VErtigo Reduction by Sensory Attenuation (VERSA)

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I am an experimental psychologist and cognitive neuroscientist. Over the last decade, my research has focused on a fundamental reconceptualization of the function of the vestibular system in human cognition. In most textbooks the vestibular system is considered an organ specialized for balance, self-motion and control of eye movements. However, vestibular inputs turn out to be involved in almost all our interactions with the external world in ways that go far beyond these reflexes. Vestibular signals have extensive projections throughout the cerebral cortex and cerebellum, including brain areas traditionally considered as visual, somatosensory, motor, memory-related and affective. My research focuses on the interaction between vestibular, visual and tactile inputs. Using a range of techniques from neuroscience, neurophysiology and experimental psychology, I have demonstrated that vestibular–multisensory interactions are crucial in several cognitive and perceptual processes, including spatial representation, somatosensation, bodily representation and decision-making. The research grant awarded by the UK Ménière's Society will allow me to further investigate vestibular–multisensory interactions, and to propose a novel mechanism-based non-invasive intervention to reduce vertigo.

A good sense of balance and stability of our surroundings are crucial to our everyday activities: even driving to the closest supermarket can become a major challenge for someone affected by sudden episodes of vertigo. The majority of us may only experience vertigo and dizziness in rare occasions. However, patients with vestibular disorders, including Ménière's disease, report vertigo as being the most common and compelling symptom. Vertigo is defined as an illusion of movement of the person or of the surrounding environment. Episodes of vertigo vary from seconds, minutes to few hours with intensity ranging from moderate to severe in the majority of cases (where moderate is defined as "I must quit my activity" and severe as "I must lie down"). Vertigo is profoundly unsettling; when acute episodes occur, patients report a significant decrease in their well-being and high levels of distress, which may impact both professional and personal lives. To date, no effective medical or pharmaceutical treatment has been found to reliably alleviate vertigo during acute episodes.

The VErtigo Reduction by Sensory Attenuation VERSA project supported by the UK Ménière's Society aims to offer a lab-based neurocognitive model to reduce the sensation of vertigo frequently experienced by patients affected by vestibular disorders. *How does it work?* Our brain constantly integrates vestibular signals with information from other sensory modalities to create coherent perceptual and cognitive representations of both our body and the external environment. Interactions between visual, tactile and vestibular inputs have been described in almost all vestibular relays, including the vestibular nuclei, the thalamus and several areas in the cerebral cortex. Growing evidence indicates a functional interaction between vestibular and tactile signals from the skin. For instance, patients with vestibular disorders have been shown to regain balance by touching a surface with their fingers: the postural sway was significantly reduced following light touch applied on a metal surface. Similarly, better balance was obtained by passively delivering touches to the fingers. We have recently demonstrated that light tactile stimulation (i.e. vibration on the skin) decreased vertigo-like illusionary movements in healthy participants, an effect we call *somato-vestibular sensory attenuation*. We have therefore hypothesized that this sensory attenuation might have a key function in reducing vertigo in patients affected by Ménière's disease.

We have developed innovative methods to explore the effectiveness of sensory attenuation in controlled lab-settings, which allow us to reliably mimic vertigo-like illusionary movements. In particular, we will investigate the influence of faint tractile stimuli applied on the skin on vertigo-like symptoms induced by artificial disruptive Galvanic Vestibular Stimulation (dGVS) in healthy participants. dGVS implies a small direct quasi-random current passed between the mastoids which stimulates the vestibular organs, generating temporarily dysfunctional vestibular signals. In a series of experiments, we will identify both the perceptual and physiological changes induced by sensory attenuation.

We believe that this project could constitute a foundation for the development of low-cost wearable technologies designed to alleviate vestibular symptoms during sudden episodes of vertigo: we aim to provide non-invasive, cost-effective way of reducing vertigo during acute attacks, in order to improve the patients' quality of life.

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