2nd International Workshop on Mobile Cognitive-Augmenting and Cognition-Altering Technologies (CAT) in Human-Centered AI

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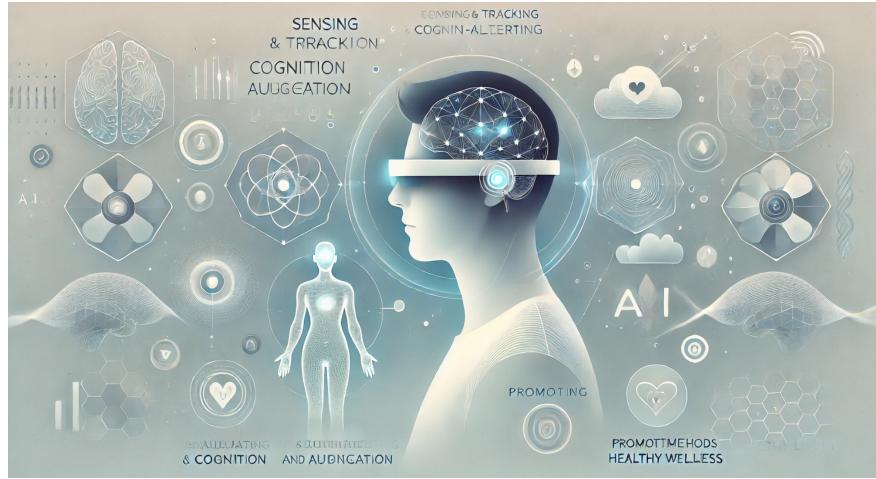
Figure 1: AI's view on the Workshop topic (image generated by Dalle based on the Workshop's topics)

Abstract

The quest for enhanced cognition is still a driving force behind human advancement. Following the success of the first installment of the mobiCHAI workshop in 2024, mobiCHAI2 will continue to explore the intersection of Mobile Cognition-Altering Technologies (CAT) and Human-Centered AI (HCAI), focusing on their potential to augment and modify human cognition in real-world applications. Building upon previous discussions, this workshop aims to bridge insights from cognitive science, AI, and human-computer interaction (HCI) to address key challenges and opportunities in developing trustworthy, effective, and ethical AI-driven cognitive augmentation tools. Core themes of the workshop include ubiquitous sensing for cognitive tracking, AI-driven cognitive modeling, interactive augmentation methods, and ethical implications of deploying CAT in education, healthcare, and productivity. Special attention is given to the societal and ethical impact of cognition-altering AI, ensuring that augmentation technologies enhance human agency rather than compromise autonomy. Through interdisciplinary collaboration, the workshop fosters discussions on how AI can complement, rather than replace, human cognitive abilities, setting a foundation for responsible and socially acceptable digitization.

CCS Concepts

• **Human-centered computing** → *Ubiquitous and mobile computing design and evaluation methods*; *Collaborative and social computing theory, concepts and paradigms*; *Interactive systems and tools*.

Keywords

Human-Centered AI; Hybrid-Human Artificial Intelligence; cognitive science; augmenting human capabilities; ubiquitous technologies; shaping cognitive and social behavior; generative AI

1 Introduction

Enhancing human cognition has always been a key driver of innovation and societal advancement. Cognition-altering technologies (CAT) aim to improve cognitive capabilities, impacting fields such as education, decision-making, healthcare, and productivity. With the rise of Human-Centered AI (HCAI) and Hybrid-Human-AI (HHAI), there is an unprecedented opportunity to develop technologies that not only mimic but also actively augment human cognition in real-life scenarios. This will be the focus of this year's MobiCHAI Workshop:

Artificial intelligence (AI) plays a central role in cognitive-modifying and cognitive-enhancing technologies and offers significant potential to enhance human capabilities. However, several challenges must be overcome to ensure that these technologies are effective, ethical, and useful. Addressing these challenges requires interdisciplinary collaboration, sound ethical frameworks, and broad public discourse to responsibly navigate the complex landscape of AI in the area of cognitive enhancement. These challenges include:

- **Ethical considerations:** AI-driven cognitive enhancement tools often require access to personal data, raising concerns about privacy and individual autonomy. It is important to ensure that users retain control over their data and that consent is informed and voluntary. Additionally, there is a

risk that AI could influence decisions in a way that compromises personal autonomy, raising ethical concerns about manipulation and control.

- **Technical challenges:** AI systems rely on large data sets that may contain *biases*. If these *biases* are not addressed, AI could perpetuate or even exacerbate existing biases, leading to unfair outcomes in cognitive enhancement applications.
- **Societal implications:** Access to cognitive enhancement technologies could reinforce existing social inequalities if only certain groups can afford or gain access to these enhancements, leading to a society segregated by cognitive ability. Moreover, the ability to enhance or alter cognition raises profound ethical and philosophical questions about what it means to be human. The potential for AI to influence human thought processes challenges our notions of free will and individual responsibility.

Building upon the results of last year's workshop, this workshop extends the discussion to explore how mobile cognition-altering technologies (CAT) can be implemented using AI-driven augmentation techniques. Our goal is to merge insights from both communities, fostering interdisciplinary collaboration between researchers in ubiquitous computing, human-computer interaction (HCI), cognitive science, and AI.

Last year in MObileHCI 2024 [3], we established a strong interest in developing AI systems that can evaluate, influence, simulate, and sense cognitive functions. Prior literature also showed benefits to CATs in several use cases, such as supporting brainstorming [9], supporting education [5], and productivity [7]. The community showed a strong interest in continuing to work on this topic, and further collaborations resulted from last year's workshop, such as invitations to prestigious seminars like Dagstuhl, between new members that met through the workshop. Thus, we want to continue this series to provide a platform for such an interdisciplinary community to drive human-centred AI innovation.

2 Workshop Topics and Scope

As in the previous mobiCHAI workshop, this year as well, we aim to have an interdisciplinary group of researchers. This group can include but is not limited to education and didactics, health and mental care, fitness and well-being, economy, sociology, and others. We focus on the cognitive functions discussed in the introduction composed of perception, attention, memory, language, problem-solving, reasoning, and decision-making. For each function, participants could submit about their *human-centered AI explorations* in topics such as (but not limited to):

Sensing and Tracking Cognition • Ubiquitous sensing and physiological monitoring for cognitive state detection • Non-intrusive tracking of cognitive load and emotional states • Integrating multi-modal data (video, sound, textual descriptions) to model cognition

Modeling and simulating cognition Methods such as machine learning algorithms, but also generative AI methods to model cognitive processes, are part of this topic. Questions like the simulation of users in tasks and design processes

should be answered, as well as how to help CAT builders better design their systems but having accurate approximations of human behavior.

AI Methods for Cognitive Alteration and Cognitive Augmentation How can we create a new CAT to alter or augment human cognition? Participants are invited to submit proposals for new ideas for applications that affect cognitive functions or give users new ones (if possible). Such application areas can include, but are not limited to, business, education, health care, and fitness.

Promoting healthy living using CAT This topic particularly focuses on promoting healthy lifestyles using CAT.

Interactive Methods in CAT This topic includes: AI-mediated interventions for habit formation and behavioral change • Techniques for AI-supported decision-making and problem-solving • Cognitive scaffolding via wearable and mobile AI assistants

Ethics and Societal Implications Topics include: Privacy and ethical concerns in AI-driven cognitive enhancement, Balancing augmentation and human autonomy, Responsible design principles for cognitive AI systems

3 Format and Schedule

We are proposing a **full-day workshop** for anyone interested in attending - **we expect around 15-20 participants**, but overall, attendance will not be restricted or limited beyond the capacities of the available room. We will encourage participants to attend the workshop in person, and the overall workshop will be held in person. Nevertheless, due to the limited room capacity, we will allow remote attendance for specific cases. (The main reasons for remote attendance will be difficulties in getting a visa on time and accessibility barriers. Also, possible last-minute travel restrictions and illness will be considered.

3.1 Submissions

Submissions to this workshop will take the form of abstracts or short papers: *Short papers* (up to 2 pages) are encouraged to report novel and creative ideas that are yet to produce concrete research results but are at a stage where community feedback would be useful. Short papers could also include provocations for envisioned systems/benefits/ or risks of CAT. Accepted short papers will be presented at the Workshop in 7-minute slots.

Abstracts (up to 1 page) Abstracts can introduce new ideas or ongoing work, and can also, but do not have to include, the presentation of a demo during the workshop. During the Workshop these ideas or ongoing works will be presented in a 2-minute 1-slide pitch-style presentation. After submission, the papers will be divided for review between the workshop organizers and the invited reviewers (at least 2 reviews per paper). Reviewing will be based on quality and relevance to the workshop topics. After the discussion of all submissions, accepted papers will be invited to the workshop. All papers will be digitally available through the workshop website. At least one author of an accepted submission must attend the workshop.

After submission, the papers will be divided for review between the workshop organizers and the invited reviewers (at least 2 reviews per paper). Reviewing will be based on quality and relevance to the workshop topics. After the discussion of all submissions, accepted papers will be invited to the workshop. The planned schedule of the workshop includes the presentation of a maximum of 15 short papers and a not limited number of abstract presentations. However, more important than the number of publications is the quality and relevance of the papers. In addition, we aim to have an interdisciplinary and balanced group of researchers in the field. We will solicit contributions to the workshop extensively and internationally.

3.2 Preliminary Agenda

After the welcome and introduction to the schedule and means of the workshop, it will begin with a keynote presentation, followed by the first presentation session for accepted submissions. Following these presentations, 3-4 smaller working groups will be formed to address specific subtopics. The goal of these breakout sessions is to invite people from the different communities to engage in discussions based on the previously presented papers. This first breakout session will focus on identifying key research priorities for the community around CAT and how they can be included in the presented submissions. After the lunch break, break out groups should of the morning session will present their insights gained in the break outs. Afterward, the second presentation session will take place. This will, once again, be followed by the second break-out session. This second breakout session will focus on discussing the challenges and opportunities of AI for CAT in a series of proposed scenarios in areas of cognitive healthcare, work, and education, but also in the respective submissions of the workshop participants.

The workshop will conclude with a demo poster/discussion session where participants will be able to show demos of their accepted submissions, and possible outcomes of the breakout sessions will be presented. The main goal of the demo/discussion session is to allow both communities to meet people outside their respective research areas to create new opportunities for collaboration. (See Figure 2)

4 Recruitment and Dissemination

We aim to have an interdisciplinary and balanced group of researchers in the field. We will solicit contributions to the workshop extensively and internationally. We will reach out to relevant research consortia such as the ten AI European Networks of Excellence (e.g., Humane AI Net). We will use the social media accounts and mailing lists of the networks to promote the workshop. We will also check the list of accepted papers in MobileHCI and invite authors with relevant topics to attend the workshop.

4.1 Pre-Workshop activities

After acceptance of the workshop, the workshop's website will be set up. This website will not only suffice as a pre-workshop information source, but also the outcomes of the workshop will be made available and should form a platform for interaction between the target communities. After the notification of acceptance, the authors of all accepted submissions will be invited to prepare a

one-pager (small posters or handouts) highlighting the essence of their work. These one-pagers are supposed to spark the discussions specifically in the Demo/Discussion sessions and will be made available on the workshop's website after the conference. The organizers of the workshop will select submissions they invite to present as Demos during the Demo/Discussion session in the afternoon of the workshop. To support diversity, we will allow remote attendance for specific cases such as difficulties in getting a visa on time, accessibility barriers, possible last-minute travel restrictions, and illness. Additionally, the list of organizers covers geographical, seniority, and gender diversity, enabling us to reach out to wider communities. The organizing team is also interdisciplinary (psychologists, social scientists, Artificial Intelligence researchers, Human-Computer Interaction researchers, and Ubicomp researchers). Thus, we will use personal recruitment through our networks to widen the participation in the event.

5 Outcomes and Post-Workshop Follow Up

The results of the workshop will be summarized and published on the workshop's website. Participants will also be asked to revise and advance their work based on the discussions during the workshop and provide expanded versions of the one-pagers, which will be posted on the website. Due to the good connections of the organizers to the relevant research communities, we expect that the workshop will contribute to further activities beyond concrete plans. These include new project collaborations but also repeats of this workshop at future conferences. This workshop is intended to be the launching pad for the above-mentioned anticipated activities, and the workshop website is intended to become the contact point for organizing these further activities. Therefore, the website will remain online and will continue to be updated regularly.

A major goal for post-workshop activities is to publish a special issue in a scientific journal. We are currently in the process of identifying potential journals that would be interested in a special issue on the topic of our workshop. Our aim is a special edition for TOCHI. Participants of the workshop who introduced promising ideas, will be invited to submit advanced versions of their work to the special issue. In addition, the discussions and results of the workshop will be compiled into a "foundational report" that will be published as an editorial in this special issue.

6 Organizers

The authors and joint organizers systematically collaborate on well-attended events. Their success together is evident by the exceptionally well-attended workshop in last year's MobileHCI 2024 in Melbourne [3] with 25+ attendees and the 15+ attendees in I-Trust-U workshop at Percom'25, in Washington DC. Previous events in relevant HCI and AI conferences included [1, 2, 4, 6, 8] with participants' size ranging between 10 and 50+ attendees. They are also part of larger research consortia and organizations in the AI scene such as ADRA, Humane AI Net [1] and SCOPE [2].

Agnes Grünerbl (*The primary contact*) is a postdoctoral researcher at the DFKI and RPTU, Germany. She holds a Ph.D.

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[1]https://www.humane-ai.eu/
[2]https://psy.rptu.de/aes/ikm/kommunikationspsychologie/forschung/
potentialbereich-scope-societal-communication-in-times-of-permacrisis

	10 Min	45 min	45 min	20 min	90 min	90 min	Duration
Morning	Welcome	Keynote	1st Presentations	Coffee Break	1st Break-out	Lunch Break	Session
	30 min	45 min	20 min	90 min	50 min	15 min	Duration
Afternoon	Insights	2nd Presentations	Coffee Break	2nd Break-outs	Discussion	Closing	Session

Figure 2: Overview of the schedule of the workshop.

in natural sciences from the Technical University of Kaiserslautern. Her research interests are in artificial intelligence, mobile and mental health, cognitive science, and education.

Jan Spilski is a scientific coordinator in the field of cognitive science at the RPTU and CRO and Co-founder of Insight.out GmbH, a digital diagnostic company.

Giulia Barbareschi is a Senior Assistant Professor at the Keio School of Media Design in Yokohama. Her current research focuses on empowering disabled people and other minority groups to gain access to opportunities using diverse technologies from mobile phones to robotic avatars.

Kai Kunze works as a Professor at the Keio Graduate School of Media Design in Japan. Beforehand, he held an Assistant Professorship at Osaka Prefecture University. He received a Summa Cum Laude for his PhD thesis from Passau University. His research interests span across wearable computing and IoT systems with a focus on quantifying cognitive states to augment our mind, using wearable technology to support more inclusive interactions.

Thomas Lachmann is a Professor of Psychology, Head of the Center for Cognitive Science, Director of the Graduate School of Cognitive Science, Speaker of Research Initiative (Universitärer Potentialbereich Cognitive Science), PI Research Initiative AI Enhanced Learning and Cognition at the Rheinland-Pfälzische Technische Universität (RPTU).

Passant Elagroudy is a Post-doctoral Researcher at DFKI and RPTU, Germany. She works in the field of Human-Computer Interaction. Her work largely focuses on creating technologies for augmenting cognition. Her technical expertise is focused on using ubiquitous technologies, wearables, and virtual reality to manipulate human memories.

Paul Lukowicz is a Professor of Computer Science at RPTU, Embedded Intelligence Lab, and Scientific Director at the DFKI, Germany. His research focuses on human-centered and context-aware ubiquitous and wearable systems, including sensing, pattern recognition, system architectures, models of large-scale self-organized systems, and applications in areas ranging from healthcare through Industry 4.0 to smart cities.

Acknowledgments

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