Gaze control during walking: a gateway to understanding sensory and cognitive functioning, dynamic postural control, and fall risk in older adults?

Embrechts E (1, 2, 3, 4), Lambrecht E (1), Beckwée D (1, 2, 3), De Hertogh W (1), Vereeck L (1), Nijboer TCW (4), Hallemans A (1)

1) Research Group MOVANT, University of Antwerp, Belgium
2) Rehabilitation Research Group, Vrije Universiteit Brussel, Belgium
3) Brubotics Human Robotics Research Center, Vrije Universiteit Brussel, Belgium
4) Helmholtz Institute, Universiteit Utrecht, The Netherlands

Gaze control – the ability to perceive and follow (moving) objects effectively - is crucial for safe mobility, yet its role in fall risk among older adults remains largely overlooked. Navigating real-world environments requires individuals to efficiently control their gaze in order to perceive, predict, and track moving objects—abilities that depend on the coordination of sensory, cognitive, and motor processes. Impaired gaze control may therefore reflect broader declines in these functions, making it a valuable proxy for fall risk.

Current fall prediction models, based on controlled laboratory tasks, often lack ecological validity. They typically assess sensory, cognitive, and motor deficits in isolation, neglecting their integration during real-world navigation and overlooking the role of gaze control. However, gaze control is linked to established fall risk factors, such as sensory and cognitive impairment, and postural instability, yet remains underexplored as a neurobiological marker of fall risk.

This study proposes that gaze control could serve as a key predictor of fall risk, as it may potentially reflect underlying deficits in sensory, cognitive, and motor functioning. It also hypothesizes that integrating gaze control into fall prediction models will significantly enhance their accuracy.

To address previous methodological limitations, this research employs Augmented Reality to create dynamic, life-like environments while simultaneously tracking gaze. This innovative approach provides a more ecologically valid and comprehensive framework for assessing fall risk, bridging the gap between controlled experiments and real-world navigation