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Age Dependant Modulation of Sensory Reweighting for Controlling Posture in a Dynamic Environment

The ability to synthesize and reweight multiple sensory inputs is of paramount importance for ensuring appropriate postural corrections when the accuracy of a particular sensory modality is compromised in a dynamic environment. In this talk, I will present the results of three studies designed to investigate the impact of ageing on the central nervous system's capacity to reweight multiple sensory information while standing in a dynamic virtual environment. In the first experiment, young (n=20) and old (n=16, > 65 years) adults stood in a virtual environment for 240 s while visual reweighing was evoked by visual surround oscillations (0.3 Hz, 20 cm) while introducing a visual event (i.e. collision avoidance) to probe the visual modality. The resulting postural behaviour patterns revealed that visual anticipation of a collision avoidance event negatively affected the intra-modal visual reweighting in both age groups[1]. In the second experiment, proprioceptive reweighting was evoked by bilateral application of Achilles tendon vibration (80 Hz, 3 mm) while introducing a visual event (i.e. collision avoidance) to probe the visual modality. Visual anticipation of collision avoidance reduced the relative postural sway variance induced by Achilles tendon vibration pointing to the facilitatory effect of visual probing on proprioceptive down-weighting. Older adults were delayed in exploiting visual anticipation in order to reduce the destabilizing effect of tendon vibration[2]. In the third experiment, multisensory reweighting was evoked by perturbing vision and proprioception independently or in combination while introducing short-duration (2 s) trains of Galvanic Vestibular Stimulation (GVS) to probe the vestibular modality. The vestibular system plays a critical role in the maintenance of balance when multisensory accuracy is compromised. Intermittent GVS reduced the destabilizing influence of the proprioceptive and combined perturbations in young but not in older participants [3]. Overall, the results of these experiments indicate that sensory reweighting can be modulated by top-down perceptual processes such as visual anticipation of collision avoidance and intermittent vestibular stimulation. Elderly adults delay exploiting visual anticipation to down-weight the inaccurate proprioception possibly due to their long term overreliance on vision. Finally, our results reveal promising evidence for the use of vestibular stimulation in balance rehabilitation or as prosthesis in individuals at risk of falls.

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References

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