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The Role of Motor Feedback in Second Language Sign Learning

Sign languages are natural human languages whose comprehension and production follow similar principles to spoken languages (Emmorey, 2002; MacSweeney et al., 2008). Unlike speech, however, they are produced in the visual–manual modality, where direct self-monitoring is limited: signers cannot always see their own signing space and thus rely heavily on somatosensory and proprioceptive feedback for articulation (Emmorey et al., 2009). Previous work suggests that motor systems contribute to both comprehension and learning, but their role appears to vary with linguistic experience and task demands. For example, late L1 and L2 signers show egocentric motor simulation effects during comprehension (Corina & Gutierrez, 2016; Watkins & Thompson, 2017), while native signers rely more on abstract linguistic representations. Similarly, motor involvement in speech is heightened under perceptually difficult conditions such as accented or noisy input (Adank et al., 2013; Hickok et al., 2011).

In learning contexts, producing gestures or signs enhances recall, particularly when learners rely on motor rather than visual feedback (Garcia-Gamez & Macizo, 2019; Morett, 2015; Morett et al., 2024). However, existing studies have rarely examined how somatosensory feedback supports both comprehension and production in new sign learners.

We address this gap by experimentally manipulating motor feedback during Hong Kong Sign Language (HKSL) learning. Hearing nonsigners will learn 48 low-iconicity signs (Ortega & Morgan, 2015; Ortega et al., 2019; Karadöller et al., 2024), balanced for phonological complexity, under four conditions: (1) normal practice, (2) motor-only feedback (eyes closed; cf. Morett et al., 2024), (3) altered feedback (using robotic gloves to distort proprioceptive signals; cf. Solomon et al., 2016), and (4) no motor feedback. Learning outcomes will be assessed through comprehension (forced-choice recognition) and production (recall). Production will be evaluated both linguistically and kinematically, using data recorded via a Qualisys 3D motion capture system alongside video, with motion similarity quantified using Dynamic Time Warping (Mueen & Keogh, 2016; Pouw et al., 2021).

We predict that the quality of motor feedback will strongly modulate learning outcomes. Participants are expected to perform best in the full-feedback condition, and better when motor feedback is available without visual input than when visual input is available without motor feedback. When motor feedback is restricted (altered via gloves), performance should remain above the no-feedback condition, reflecting a gradient benefit of somatosensory cues. Crucially, learning should be more successful when motor feedback is intact but visual feedback is blocked, compared to when visual feedback is intact but motor feedback is distorted. Finally, we predict that phonologically complex signs (e.g., marked handshapes, two-handed asymmetry) will show the greatest dependence on intact motor feedback, with the benefits of somatosensory input most pronounced for these items.

Together, this project will clarify the role of somatosensory feedback in the comprehension and production of a new sign language, highlighting how sensory–motor systems support learners adapting to a novel linguistic modality.

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