

- [Home](#)
- [About the CVR](#)
- [News](#)
- [Members](#)
- [Seminar Series](#)
- [Conference](#)
- [Resources](#)
- [CVR Summer School](#)
- [Research Labs](#)
- [Training at the CVR](#)
- [Partnering with the CVR](#)
- [Contact Us](#)

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The dorsal stream in kinesthetic action control and working memory

There is wide agreement that the dorsal stream processes visual information for movement control (Goodale & Milner, 1992). However, movements depend not only on vision but also on tactile and kinesthetic information (= haptics). Using functional magnetic resonance imaging, we investigated to what extent networks within the dorsal stream are also utilized for kinesthetic action control and whether they are also involved in kinesthetic working-memory. Blindfolded participants performed a delayed-recognition task in which hand movements had to be encoded, maintained, and later recognized without any visual feedback. Encoding of hand movements activated somatosensory areas, superior parietal lobe (dorsal stream), anterior intraparietal sulcus and adjoining areas (dorsal stream), premotor cortex and occipito-temporal cortex (ventral stream). Short-term maintenance of kinesthetic information elicited load-dependent activity in the anterior intraparietal sulcus (dorsal stream) of the left hemisphere. We propose that the action-representation system of the dorsal stream is utilized not only for visual but also for kinesthetic action control. Moreover, the present findings demonstrate that networks within the dorsal stream, in particular the left anterior intraparietal sulcus, are also engaged in working-memory maintenance of kinesthetic information.

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