mobiCHAI - 1st International Workshop on Mobile Cognition-Altering Technologies (CAT) using Human-Centered AI

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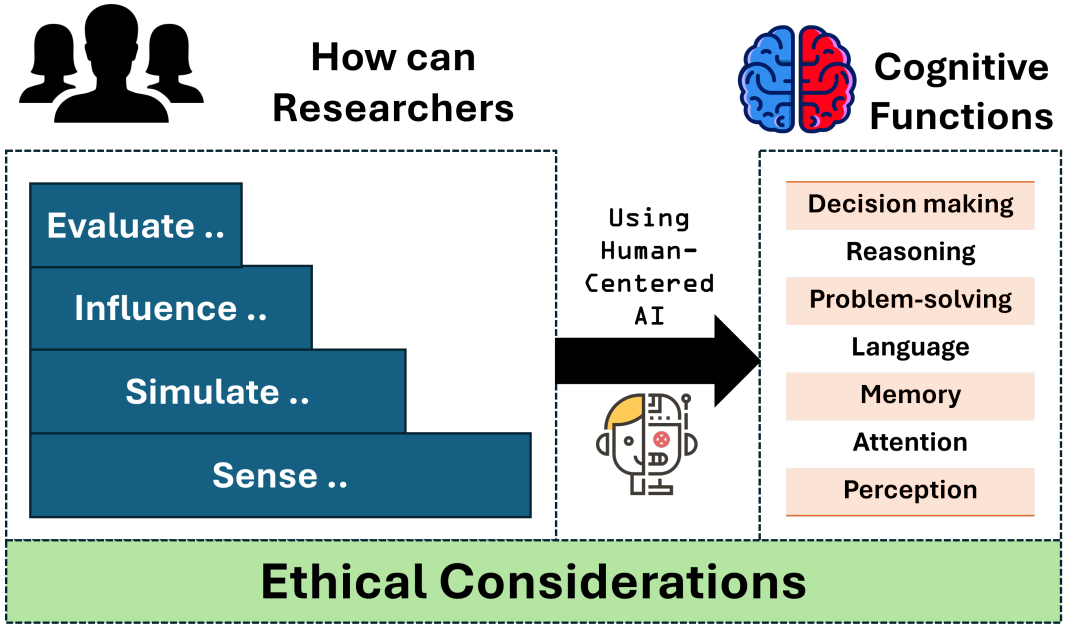

Figure 1: Overview of the topics targeted in the workshop. We want contributions showing how we can do the actions on the left to support the functions on the right using human-centered AI and GenAI specifically.

ABSTRACT

The quest for enhanced cognition has been a driving force behind human advancement, fostering innovation and personal fulfillment.

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Cognition Altering Technologies (CAT) holds immense promise in elevating the quality of life across diverse domains including education, decision-making, healthcare, and fitness. The current proliferation of Artificial Intelligence (AI), particularly the widespread adoption of Generative AI and foundational models, presents an unprecedented opportunity to prototype new CAT that can augment human capabilities. This workshop aims to unite interdisciplinary research communities to explore the potential of leveraging GenAI and human-centered AI to develop relevant CAT. Taking place at MobileHCI 2024, this one-day workshop invites researchers, practitioners, and designers from fields such as artificial intelligence, ubiquitous computing, human-computer interaction, and social sciences to collaborate and chart the future of cognitive enhancement through technology.

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

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1 INTRODUCTION AND RELATED WORK

Throughout history, enhancing cognitive skills has been central to human progress, propelling us toward greater insights, innovation, and fulfillment. Cognition covers the mental processes of perceiving, understanding, storing, and utilizing knowledge to react to stimuli [3, 28]. The key functions of the human cognition pipeline are [5] 1) *perception* referring to interpreting environmental stimuli, 2) *attention* referring to focusing mental and physical resources on a task, 3) *memory* referring to encoding, storing, and retrieving information, 4) *language* referring to our ability to communicate, 5) *problem solving* referring to our ability to decompose complex problems, 6) *reasoning* referring to our capability to draw conclusions and synthesize knowledge, and finally 7) *decision making* referring to our ability to choose between alternatives and reason about the choice.

Prior literature has extensively explored Cognition-Altering Technologies (CAT) for their significant potential to enhance people's quality of life. For example, CAT can improve productivity by automating repetitive tasks and streamlining workflows [7, 18, 20, 23]. Additionally, they can support education by personalizing learning experiences [10, 11, 13, 15, 32]. Moreover, they can enhance memory and comprehension [16, 24], besides supporting brainstorming, generating ideas, and artistic co-creation [8, 9, 27, 29, 31] leading also to higher productivity. CAT can also support decision-making processes [21, 22, 26]. CATs can also support inclusive daily interactions by reducing cognitive disparities [2, 19].

The central challenges for developing efficient CAT systems usually include understanding the user's context, sensing the cognitive states efficiently and accurately without using intrusive technology, providing a natural interaction with the user that is sufficient for complicated scenarios, filtering out efficiently through the collective knowledge of the user and the others despite the ambiguous inputs. The recent developments (starting November 2022) in Generative Artificial Intelligence (GenAI) technologies provide a promising road to re-imagine CATs and harness benefits that we have not seen before. Versatile foundational models such as Large Language Models (e.g. GPT by OpenAI, BART and RoBERTa by Meta AI, T5, and BERT by Google), text-to-visual models (e.g. DALL-E, SORA, and CLIP by OpenAI), and multimodal models (e.g. Gemini by Google and LXMERT by Meta AI and Georgia Tech) provide unprecedented opportunities for designers and users alike to 1) create new experiences that were not possible before, 2) in shorter periods, 3) with higher quality, and 4) leverage the collective knowledge of the society. Combined with the prevalence of mobile technologies, they can turn CATs into widely used ubiquitous everyday commodities. They also offer an opportunity to better understand cognition in humans [17]. However, we still do not fully understand as a research community the implications of using such systems widely on society and their social acceptability. Given the consistent interest in cognitive augmentation within Mobile HCI and similar communities (e.g. [30] in MobileHCI'23, [12] in CHI'24, [6] in UbiComp'17, augmented cognition conference as part of HCI International conference [1]), we aim to harness the interdisciplinary expertise of the community to *explore leveraging GenAI for creating new cognitive augmentation technologies.*

2 WORKSHOP TOPICS AND SCOPE

In the mobiCHAI workshop, we aim to have an interdisciplinary group of researchers including but not limited to education and didactic, health- and mental care, fitness and well-being, economy, sociology, and others. However, we expect the majority of submissions to come from computer science from system designers.

Figure 1 summarizes the core topics of the workshop. 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 cognition This topic focuses on how sensor systems could be optimized for tracking cognitive states and/or social behavior. How can technologies and study designs be improved to reduce the burden of sensing and determining a cognitive condition? What methods can help understand the context?

Modeling and simulating cognition This topic focuses on methods such as machine learning algorithms and generative AI to model cognitive processes. It also targets questions like the simulation of users in tasks and design processes.

The main target is to help CAT builders better design their systems but having accurate approximations of human behavior.

Influencing cognition using CAT This topic focuses on creating a new CAT to alter human cognition. Participants are invited to submit proposals for new application areas and explorations that affect cognitive functions or give users new ones (if possible). Application areas for CAT 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.

Evaluating CAT/cognition This topic targets the metrics for evaluating the impact of CAT on cognition. We welcome explorations discussing short-term and long-term effects. Additionally, we welcome explorations reflecting on the impact on the individual vs. the society at large. Reflective contributions on new metrics and methods of evaluation for cognition or one of its functions are encouraged. Proposing methods to measure existing metrics such as reducing the user's effort by altering the cognitive load, physiological responses, and/or subjective perception of effort, and enhancing performance are also encouraged. We would also like to see submissions about the adverse effects of using CAT on the individual and society at large.

Ethical considerations about CAT Topics include: does using CAT support/circumvent natural diversity in abilities? What are the privacy considerations while designing CAT? How to navigate ownership of produced content when AI helps the user? Which bias can be mitigated/accentuated through CAT? Is it ethical for organizations to use CAT without the individual consent of the members?

3 FORMAT AND SCHEDULE

We are proposing a **full-day workshop** for anyone interested in attending. Historically from previous workshops in MobileHCI, we expect around 15 participants. However, the workshop is flexible enough to accommodate changes in the number of participants. We will encourage participants to attend the workshop in person, and the overall workshop will be held in person except in special cases, remote attendance will be allowed.

3.1 Submissions

Submissions to this workshop will take the form of full and short papers: *Full papers* (up to 6 pages) should report reasonably mature work within the scope of mobiCHAI and are expected to demonstrate concrete and reproducible results. Accepted full papers will be presented and discussed in 10-minute slots. *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 3-minute slots. *Abstracts* (up to 1 page) are encouraged to present novel and creative ideas that have not been deployed yet and would greatly benefit from discussions to form concrete plans. Accepted short papers will be presented at the Workshop as One-slide pitches.

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 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.

3.2 Preliminary Agenda

Figure 2 summarizes the schedule. The day starts at 9:00 and ends at 17:00, with two planned coffee breaks (each 15 minutes) and one lunch break (60 minutes). Participants start the day by presenting themselves using a template slide for 30 seconds each. Afterward, we have an intriguing keynote from *Thad Starner*, one of the pioneers in wearable computing and human-computer interaction. Next, we will have paper presentations and discussions. In the next part, participants are divided into groups to think about the research gaps of the domain in a structured way. Each group should come up with two MSc theses ideas, two PhD theses ideas, and one research group idea, and one research institute idea then present it to the rest of the participants. Each group will also identify one existing research fund call relevant to CATs and share it with the audience. Next, we provide a hands-on tutorial about prompt engineering using ChatGPT. Participants are then divided again into groups and asked to come up with a "startup" idea for a new CAT (cognitive altering technology). They will use ChatGPT and other prototyping tools to generate a pipeline for building that startup and then pitch it to the workshop attendees. For each startup idea, we will discuss potential scientific venues to create a paper out of it. We expect to have between 3-4 groups. We end the day with a synthesized form of key information and plan future collaborations between participants.

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.

After the workshop acceptance, the workshop's website will be set up. This website not only will suffice as a pre-workshop information source but also outcomes of the workshop will be made available and should form a platform for interaction between the UbiComp, HCI, and Human-Centered AI communities. Accepted submissions will be available on the website. Participants will be encouraged to bring demos for CAT with them to present them during the coffee breaks.

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,

Duration	Activity (additional 2*15 mins coffee breaks + 60 mins Lunch)
20 mins	Workshop welcome + Lightening introductions
20 mins	Opening keynote
60 mins	Papers presentations and discussions
30 mins	**Group activity 1:** Paper ideas targeting workshop topics
45 mins	Tutorial: Prompt engineering
30 mins	**Group activity 2:** Conceptual ideation for a CAT startup
110 mins	**Group activity 3:** Prototyping the CAT
60 mins	Presentation of the startups + discussion of submission venues
15 mins	Reflections and closing remarks

Figure 2: Overview of the schedule of the workshop.

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

The results of the workshop will be summarized and published on the workshop's website. We also plan to have a unifying submission summarizing the workshop outputs in a venue like Interactions Magazine or CHI Late-Breaking Work. Individual "startup" ideas will be encouraged to submit papers to relevant conferences like CHI, HHAI, and MobileHCI. We would also like to facilitate joint international grant proposal writing through the workshop. We also would like to scout more organizers to conduct further editions of the workshop in other communities. Thus, 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.

6 ORGANIZERS

The authors have a long history of organizing together successful similar events in top-notch venues. Examples include a workshop in UbiComp'17 (45 participants in Hawaii) [6], a tutorial in UbiComp'23 (30 participants in Mexico) [14], a workshop in IoT'24 (20 participants in Japan) [4], a hackathon'24 (35 participants in Germany) [25], and an upcoming Special Interest Group in CHI'24 (in Hawaii) [12]. Similarly, all authors belong to larger international research consortia that would be interested in the topic such as Humane AI Net [1] and SCOPE [2].

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

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.

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

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