Adaptation to the absence of tactile and proprioceptive feedback in object handling

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Title: Adaptation to the Absence of Tactile and Proprioceptive Feedback in Object Handling

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Background and aims: Dextrous manipulation necessitates efficient sensorimotor feedback mechanisms to orientate handheld objects, adjust for movement dynamics and respond to perturbations. In particular, cutaneous and proprioceptive signals are paramount in the regulation of hand-object interactions (Johansson, 1991; Nowak et al., 2004). This study further examined the object handling skills of a person with massive peripheral deafferentation (consequent to sensory neuropathy) in order to improve knowledge of how people adapt/compensate for the loss of somatosensory feedback. **Methods:** Object handling abilities of a deafferented woman (GL) were compared to eight age-matched control subjects using three experimental tasks: 1) discrete vertical movements; 2) functional grasp and place and; 3) static holding with perturbations (taps) applied to the top of the object—firstly by the person themselves and secondly by the experimenter. Tasks 1 and 3 were performed under full vision and blinded conditions. Grip force and object acceleration/orientation were recorded using a portable, instrumented object. **Results:** When compared to control subjects, GL demonstrated a global increase in grip force with diminished temporal coupling to changes in object acceleration and impaired ability to maintain orientation of the handheld object in the absence of visual feedback. All phases of the grasp and place task were of greater duration for GL and a qualitatively distinct acceleration profile was observed. In the hold perturbation tasks, GL exhibited greater time delays between perturbation and grip force response but proved highly efficient at gauging grip force response with respect to the magnitude of the perturbation. **Conclusions:** Whilst somatosensory deficits limit temporal precision of grip force adjustments in object handling, visuomotor strategies and auditory feedback may assist in regulating object orientation during functional tasks and grip force scaling during perturbations. Future studies might investigate the feasibility of augmented visual/auditory feedback devices to optimise object handling for people with somatosensory deficits.