PROGETTO 1/ PROJECT 1

Supervisore/*Supervisor*:	Prof. Claudio de'Sperati
Titolo/*Title:*	Improving virtual technologies for health care through sensorimotor optimization
Corso */PhD Course*	Cognitive and behavioral sciences
Curriculum:	See attached CV

Link alla pagina personale OSR/UNISR/ *Link to OSR/UniSR personal page:* https://www.unisr.it/en/docenti/d/de-sperati-claudio

Descrizione del progetto/Project description (Tra i 2.000 e 3.000 caratteri spazi inclusi/ *Number of characters, including spaces*: 2.000 - 3.000):

Immersive virtual technologies are rapidly gaining traction in health care, including psychology. Their enormous potential, however, is hindered by a still immature usability, accessibility, and cyber-sickness protection (Hoeg et al 2021). This PhD project is aimed at developing, implementing and testing measures to improve these aspects when wearing a Head-Mounted Display (HMD). The focus will be on sensorimotor mechanisms, in particular binocular vision and visuomotor adaptation, where two "perceptual tricks" will be studied, namely, quasi-3D and augmented gaze. The former term indicates a condition of binocular vision intermediate between 2D and 3D vision (Rebenitsch & Owen 2016), and is expected to alleviate cybersickness, while the latter term indicates a condition where head rotations yield amplified visual rotations (Ragan et al 2017), and is expected to facilitate visual exploration in immersive virtual reality. Both adult and elderly healthy populations will be studied. A first research line targets the role of oculomotor load (in particular vergence eye movements) in inducing cyber-sickness symptoms, especially asthenopia. A second research line targets tolerance to augmented gaze, where several different relationships between head rotation and contingent visual rotation will be tested, as well as the long-term effects of augmented gaze. In our laboratory (Lapco) we have already conducted preliminary experiments and some findings were recently published (de'Sperati et al 2023). The preliminary results showed both pros and cons of quasi-3D (reduced virtual environments only), and a remarkable tolerance to augmented gaze in elders (linear only, and short-term only). Future experiments should explore new scenarios for quasi-3D evaluation as well as short-term and long-term adaptation to various visuomotor relationships for augmented gaze. Additional psycho-physical benefits of these manipulations will also be assessed, such as stress reduction and motivation increase. In

addition to improving usability and accessibility of immersive virtual reality technologies, which are important aspects to promote the diffusion of virtual reality-based treatments in clinical settings (Emmelkamp & Meyerbröker 2021; Sokolov et al 2020), this project will shed light on a more theoretical and fundamental issue in cognitive sciences, namely, what are the perceptual and motor factors that mostly contribute, and how, to build our sense of reality (Dijkstra & Fleming 2023; Seth 2014; Slater 2009).

Competenze che deve acquisire lo studente/Skills to be acquired by the student (Max 600 caratteri spazi inclusi/ *Number of characters*, *including spaces*: max 600):

- Experimental designs applied to real-world scenarios
- Analyses of psychophysical, psychophysiological and behavioral data
- Computer programming
- Virtual reality technologies
- Scientific writing

Bibliografia/References (max. 15)

de'Sperati C., Dalmasso V., Moretti M., Høeg E.R., Baud-Bovy G., Cozzi R., Ippolito J. (2023). Enhancing Visual Exploration through Augmented Gaze: High Acceptance of Immersive Virtual Biking by Oldest Olds. Int J Environ Res Public Health. 17;20(3):1671.

Dijkstra N, Fleming SM. (2023). Subjective signal strength distinguishes reality from imagination. Nat Commun. Mar 23;14(1):1627.

Emmelkamp PMG, Meyerbröker K. (2021). Virtual Reality Therapy in Mental Health. Annu Rev Clin Psychol. May 7;17:495-519.

Høeg E.R., Povlsen T.M., Bruun-Pedersen J.R., Lange B., Nilsson N.C., Haugaard K.B., Faber S.M., Hansen S.W., Kimby C.K., Serafin S. (2021). System Immersion in Virtual Reality-Based Rehabilitation of Motor Function in Older Adults: A Systematic Review and Meta-Analysis. Front. Virtual Real. 2:30.

Kristjánsson Á, Jóhannesson ÓI, Thornton IM. (2014). Common attentional constraints in visual foraging. PLoS One. Jun 25;9(6):e100752.

Ragan E.D., Scerbo S., Bacim F., Bowman D.A. (2017). Amplified Head Rotation in Virtual Reality and the Effects on 3D Search, Training Transfer, and Spatial Orientation. IEEE Trans Vis Comput Graph. Aug;23(8):1880-1895.

Rebenitsch L, Owen C. (2016) Review on cybersickness in applications and visual displays. Virtual Reality 20:101-125.

Seth AK. (2014) A predictive processing theory of sensorimotor contingencies: Explaining the puzzle of perceptual presence and its absence in synesthesia. Cogn Neurosci. 5(2):97-118.

Slater M. (2009) Place illusion and plausibility can lead to realistic behaviour in immersive virtual environments. Phil Trans Royal Society B: Biol Sci, 364, 3549-3557.

Sokolov A.A., Collignon A., Bieler-Aeschlimann M. (2020). Serious video games and virtual reality for prevention and neurorehabilitation of cognitive decline because of aging and neurodegeneration. Curr Opin Neurol. Apr;33(2):239-248.