

# 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** (1<sup>st</sup> (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 reality for the vocational and cognitive rehabilitation of breast cancer survivors with cognitive impairment. This PhD features the need and acceptability analysis of the targeted population, the design and evaluation of a vocational rehabilitation prototype in VR, and explores innovative approaches regarding VR, with the design and evaluation of an adaptive model integrating users' affective and cognitive states, and the assessment of a haptic interface for stress regulation. 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	<b>Virtual Environments for Vocational and Cognitive Rehabilitation after Breast Cancer</b>
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 Mélanie 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 people's lives. After their recovery, cancer survivors have every right to expect to return to their lives. However, they report a <b>cognitive complaint</b> that prevents them from returning to work, along with <b>anxiety</b> 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 <b>ecological and controlled</b> world. VR allows us to replace the real world with an immersive yet safe virtual one on a <b>multi-sensory</b> level. By modifying this virtual world to the user's actions and mental states <b>in real time</b>, we can personalize experiences for rehabilitation, training, or entertainment. With this thesis, we aim to explore the use of VR for vocational and cognitive rehabilitation for people with Cancer-Related Cognitive Impairment (CRCI), to improve their experience and ease their return to work.</p> <p>We first focused on establishing the <b>state of the art</b> 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. We assessed the <b>need for rehabilitation and acceptability for VR</b> of people with CRCI and their caregivers at the CHU in Rennes and the Centre Baclesse in Caen, in a study submitted to Annals of Physical and Rehabilitation Medicine journal. We then designed a <b>prototype of a VR application for vocational rehabilitation</b>. We evaluated this prototype with a feasibility and acceptance study with people with CRCI at the Centre Bablesse in Caen.</p> <p>This thesis highlights the importance of affective and cognitive states in users' perception and performance. We studied new approaches integrating these mental states in VR, with the design of an <b>adaptive model</b> and its evaluation in a user study assessing our <b>mental workload-based adaptation strategy</b>, and a user study on the impact of <b>thermal feedback</b> on stress and performance. This study resulted in a short paper published at the Eurohaptics 2024 conference.</p>
Main results	Regardless of the <b>lack of VR studies</b> with people with CRCI, they have a strongly <b>identified need</b> for rehabilitation and a <b>high acceptability</b> for VR. They identified <b>realism</b> as an important aspect of a vocational rehabilitation tool. Our adaptive model integrates users' affective and cognitive states to personalize their experience, which showed results in a <b>better experience</b> for users. Thermal feedback didn't show strong evidence of reducing every user's stress during a cognitive task, but <b>cool thermal feedback</b> was found efficient for <b>reducing the perceived stress and arousal</b> of participants with a natural predilection for cold temperature. Finally, the preliminary results of acceptance of a VR prototype from people with CRCI suggest a <b>high acceptance</b> and open the perspective of <b>future clinical studies</b> .

## 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](https://doi.org/10.1007/978-3-031-06249-0_22) 