
Kinematic maturation of movement into manual language

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Maturation of movement into a conventionalized manual system is often accompanied by segmentation into shorter units, reduced iconicity, and new functional markers (Motamedi et al. 2019; Frishberg 1975). These shifts are paralleled by motor reduction as the system sediments into a skilled routine (Lupton & Zelaznik 1990; Pouw et al. 2021). Approaching language as a motor skill, we ask whether and which kinematics mark the shift from improvised gesture to conventionalized sign – and whether these ‘evolutionary’ motor changes mirror those that occur in individual acquisition of an existing system.

We analyze data from Spruijt et al. (2025; in revision), comprising video-recordings of silent gestures produced by hearing non-signers and signs (re)produced by naive, beginner, and native signers. Using MediaPipe (Lugaresi et al. 2019), we extracted kinematic features corresponding to key phonological parameters of sign languages (i.e., location and movement) from signals like speed, acceleration, and wrist-body distance. With Principal Component Analysis, we identify the features that distinguish (a) gesture from sign, and (b) learner from native signer.

Results focusing on gross motor patterns show that gestures and signs are clearly distinguishable from one another. Most variance is explained by (i) the location of the wrist relative to the body, (ii) the number of peaks in speed and acceleration, and (iii) speed. Learners and native signers seem to vary in acceleration, but clear clusters are absent. Learner error analysis suggests that handshape (fine motor skill) is under development in early acquisition (Spruijt et al., in revision), and we expect our analysis of finger kinematics to mirror this.

These findings contribute to a comprehensive account of both gross and fine motor patterns and their roles in both system-evolutionary (gesture-to-sign) and individual-acquisitional (naive-learner-native) trajectories of manual language.

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