

Jonathan Cole – Selected references

Cole, J. (2011). Pathways to the reconstruction of selfhood in chronic transformative disability: the example of spinal cord injury. *Topics in Stroke Rehabilitation, 18*, 74-78.

Notes: This essay contrasts the responses of persons with stroke described by Kaufman with the reflections of persons with spinal cord injury (SCI). It is suggested that, over the last decade or so, mainstream medicine has become less reductionist and more humane in focus. Many with SCI become reconciled to their new bodies, though this may take years. It is not clear whether this apparent difference in the responses of those with stroke, related by Kaufman, reflects their older age or other factors. Perhaps it takes longer than 2 to 3 years for some people to become reconciled to profound alterations in their embodiment. Medical and social models of impairment are discussed. The effects of personal reductions in function may be lessened in significance through appropriate environmental adaptations and changes in social attitudes. In agreement with Kaufman, the importance of an effective personal assistant/employer relationship is illustrated in relation to those with quadriplegia. Overall the perspective of persons with SCI is not as pessimistic as that of those with stroke, as related by Kaufman. However, her plea for a deeper and richer exploration of the lived experience of chronic impairment is supported for many reasons

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Foell, J., Bekrater-Bodmann, R., Flor, H., & Cole, J. (2011). Phantom limb pain after lower limb trauma: origins and treatments. *Int.J.Low Extrem.Wounds., 10*, 224-235.

Notes: Phantom sensations, that is, sensations perceived in a body part that has been lost, are a common consequence of accidental or clinical extremity amputations. Most amputation patients report a continuing presence of the limb, with some describing additional sensations such as numbness, tickling, or cramping of the phantom limb. The type, frequency, and stability of these phantom sensations can vary immensely. The phenomenon of painful phantom sensations, that is, phantom limb pain, presents a challenge for practitioners and researchers and is often detrimental to the patient's quality of life. In addition to the use of conventional therapies for chronic pain disorders, recent years have seen the development of novel treatments for phantom limb pain, based on an increasing body of research on neurophysiological changes after amputation. This article describes the current state of research in regard to the demographics, causal factors, and treatments of phantom limb pain

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Cole, J., Crowle, S., Austwick, G., & Slater, D. H. (2009). Exploratory findings with virtual reality for phantom limb pain; from stump motion to agency and analgesia. *Disability and Rehabilitation, 31*, 846-854.

Notes: PURPOSE: Phantom limb pain is chronic and intractable. Recently, virtual reality (VR) and motion capture technology has replicated the mirror box device of Ramachandran (Ramachandran et al. Nature 1995, 377, 489-490; Ramachandran and Rogers-Ramachandran Proc R Soc Biol Sci 1996, 263, 377-386) and led to reductions in this pain. We present results from a novel variation on this method which captures motion data directly from a patient's stump (rather than using the opposite remaining

limb) and then transforms it into goal directed, virtual action enacted by an avatar in a VR environment. **METHOD:** A sample of subjects with 'arm' (n = 7) and 'leg' (n = 7) amputations underwent trials of a virtual reality (VR) system, controlled by motion captured from their stump which was translated into movements of a virtual limb within the VR environment. Measures of pain in the phantom limb were elicited from patients before and during this exercise as they attempted to gain agency for the movement they saw, and feel embodied within the limb. After this each subject was interviewed about their experiences. **RESULTS:** Five subjects in each group felt the virtual limb to be moved by them and felt sensations of movement within it. With this they also reported reductions in their phantom limb pain greater than expected from distraction alone. No carry over effect was seen. **CONCLUSIONS:** This technique, which has shown similar success rates to trials of a virtual mirror box, is relatively cheap and portable, and will allow further trials in a home environment
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Balslev, D., Miall, R. C., & Cole, J. (2007). Proprioceptive deafferentation slows down the processing of visual hand feedback. *Journal of Vision*, 7, 12-17.
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During visually guided movements both vision and proprioception inform the brain about the position of the hand, so interaction between these two modalities is presumed. Current theories suggest that this interaction occurs by sensory information from both sources being fused into a more reliable, multimodal, percept of hand location. In the literature on perception, however, there is evidence that different sensory modalities interact in the allocation of attention, so that a stimulus in one modality facilitates the processing of a stimulus in a different modality. We investigated whether proprioception facilitates the processing of visual information during motor control. Subjects used a computer mouse to move a cursor to a screen target. In 28% of the trials, pseudorandomly, the cursor was rotated or the target jumped. Reaction time for the trajectory correction in response to this perturbation was compared under conditions with normal and reduced proprioception after 1-Hz rTMS over the hand-contralateral somatosensory cortex. Proprioceptive deafferentation slowed down the reaction time for initiating a motor correction in response to a visual perturbation in hand position, but not to a target jump. Correlation analyses suggested that reaction time was influenced by the size of the visual error rather than the visuo-proprioceptive conflict or the variance in cursor position. We suggest that during movements intact proprioception is necessary for the rapid processing of visual feedback

Balslev, D., Cole, J., & Miall, R. C. (2007). Proprioception contributes to the sense of agency during visual observation of hand movements: evidence from temporal judgments of action. *Journal of Cognitive Neuroscience*, 19, 1535-1541.
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The ability to recognize visually one's own movement is important for motor control and, through attribution of agency, for social interactions. Agency of actions may be decided by comparisons of visual feedback, efferent signals, and proprioceptive inputs. Because the ability to identify one's own visual feedback from passive movements is decreased relative to active movements, or in some cases is even absent, the role of proprioception

in self-recognition has been questioned. Proprioception during passive and active movements may, however, differ, and so to address any role for proprioception in the sense of agency, the active movement condition must be examined. Here we tested a chronically deafferented man (I.W.) and an age-matched group of six healthy controls in a task requiring judgement of the timing of action. Subjects performed finger movements and watched a visual cursor that moved either synchronously or asynchronously with a random delay, and reported whether or not they felt they controlled the cursor. Movement accuracy was matched between groups. In the absence of proprioception, I.W. was less able than the control group to discriminate self- from computer-produced cursor movement based on the timing of movement. In a control visual discrimination task with concurrent similar finger movements but no agency detection, I.W. was unimpaired, suggesting that this effect was task specific. We conclude that proprioception does contribute to the visual identification of ownership during active movements and, thus, to the sense of agency