

Emilie HUMMEL, PhD student

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Summary

Profile

Current position: PhD student at Hybrid team, Inria, IRISA, Rennes, France

PhD defense: 28/11/2024

Age: 26 years old

Research interests: virtual reality, cognition, rehabilitation, haptics, sustainability, user-centered design

Research, teaching and responsibilities

Teaching experience: 58h of lecture and 46h of practical works (L1-2)

Supervision: 1 student project (L3) and 3 internships (2xM2 & 1xM1)

Publications

Total number (1st (co-)author/collaboration)

2 (1/1) journal papers

2 (2/0) conference papers

1 (1/0) demo

~3 citations, 47 pages

Journals and conferences: TNSRE (*IF*: 4.8), Annals of Physical and Rehabilitation Medicine (*IF*: 3.9), Eurohaptics (*IF*: 0.8)

Education

2021-2024

Computer Science PhD: at INSA Rennes, Inria, IRISA, Rennes, France, directed by **Anatole Lécuyer** (Research Dir., Inria) and **Valérie Gouranton** (Assoc. Prof., INSA Rennes) and supervised by **Mélanie Cogné** (Assoc. Prof., M.D., PhD, Inria) and **Marie Lange** (PhD, Univ Caen).

Funding: Inria and INSERM scholarship

2016-2021

Graduated from INSA Rennes engineering school in Computer Science, with a Master in Computer Science for Research at Univ Rennes

2015-2016

Baccalaureate in science with honors at Lycée Jules Verne, Limours, France

Scientific profile

Computer science

- ✓ Virtual Reality development
 - C#
 - Unity
- ✓ Integration of haptic device
 - Arduino
- ✓ User experiment design: conception, implementation, assessment
- ✓ Statistical analysis of experimental data
 - R

Transversal axes

- ✓ Cognition
- ✓ Vocational rehabilitation
- ✓ Cultural heritage

Research experience

October 2021 – November 2024: PhD with Anatole Lécuyer, Valérie Gouranton, Mélanie Cogné and Marie Lange

PhD on the use of virtual and adaptive environments for the vocational rehabilitation of breast cancer patients with cognitive impairment. This PhD features the need and acceptability analysis of the targeted population, the conception of an adaptive model, the implementation of a virtual reality prototype and the assessment of acceptance and adaptability of the prototype with user studies. It took place at INSA Rennes and Inria Rennes Bretagne Atlantique with the Hybrid team.

March – August 2021: Internship with Claudio Pacchierotti, Valérie Gouranton, Anatole Lécuyer, Ronan Gaugne and Théophane Nicolas

Internship on the conception and implementation of a haptic device for the manipulation of virtual artifacts: an ancient rattle, with the Museum of Fine Arts of Rennes. It took place at Inria Rennes Bretagne Atlantique, with the Rainbow and Hybrid teams.

Title	Virtual Environments for Vocational and Cognitive Rehabilitation after Breast Cancer
Defense	Planned on November 28. 2024 at IRISA, Rennes, France
Thesis supervisors	Anatole Lécuyer, research director, Inria Rennes, France Valérie Gouranton, associate professor, INSA Rennes, France Mélodie Cogné, associate professor and medical doctor, University Hospital of Rennes, Inria Rennes, France Marie Lange, PhD, Centre François Baclesse, Caen, France
Jury	Bradford McFadyen, full professor, Laval University, Québec, Canada (Reviewer) Antonio Capobianco, full professor, IUT de Haguenau, France (Reviewer) Sophie Jacquin-Courtois, full professor and medical doctor, neuroscience research center, Lyon, France (Examinator) Indira Thouvenin, full professor, Technological University of Compiègne, France (Examinator) Florence Joly, research director and medical doctor, University Hospital of Caen, France (Guest)
Keywords	Virtual reality; adaptation; cognition; vocational rehabilitation; breast cancer
Summary	<p>With the improvement of cancer screening and treatments over the years, breast cancer is dealt with earlier in patients' lives. After their recovery, these patients have every right to expect to return to their lives. However, patients report a cognitive complaint that prevents them from returning to work, along with anxiety concerning their situation. Cognitive rehabilitation can help them recover their cognitive functions and reduce their stress but is limited regarding transferring rehabilitation techniques to work-specific tasks and environments.</p> <p>VR has been used to immerse the user in an ecological and controlled world. VR allows us to replace the real world with an immersive yet safe virtual one on a multi-sensory level. By adapting this virtual world to the user's actions in real time, we can personalize experiences for rehabilitation, training, or entertainment. With this thesis, we try to improve our knowledge of how to adapt a VR application, to improve their experience, and also to provide better vocational rehabilitation for patients with Cancer-Related Cognitive Impairment (CRCI).</p> <p>We first focused on establishing the state of the art concerning cognitive rehabilitation and virtual reality (VR). This bibliographical research resulted in a publication published in the IEEE Transactions on Neural Systems and Rehabilitation Engineering. Throughout the thesis, we worked on the conception of an innovative adaptive model. This model evaluates and modifies the environment and virtual actors to enhance the user experience. We assessed the use of a thermal interface to mitigate stress during mental exercise, resulting in a short paper published at the Eurohaptics 2024 conference.</p> <p>Our work on this adaptation model and use case for cognitive rehabilitation after breast cancer has enabled us to launch three studies. Firstly, a needs and acceptability study among patients with cognitive impairment after breast cancer and the caregivers treating them, at the CHU in Rennes and the Centre Baclesse in Caen, the results of which will be submitted for publication shortly. Secondly, an acceptance study with patients at the Centre Baclesse in Caen. Finally, a study evaluating the adaptation methods derived from our model in healthy subjects.</p>
Main results	Regardless of the lack of VR studies with patients with CRCI, these patients have a strongly identified need for rehabilitation and a high acceptability for VR. They identified realism as an important aspect of a vocational rehabilitation tool. Our adaptive model includes the psychological state and cognition of users to personalize their experience. Thermal feedback didn't show strong evidence of reducing every user's stress during a cognitive task, but cool thermal feedback was found efficient for reducing the perceived stress and arousal of participants with a natural predilection for cold temperature. Finally, the preliminary results of acceptance of a VR prototype from patients with CRCI suggest a high acceptance and open the perspective of future clinical studies .

Scientific activities

Conferences

- **Oral presentation:** Eurohaptics 2022 at Hamburg, Germany
- **Poster presentation:** Eurohaptics 2024 at Lille, France

Seminar

- **Oral presentation:** SOFMER 2023 at Le Havre, France

Scientific presentation

- Presentation of research and my PhD for 1st year university students
- Presentation of my PhD for Laval Virtual's Doctoriales 2024

Teaching experience

I gave **58 hours** of lecture (L) and **46 hours** of practical works (PW) and supervised **1** student project:

Years	Course	Number of hours	Responsible of the option	Description
2023-2024	L1 INSA Rennes preparatory class	18h L, 16h PW	Jean-Louis Pazat	Algorithm, imperative and object programming Introduction to Java language (types, arrays, scope of identifiers, objects, methods) and analysis or modelization of real problems using UML diagrams
2022-2023	L2 INSA Rennes preparatory class	22h L, 20h PW	Pascale Sébillot	Introduction to database management with SQL Learning of relational algebra, creation and manipulation of relational databases using SQL, use of queries in mono-user and competitive access, conceptual modelling and Java application
2022-2023	L3 INSA Rennes, computer science department	-	Valérie Gouranton	Student project supervision Supervision of four students for the conception and prototype of a virtual reality cognitive assessment application to answer a given problematic of ecological assessment
2021-2022	L2 INSA Rennes preparatory class	18h L, 10h PW	Pascale Sébillot	Introduction to database management with SQL Learning of relational algebra, creation and manipulation of relational databases using SQL, use of queries in mono-user and competitive access, conceptual modelling and Java application

Supervision


I supervised **3 internships** (2 M2 and 1 M1):

Internships



- **Vincent Philippe** (M2 ECE Paris – 6 months – May 9. to November 11. 2023) Co-supervision with J. Hecquard, J. Saint-Aubert, F. Argelaguet, M. Macé, V. Gouranton, C. Pacchierotti, A. Lécuyer – Subject: Assessing the impact of thermal haptics on stress during non-social cognitive task and the potential of cool feedback of relaxing participants. Published conference paper: [Philippe et al., 2024]. Now PhD student.
- **Sarah Oury** (M1 INSA Rennes – 3 months – May 30. to August 31. 2022) Co-supervision with M. Cogné and V. Gouranton – Subject: Natural language processing for the analysis of need and acceptability of virtual reality study results with cognitively impaired breast cancer patients. Submitted journal paper: [Hummel et al., submitted].
- **Nawid Zafar** (M2 UTC – 6 months – March 1st to August 31 2022) Co-supervision with C. Pacchierotti, A. Lécuyer, V. Gouranton, R. Gaugne – Subject: Enhancing the museum experience by allowing visitors to handle a virtual ancient pig rattle with a tangible haptic device and a fishtank approach.

Ordered by type of publication and year of publication. Demo are in grey.

Scientific journals with review panel

1. **Hummel, E.**, Cogné, M., Lange, M., Lécuyer, A., Joly, F. and Gouranton, V., 2023. VR for Vocational and Ecological Rehabilitation of Patients with Cognitive Impairment: A Survey. *IEEE Transactions on Neural Systems and Rehabilitation Engineering*. 12 pages. DOI: <https://doi.org/10.1109/TNSRE.2023.3324131> 
2. Merceur, M., Reilly, K.T., Bonan, I., Holé, J., **Hummel, E.**, Cogné, M. and Jacquin-Courtois, S., 2024. A systematic review of rehabilitation programs for cognitive impairment related to breast cancer: Different programs at different times? *Annals of Physical and Rehabilitation Medicine*, 67(5), p.101832. 18 pages. DOI : <https://doi.org/10.1016/j.rehab.2024.101832>
3. **Hummel, E.**, Merceur, M., Lange, M., Lécuyer, A., Oury, S., Gouranton, V., Cogné, M., Submitted in 2024. Vocational rehabilitation of cancer-related cognitive impairments after breast cancer: need analysis and acceptability of virtual reality.

International conferences with review panel

1. Philippe, V., Hecquard, J., **Hummel, E.**, Argelaguet, F., Macé, M.J.M., Gouranton, V., Pacchierotti, C., Lécuyer, A. and Saint-Aubert, J., 2024, June. Cool Me Down: Effects of Thermal Feedback on Cognitive Stress in Virtual Reality. *In Eurohaptics 2024*. 7 pages. 
2. Cheymol, A., Fouché, G., Gramoli, L., Hirao, Y., **Hummel, E.**, Mavromatis, M., Moullec, Y., Argelaguet, F. and Nouviale, F., 2022, March. The rubber slider metaphor: Visualisation of temporal and geolocated data. *In 2022 IEEE Conference on Virtual Reality and 3D User Interfaces Abstracts and Workshops (VRW)* (pp. 904-905). IEEE. 2 pages. DOI : <https://doi.org/10.1109/VRW55335.2022.00303> 
3. **Hummel, E.**, Pacchierotti, C., Gouranton, V., Gagne, R., Nicolas, T. and Lécuyer, A., 2022, May. Haptic Rattle: Multi-modal rendering of virtual objects inside a hollow container. *In International Conference on Human Haptic Sensing and Touch Enabled Computer Applications* (pp. 189-197). Cham: Springer International Publishing. 8 pages. DOI : https://doi.org/10.1007/978-3-031-06249-0_22 