

Thesis topics (BSc or MSc) within CeTI's U1-Surgery Room.

These interdisciplinary thesis topics are part of CeTI's [U1 room](#), focusing on the integration of psychology, VR/AR, and human-machine interaction. They explore innovative approaches to understanding perception and cognition in immersive environments, combining psychological research with cutting-edge technology.

These projects benefit from the expertise of a second advisor, a surgeon at the Chair of AI-based Assistance Systems in Surgery, who will provide insights into the practical applications of VR in surgical contexts. By bridging psychology and surgery, these projects aim to inform both theoretical understanding and real-world applications in high-stakes domains like surgery.

Systematic Review of Scene Grammar and Scene Semantics in 2D vs. 3D/VR Perception Scenarios

- **Type:** systematic review (ggf. meta analysis if data permits)
- **Rationale:** Scene grammar and, especially, scene semantics—encompassing the meaning, functional context, and relationships between objects—are foundational to visual perception. While much of the foundational research has been conducted using 2D paradigms, the transition to 3D and VR environments introduces new dimensions of depth, interactivity, and embodiment that may reshape how scene semantics are processed. Unlike 2D images, VR environments immerse users in dynamic, interactive spaces, where the meaning and context of objects and scenes play a critical role in guiding perception, attention, and behavior. This review aims to explore how these immersive settings influence the processing of scene semantics and whether existing models of scene perception require adaptation to account for the unique affordances of 3D/VR.
- **Potential Key Research Questions:**
 - How do scene grammar and scene semantics influence visual attention and object perception differently in 2D versus 3D/VR environments?
 - Does the addition of depth, interactivity, and embodiment in VR amplify or attenuate reliance on scene grammar/semantics during visual search and object recognition?
 - Are established cognitive models of 2D scene perception transferable to 3D/VR settings, or must they be adapted to account for immersion, embodiment, and presence?
 - How does the immersive nature of VR environments affect the role of scene semantics in guiding user behavior and interaction?
- **Kontakt:** evelyn.muschter@tu-dresden.de Rayan.Younis@ukdd.de

The Impact of Sense of Embodiment (SoE) and Its Subcomponents (Ownership, Agency) on Learning Outcomes in Medical VR/MR

- **Type:** systematic review
- **Rationale:** VR/MR is widely used for procedural and skill-based training in medicine, with embodiment and multisensory feedback as critical factors. --> Clarifies the operationalisation and impact of SoE, guiding future VR/MR intervention design and measurement standardization.
- **potential Key Research Questions:**
 - How do sense of ownership and agency (SoE components) affect skill acquisition in medical VR/MR training?
 - What is the impact of multisensory feedback (haptic, auditory, visual) on learning outcomes and error rates?
 - How do place illusion and plausibility illusion contribute to the sense of presence (SoP) and training effectiveness?
- **Kontakt:** evelyn.muschter@tu-dresden.de Rayan.Younis@ukdd.de

Differences in visual attention in 2D vs. VR/MR surgical scene perception

- **Type:** empirical study
- **Rationale:** VR/MR technologies are increasingly used to visualize surgical data, anatomy, and operating room environments. These immersive environments allow users to physically move through and interact with surgical scenes, offering a fundamentally different experience compared to traditional 2D displays. Such differences may influence how users allocate visual attention, search for clinically relevant information, and build situational awareness. Understanding these effects is critical for optimizing the design of VR/MR systems to enhance surgical performance and reduce cognitive load.
- **potential Key Research Questions:**
 - How does visual attention distribution differ between conventional 2D displays and immersive VR/MR representations of surgical scenes?
 - Do users identify clinically relevant surgical information more efficiently in VR/MR environments compared to 2D displays?
 - Which spatial arrangements of virtual information overlays in MR lead to the most efficient visual search behavior and lowest attentional burden?
- **Kontakt:** evelyn.muschter@tu-dresden.de Rayan.Younis@ukdd.de