AN EMERGENT LANGUAGE BECOMES SMALLER AS IT EVOLVES: NEW EVIDENCE FROM MOTION TRACKING IN NICARAGUAN SIGN LANGUAGE

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With the founding of a new school in Managua approximately forty years ago, Deaf Nicaraguans came together in greater numbers than before. Though teaching was in Spanish, Deaf students soon began to communicate manually. This was the beginning of a new language: Nicaraguan Sign Language (NSL). Each year children enter the school and learn the language from their older peers, eventually becoming Deaf adults who use NSL for daily communication. Over successive generations, the language grows and changes. By comparing signers of different generations, we can document these changes. Here we investigate this structural change with motion tracking technology. Using the Kinect Motion Sensor (similar to Namboodiripad et al., 2016), we quantify a change that has often been hypothesized to occur in the development of a new sign language: reduction in size of the signing space.

Decrease in the size of a language's signing space, the area in front of the body in which signers produce signs, has been cited as evidence of maturation of a language and development away from gestural roots (e.g., Nyst, 2007). This phenomenon has previously been mentioned in NSL (Kegl et al., 1989), but in the twenty years since that first mention it has not been rigorously quantified.

Seventeen Deaf Nicaraguan Signers participated, all of whom began signing in childhood. Participants were drawn from a wide age range, having entered the Deaf Community from soon after the founding of the school (1974) to nearly thirty years later (2003). During an elicitation task, we tracked the position of signers' wrists using the Kinect, which returns inferred XYZ positions of 21 joints at a target frame rate of 30 fps (Schotton et. al., 2013). Before analysis, skeleton data for each participant was filtered using median filtering to reduce noise, and

skeletons were scaled to have the same upper-arm length to minimize effect of differing body proportions.

We measured signing space using the Euclidean distance between the tracked position between the shoulders and the tracked position of each wrist. This distance was computed at each frame and averaged over the session to obtain the mean distance of the wrists to the base of the shoulders for each signer. A simple linear model predicting size of signing space as a function of year of entry finds a significant effect ($F(1,15)=6.15$, $p=0.025$): overall signing space decreases with later year of entry. As this measure characterizes all of the sign and non-sign movements produced by a participant over the entire session, it is potentially subject to substantial noise. To address this concern, we isolated individual utterances and repeated the same analysis on those utterances alone. Here we found the same pattern (Figure 1), signers who entered the NSL community later employ a smaller signing space than do older signers ($F(1,14)=7.43$, $p=0.016$).

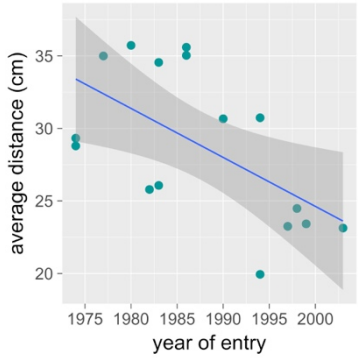

Figure 1. Normalized average distance from the base of the shoulder to the wrists for each signer during verb production. As the language matures, the size of the signing space decreases.

These results show that, even correcting for body size, younger signers who have learned NSL after it has been evolving longer employ a smaller signing space than older signers, reflecting a change in the language itself: signing space in NSL is decreasing in size as it is passed down to subsequent generations. Using motion tracking data, we have documented that as signers learn, use, and transmit NSL, the language begins to more closely resemble older world sign languages.

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References

Kegl, J., & Iwata, G. (1989). Lenguaje de Signos Nicaragüense: A pidgin sheds light on the "creole?" ASL. In *Proceedings of the Fourth Annual Meeting of the Pacific Linguistics Conference* (pp. 266-294). Eugene: University of Oregon, Department of Linguistics.

Namboodiripad, S., Lenzen, D., Lepic, R., & Verhoef, T. (2016). Measuring conventionalization in the manual modality. *Journal of Language Evolution*, *1*(2), 109-118.

Nyst, V. A. S. (2007). *A descriptive analysis of Adamorobe sign language (Ghana)* Utrecht, The Netherlands: LOT.