentence Discrimination Task. Y-axis: mean discrimination accuracy (%) for experienced ASL signers (blue line) and English speakers with no experience in a sign language (orange line); X-axis: phonemically contrastive features. HS=Hand shape; LOC=Location; MVT=Movement; ORI=Orientation; SAME=identical sentences (no contrast).*

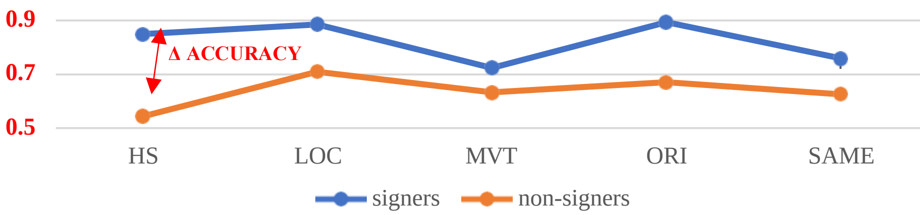

Table 1. *Results of the mixed-effects logistic regression (fixed effects) modeling responses of the sentence discrimination task. Dependent variable: log likelihood of correctly identifying a sentence pair as SAME or DIFFERENT.* Fixed effects: PHONEMICALLY CONTRASTIVE FEATURES, CONTRAST TYPE (lexical/morphological), LOCATION IN THE SENTENCE (sentence-initial/final/medial; not shown); random effects: PARTICIPANT and TEST ITEM.

	Coefficient		***z***		***p***	
Fixed effects	**Naïve signers**	**Experienced signers**	**Naïve signers**	**Experienced signers**	**Naïve signers**	**Experienced signers**
Handshape (HS)	-.38	1.36	-3.06	3.33	.002	.001
Location (LOC)	.34	1.92	2.59	4.48	.01	.001
Movement (MVT)	.05	.517	.004	1.54	.97	.125
Orientation (ORI)	.19	2.01	2.32	4.54	.02	.001
Contrast type (morphological)	.26	-.67	1.36	-2.85	.175	.004

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