PhysioCHI: Lessons Learned from Implementing Human-Centered Physiological Computing

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Abstract

Integrating physiological signals in Human-Computer Interaction research has significantly advanced our understanding of user experiences and interactions. However, the interdisciplinary nature of this research presents numerous technical challenges. These include the lack of standardized protocols, unclear guidelines for data collection and preprocessing, and difficulties in pipeline management, reproducibility, and transparency. The purpose of this meet-up is to offer a lightweight opportunity for CHI attendees to connect around these issues, exchange experiences, share tools and workflows, and identify best practices. By fostering open exchange, we aim to improve the reliability of physiological data in HCI, promote open science, and build a sustainable community. Ultimately, our goal is to overcome technical barriers and strengthen the foundation for future research in physiological computing.

CCS Concepts

• **Human-centered computing → Human computer interaction (HCI)**.

Keywords

Physiological Computing, Open Science, EEG, fNIRS, Brain-Computer Interface, Eye Tracking, Electrodermal Activity, ECG, EMG

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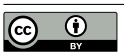

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1 Motivation and Meet-up Goal

In Human-Computer Interaction (HCI), integrating physiological data into interactive systems is a growing focus for creating more intuitive, adaptive, and responsive experiences. Sensors measuring heart rate, eye gaze, respiration, electrodermal activity, muscle tension, and brain activity provide objective insights into users' physical and affective states [19]. These signals enable systems not only to adapt in real time to user needs but also to inform ergonomics and usability by revealing how people physically and cognitively engage with technology. By drawing on these measures, physiologically adaptive systems can promote natural interactions, improving both usability and user experience [4, 8, 9, 13]. With sensor technologies becoming more practical and reliable, applications are rapidly expanding into real-world settings [2, 3].

Although researchers have explored innovative methods for integrating neural and physiological data into HCI, the field still lacks shared theoretical and methodological standards and best practices [6, 10, 20]. Recent community discussions have called for greater scientific rigor and highlighted significant gaps in theory and methodology [1, 12]. Addressing these issues is essential to improve the effective and reliable use of physiological signals in HCI and to guide the development of explainable adaptive systems that respect user privacy and ethical standards [17].

One of the main reasons for these difficulties lies in the steep interdisciplinary expertise required to work with physiological data. Advancing this field demands knowledge spanning physiology, signal acquisition, signal processing, machine learning, software engineering, and HCI design [16], often leading to isolated efforts where methods, pipelines, and datasets are developed independently. This fragmentation, combined with the absence of shared standards, makes it difficult to reproduce results, build on prior work, or align on best practices [1, 15, 24].

Overcoming this fragmentation requires a collective effort, shared frameworks, and alignment on technical and methodological practices. This meet-up aims to provide a space for the HCI community to exchange experiences and begin aligning our shared best-practice

approaches. Doing so opens the opportunity for physiological computing in HCI to mature into a reliable, objective complement to established evaluation methods. By providing a forum for experts as well as novices, this meet-up will provide an engaging and focused space for exchanging ideas, offering solutions to common challenges, and sharing questions and answers. To structure this discussion, we highlight four research goals:

- Developing methods for collecting and recording high-quality physiological data in HCI contexts
- Establishing guidelines and best practices for preprocessing and pipeline management
- Ensuring reproducibility and transparency across physiological studies
- Building sustainable infrastructures for open and collaborative research

Building on the discussions with participants, we will share the outcomes through blog posts and articles in ACM Interactions. In addition, we invite everyone to join our Slack workspace, helping to foster an ongoing community around human-centered physiological computing.

2 Meet-Up Structure & Activities

The meet-up comprises three parts: an introduction, two rounds of world-café discussions, and a synthesis of key challenges and solution approaches, as outlined in Table 1.

Table 1: The schedule of the Meet-Up.

Duration	Activity
15 min	**Introduction and Context Setting** The meet-up will open with a short introduction of the organizers and an overview of the topics. Attendees will then be invited to join the table of their preferred first topic. To ensure focused discussions in manageable group sizes, participants may be asked to split further by sensor type depending on the number of attendees.
2×30 min	**World Café Discussions** Participants will rotate between small groups addressing four core themes: (1) developing reliable methods for collecting physiological data in HCI, (2) defining best practices for preprocessing and pipeline management, (3) ensuring reproducibility and transparency, and (4) building infrastructures for open and collaborative research. Table facilitators will guide the conversations and document key points. Insights will be collected digitally via QR codes linked to Google Forms, and shared in our Slack workspace, enabling participants to stay connected and continue the exchange as a community.
15 min	**Next Steps** Table facilitators will summarize the key challenges, best practices, and ideas for moving forward from their discussions. Participants will then be invited to join follow-up initiatives, such as the Slack workspace, collaborative workshops, or community-driven publications, to sustain the dialogue and build alignment beyond the meet-up.

3 Organizers

Kathrin Schnizer. (https://www.medien.ifi.lmu.de/team/kathrin.schnizer/) is a PhD researcher in Human-Computer Interaction at LMU Munich. Her research investigates EEG markers of task-oriented cognitive processes in data visualization (e.g., [18]), with the goal of establishing ERPs and FRPs as reliable measures for complex HCI interaction contexts.

Teodora Mitrevska. (https://www.medien.ifi.lmu.de/team/teodora.mitrevska/) is a PhD researcher at the LMU Munich in Human-Computer Interaction. Her research interests lie in wearable EEG devices and the usage of physiological signals as a form of implicit feedback in Human-AI interactions, for example [14].

Benjamin Tag. is a Senior Lecturer at UNSW Sydney, specializing in Human-Computer Interaction, Affective Computing, and Human-AI Interaction. His research focuses on technologies for assessing mental and physical states in virtual and real-world environments, with an emphasis on emotion regulation, cognitive psychology, and context-aware computing. His work frequently incorporates the use of physiological sensors, e.g., [1, 21, 23].

Abdallah El Ali. (https://abdoelali.com) is a research scientist at Centrum Wiskunde & Informatica, and part-time Assistant Professor at Utrecht University. He leads the research areas on Affective Interactive Systems and Trustworthy Human-AI Interaction, where he combines advances in sensing and actuation, eXtended Reality, and Artificial Intelligence to augment human cognitive, affective, and social interactions, e.g., [11, 22, 25].

Sven Mayer. (https://sven-mayer.com) is a full professor at TU Dortmund and the RC Trust. His research sits at the intersection between HCI and Artificial Intelligence, where he focuses on the next generation of computing systems. He uses artificial intelligence to design, build, and evaluate future human-centered interfaces, e.g., [3, 5, 7].

4 Description of the Community

This meet-up brings together the HCI community around shared challenges in working with physiological data. Integrating physiological sensing into interactive systems spans a wide range of expertise and sensors, including signal processing, experimental design, data analysis, and machine learning. To strengthen this field, we invite HCI researchers and practitioners from diverse backgrounds to connect around the shared vision of promoting reproducibility, transparency, and robust practices in physiological computing. The meet-up will serve as a space to exchange experiences, reflect on technical challenges, and discuss how the community can align on practices that strengthen physiological sensing in HCI. Our goal is to foster an inclusive network of researchers and practitioners dedicated to advancing physiological sensing in HCI through robust and reproducible methods.

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