

Phonetic properties of head nods across sign languages: A pose estimation study

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Head nod is one of the most commonly produced bodily signals in interaction, used by both signers/speakers and addressees during face-to-face communication. Head nod is associated with a number of different functions in communicative interaction such as affirmation, emphasis, and feedback among other (McClave 2000; Cerrato 2005; Pupponen et al. 2015). Sign languages linguists have so far described head nods as aspectual or prosodic non-manual markers to signal clause and constituent boundaries and to mark phonological and intonational phrases in signed narratives (Liddell 1980; Nespor & Sandler 1999; Volk & Herrmann 2021; Wilbur 2021). However, most claims about the phonetic properties of head nods have been based on manual annotation without reference to naturalistic text types and the head nods produced by the addressee have been largely ignored (with notable exception of Pupponen et al. 2015; Mesch 2016). We thus lack detailed information about the phonetic properties of addressee's head nod and not much is known about their interaction with manual elements. This study presents findings about the phonetic properties of the addressee's head nods in natural dyadic signed interaction. The aim is to establish whether head nods serving different functions in interaction vary in their phonetic characteristics and in the co-occurrence with manual items. We hypothesize that affirmation nods differ from feedback nods.

To test the hypothesis, we combine manual annotation in ELAN with quantitative analysis of body pose information generated using the computer vision (CV) toolkit OpenPose (Cao et al. 2019) to extract head nod measurements from video recordings and examine head nods in terms of their duration, amplitude and velocity. For this study we use data from German Sign Language (DGS) (the Public DGS Corpus (Konrad et al. 2020)) and Russian Sign Language (RSL) (Burkova 2015; Bauer & Poryadin 2023).

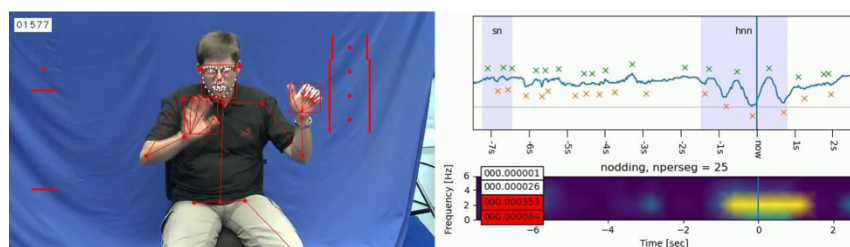


Figure 1: Visualization of head nods.

We investigate approx. 2 hours of naturalistic dyadic interaction per language and identify more than 600 occurrences of nods in each dataset. While the quantitative data analysis for RSL is ongoing, results from the analysis of the DGS sample show that feedback nods are on average slower in production and smaller in amplitude than affirmation nods, and they are commonly produced without a co-occurring manual element. Our cross-linguistic analysis reveals similarities between the two sign languages. We attribute the variations in phonetic properties of head nods to the distinct roles these cues fulfill in the turn-taking system of signed interaction.

References

- Bauer, Anastasia & Poryadin, Roman (2023), Russian Sign Language conversations, Data Center for the Humanities.
- Burkova, Svetlana (2015), The Online Corpus of Russian Sign Language, Novosibirsk State Technical University.
- Cao, Zhe, Hidalgo, Gines, Simon, Tomas, Wei, Shih-En & Sheikh, Yaser (2019), OpenPose: Realtime Multi-Person 2D Pose Estimation using Part Affinity Fields, *IEEE Transactions on Pattern Analysis and Machine Intelligence* 43(1), 172–186.
- Cerrato, Loredana (2005), Linguistic functions of head nods, in J. Allwood, and B. Dorriots (eds), *Proceedings from The Second Nordic Conference on Multimodal Communication*. Göteborg: Göteborg University, 137–152.
- Chizhikova, Anastasia & Kimmelman, Vadim (2022), Phonetics of Negative Headshake in Russian Sign Language: A Small-Scale Corpus Study, in E. Efthimiou, S-E. Fotinea, T. Hanke, J.A. Hochgesang, J. Kristoffersen, J. Mesch, and M. Schulder (eds.), *Proceedings of the 10th Workshop on the Representation and Processing of Sign Languages: Multilingual Sign Language Resources. LREC 2022*, Marseille, France: ELRA, 29–36.
- Konrad, Reiner, Hanke, Thomas, Langer, Gabrielle, Blanck, Dolly, Bleicken, Julian, Hofmann, Ilona, Jeziorski, Olga, König, Lutz, König, Susane, Nishio, Rie, Regen, Anja, Salden, Uta, Wagner, Sven, Worseck, Satu, Böse, Oliver, Jahn, Elena & Schulder, Marc (2020), MY DGS – annotated, Public Corpus of German Sign Language, 3rd release, Universität Hamburg.
- Liddell, Scott (1980), *American Sign Language Syntax*. Berlin / Boston: De Gruyter Mouton.
- McClave, Evelyn Z. (2000), Linguistic functions of head movements in the context of speech, *Journal of Pragmatics* 32(7), 855–878.
- Mesch, Johanna (2016), Manual backchannel responses in signers' conversations in Swedish Sign Language, *Language & Communication* 50, 22–41.
- Nespor, Marina & Sandler, Wendy (1999), Prosody in Israeli Sign Language, *Language and Speech* 42(2-3), 143–176.
- Puupponen, Anna, Wainio, Tuija, Burger, Birgitta & Jantunen, Tommi (2015), Head Movements in Finnish Sign Language on the Basis of Motion Capture Data: A Study of the Form and Function of Nods, Nodding, Head Thrusts, and Head Pulls, *Sign Language & Linguistics* 18(1), 41–89.
- Volk, Elisabeth & Herrmann, Annika (2021), Discourse Particles - Theoretical Perspectives, in: J. Quer, R. Pfau, and A. Herrmann (eds.), *Theoretical and Experimental Sign Language Research*, London: Routledge, 480–499.
- Wilbur, Ronnie (2021), Non-manual markers. Theoretical and experimental perspectives, in: J. Quer, R. Pfau, and A. Herrmann (eds.), *Theoretical and Experimental Sign Language Research*, London: Routledge, 530–565.