The Future of Emotion in Human-Computer Interaction

Greg Wadley, Vassilis
Kostakos, Peter Koval, Wally
Smith, Sarah Webber
University of Melbourne, greg.wadley
| vassilis.kostakos | wsmith | s.webber
@unimelb.edu.au

Anna Cox
University College London
anna.cox@ucl.ac.uk

James Gross
Stanford University
gross@stanford.edu

Kristina Höök
KTH Royal Institute of Technology
khook@kth.se

Regan Mandryk
University of Saskatchewan
regan@cs.usask.ca

Petr Slovák
King's College London
petr.slovak@kcl.ac.uk

ABSTRACT

Emotion has been studied in HCI for two decades, with specific traditions interested in sensing, expressing, transmitting, modelling, experiencing, visualizing, understanding, constructing, regulating, manipulating or adapting to emotion in human-human and human-computer interactions. This CHI 2022 workshop on the Future of Emotion in Human-Computer Interaction brings together interested researchers to take stock of research on emotion in HCI to-date and to explore possible futures. Through group discussion and collaborative speculation we will address questions such as: What are the relationships between digital technology and human emotion? What roles does emotion play in HCI research? How should HCI researchers conceptualize emotion? When should HCI researchers use interdisciplinary theories of emotion or create new theory? Can specific emotions be designed for, and where is this knowledge likely to be applied? What are the implications of emotion research for design, ethics and wellbeing? What is the future of emotion in human-computer interaction?

CCS CONCEPTS

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

KEYWORDS

emotion, emotion regulation, affective computing, user experience, embodied interaction, wellbeing, mental health, design, human-computer interaction

1 BACKGROUND

Emotion is a focus of research in many science and humanities disciplines. While emotion was rarely addressed in early HCI work it assumed greater importance in the shift to "3rd wave" HCI [2]. Figure 1 illustrates how interest in emotion has grown amidst broader growth in the HCI discipline.

A foundational stance in modern HCI holds that technology can influence users' emotions, that emotion is a core component of user experience, and that emotional experience can be designed for. Beyond this common core, multiple threads of HCI research address emotion in different ways and with different goals. For example:

- UX designers seek to support desirable emotional experiences with digital products and services;
- Affective Computing researchers design technologies that detect and adapt to emotions;
- Embodied Interaction researchers design technologies for visualizing and understanding emotion;
- Communication researchers observe human-to-human expression of emotion through technology;
- Psychology and HCI researchers develop interventions for emotional health and wellbeing.

This workshop brings together researchers across multiple traditions to encourage connection and collaboration, identify common interests, discuss and develop methodologies, and map the changing relationship between emotion and technology.

We are guided by a set of overarching questions:

- What are the relationships between digital technology and human emotion?
- What roles does emotion play in HCI research?
- How should HCI researchers conceptualize emotion?
- When should HCI researchers use interdisciplinary theories of emotion or create new theory?
- Can specific emotions be designed for, and where is this knowledge likely to be applied?
- What are the implications of emotion research for design, ethics and wellbeing?
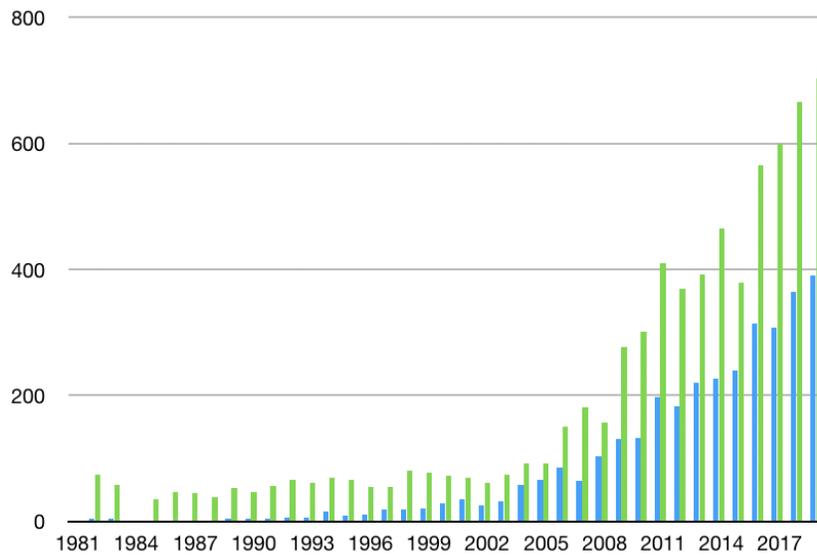- What is the future of emotion in human-computer interaction?

Figure 1: CHI papers that mention emotion (dark colour) vs all CHI papers (light colour)

1.1 HCI perspectives on emotion

HCI began to address emotion at a time when the use of digital technology was broadening beyond the workplace to include home, mobile and recreational contexts. Key publications early in the 21st century discussed the importance of enjoyment and aesthetics in motivating technology use [1, 17], the place of emotion in user experience [26], and the value of designing for positive emotional experiences [27].

Different threads of HCI research have addressed emotion in different ways. Affective computing researchers explore the possibility for technologies to understand and adapt to user emotions [3, 20, 30]. Researchers oriented to constructionist theories of emotion design novel technologies to support the expression, recording and understanding of emotion [18, 35, 38]. Physiological measures of emotion have been used to gauge user experience [24]. HCI has studied how users express emotion via communication media [16] and how emotion spreads in social networks [21].

More recently, researchers have addressed the impact of technology use on psychological wellbeing [4, 25] and designed technology interventions for mental health [9]. In therapeutic work, user emotion is not only an indicator of the quality of UX but also of intervention efficacy, and may need to be tracked over time, leading to renewed interest in automated recognition of emotional states [32]. HCI research has generated interventions for improving emotion skills [36], and observed the informal use of technologies to manage emotions [11, 43] and to cope with stress [5].

The focus on wellbeing in HCI mirrors widespread concerns about unintended emotional consequences of technology use, such as impacts of social media upon mental health [19] and social cohesion [28]. Recent news about vendors extending smartphone-based health tracking to include emotion has renewed concerns about surveillance, in part because employers and insurers might be interested in such data [12]. Studies have linked technology overuse to attempts at emotion regulation [33] and there are reports of over-reliance on technology for emotional support during the Covid-19 pandemic [13].

Emerging technologies may influence future HCI research on emotion. Recently, researchers successfully treated depression in one patient using a closed-loop brain implant that algorithmically detects activity in the amygdala and stimulates the ventral striatum when needed [34]. While deep brain stimulation requires surgery, there are less invasive approaches such as transcranial direct current stimulation [23] which was shown to improve performance in videogamers by [14]. These researchers anticipate electronic "doping" in eSports; an idea that resonates with the growing, ethically complex use of nootropics for cognitive enhancement in workplaces [31]. Brain stimulation research hints at the possibility that future digital technologies might influence emotion in a direct fashion.

We believe that this combination of advances in technology, renewed interest in the relationship between technology and emotion, and variation in approaches to emotion, warrant discussion at CHI. There have already been CHI workshops on particular aspects of emotion [6, 8, 10, 37], CHI symposia on Computing and Mental Health [42], and emotion workshops at related conferences [29, 40]. However, there have been few HCI workshops that discussed emotion more broadly. A CHI Special Interest Group on emotion was proposed [7] but is no longer current – we will use this workshop to gauge interest in restarting a SIG on emotion.

1.2 Emotions in technology interaction

While different traditions in HCI address emotion in different ways, they have in common an understanding that technology use influences emotion and that technologies may be appropriated (in part) for their emotional affordances. The following examples illustrate ways in which emotions are involved in technology use. Some involve change in emotion; however agency is often ambiguous – who is changing whose emotion, how, when?

- A workplace technology induces satisfying emotional experiences because it is useful and usable.
- Advertisements motivate consumers to buy a new phone because of the desirable emotions they expect to experience. A consumer might experience these or other emotions when using the phone.
- Mental health researchers create technology interventions that help people track, reflect upon and manage their emotions. Therapists prescribe these interventions, and they help some users.
- Aged-care centre staff provide residents with social robots and virtual reality apps to manage disruptive negative emotions.
- Workers alleviate stress by distracting themselves with smartphone-based games and streaming services. For some, this leads to increased stress later when their work is not done on time.
- Students use focus playlists provided by digital music services to block distraction, boost energy, improve mood and thereby do better work. This practice may be either facilitated or discouraged by educational institutions.
- Commuters access entertainment services via their phones to alleviate the tedium of taking the same train every day.
- Managers monitor the mood of a virtual team's text-based communication channel, managing the group's emotions by posting carefully-chosen content.
- During a Covid-19 lockdown, people use communication media to check on the emotional states of family and friends from whom they are temporarily isolated. Offline, they take the time to assemble cheerful photos and stories to share.
- During a Covid-19 lockdown, people spend hours each day doomscrolling news about rising case numbers, leading to heightened anxiety.
- Children ask their parents for subscriptions to gaming and streaming services so they can set a joyful, energetic tone when their friends visit after school.
- Exasperated parents hand their child a device to calm them down during intense bursts of emotion.
- An interactive artwork changes its appearance in response to the emotions of gallery visitors.
- Social media users are impacted emotionally by content they see in the newsfeed. This influences them to post their own emotional content to the newsfeed, which in turn influences the emotions of other users, driving further engagement.
- Social media providers tweak their algorithms to make emotional content more prominent.
- Advertisers and influencers create emotional social media content to drive engagement and sales.
- Political agents seed social media with emotional content to create division and influence elections.
- Emerging forms of social media advertising adapt to the user's emotional states.
- Emerging brain-stimulation techniques enable the invocation of specific emotional experiences upon user demand or under algorithmic control

1.3 Dimensions of emotion in HCI

Emotional phenomena can vary along dimensions which could prove useful for categorising and framing them:

- Emotion may be either *designed for* (e.g. a mindfulness app) or *emergent* (e.g. a workplace tool that induces feelings of satisfaction because it helps users get work done).
- Where emotion is shaped, the *mechanism* of influence may vary; e.g. a mental health intervention might teach emotion regulation skills, a communication app might enable meaningful social interaction, while a streaming app might offer audiovisual distraction.
- Where emotion change is intended, *agency* may lie with the user, the designer, the vendor or some other actor. Agency does not necessarily imply conscious intention, and may be manipulated.
- Emotions may be desirable or undesirable.
- Emotions may result from technology use *immediately* or may arise *later*.
- Emotions may arise from using a *single* technology or an *assemblage* of technologies.
- Emotions may arise from specific usage *events* or from *habitual use*.
- Emotions may arise within *individuals or groups* of people.

Psychology research has yielded frameworks which could help enrich our understanding of these dimensions. For example, James Gross' [15] process model differentiates emotions *generated* in response to situations (e.g. frustration caused by having to use a poorly designed website) from attempts to *change* an emotion already generated (e.g. using YouTube to distract oneself from frustration caused by having to use a poorly-designed website). Maya Tamir [41] provides a framework for categorising the *motives* for attempting to change emotions, identifying not only hedonic but also performance, social and eudaimonic motives.

1.4 Goals of the workshop

Our long-term goals are to build a community of researchers to collaborate on future research and collectively develop a framework and research agenda for informing ongoing HCI work on emotion. On the day, our goals are to map trajectories of emotion research in HCI, articulate phenomena of interest, discuss the utility of different methodologies and interdisciplinary theories, highlight important issues for research, design and policy, and discuss the implications of emerging technologies. We aim to publish a summary of our discussion and outputs, and later, a book or special issue. We may propose future iterations of the workshop, and a SIG.

2 ORGANIZERS

Our team of organizers represents a range of disciplines and geographic regions.

Anna Cox is a Professor in the UCL Interaction Centre at University College London. Her research focuses on the relationships between the design of information and communications technologies (ICTs) and behavioural outcomes, and leverages these relationships in the design of novel interfaces and systems to support people in managing their work and well-being.

James Gross is a Professor of Psychology at Stanford University. His research focuses on emotion and emotion regulation, and he has developed the widely used Process Model of Emotion Regulation.

Kristina Höök is Professor of Interaction Design at the Royal Institute of Technology (KTH), Stockholm, with research interests in affective interaction and somaesthetic design. Her recent book "Designing with the Body: Somaesthetic Interaction Design" was published by MIT Press.

Vassilis Kostakos is a Professor of Computer Science at the University of Melbourne in Australia and Head of the Human-Computer Interaction Group. His research interests focus on ubiquitous computing, human-computer interaction, social computing, and Internet of Things.

Peter Koval is a Senior Lecturer in the Melbourne School of Psychological Sciences at the University of Melbourne. His research focuses on the dynamics of subjective emotional experience and the deliberate regulation of emotion in daily life.

Regan Mandryk is a Canada Research Chair in Digital Gaming Technologies and Experiences and Professor of Computer Science at the University of Saskatchewan. Her work focuses on how people use playful technologies for emotion regulation, social connection, and to manage their mental health and wellbeing.

Petr Slovák is a UKRI Future Leaders Fellow and a lecturer at King's College London, based at the Informatics and Child Adolescent Psychiatry department. His research focuses on envisioning, designing, and evaluating new technology-enabled mental health interventions for children and families, with specific focus on emotion regulation.

Wally Smith is an Associate Professor in the School of Computing and Information Systems at the University of Melbourne. His research focus is human-centred computing, with current projects on emotion regulation, deceptive tendencies of AI, and digital engagement in cultural institutions.

Greg Wadley is a Senior Lecturer in the School of Computing and Information Systems, University of Melbourne, Australia, working on the design of technologies for health and wellbeing including projects in mental health, emotion regulation, and chronic disease management.

Sarah Webber is a Research Fellow at the School of Computing and Information Systems at the University of Melbourne. Her research focuses on design of technologies for connection with nature, and digital interactions for social connectedness and wellbeing.

3 WEBSITE

The workshop website is at https://cis.unimelb.edu.au/hci/emotion-workshop. Initially the website contains the call-for-participation and organiser details. One week prior to the workshop we will add the detailed schedule and position papers. After the workshop the website will remain in place as an archive and resource for ongoing discussion and authoring. We will use EasyChair to manage submissions: link is on the workshop website.

4 PRE-WORKSHOP PLANS

We will promote the workshop by sharing the call-for-participation to mailing lists and social media. Participants will be asked to submit a paper which may be either of two types.

- Position papers describe the author(s') background, research, and position regarding issues highlighted in this proposal. Length is 1-2 pages.
- Research papers describe a relevant study, which may be work-in-progress or one that is already published. Length is 2-4 pages.

Papers must be submitted by the deadline 24th February 2022, as per https://chi2022.acm.org/for-authors/interacting-and-discussing/workshops-and-symposia/. Submitted papers will be reviewed by the workshop organisers with the aim of choosing a set of participants with diverse perspectives who can drive the agenda of emotion research in HCI. Authors will be notified by 1st March 2022.

5 IN-PERSON, HYBRID OR VIRTUAL-ONLY

This will be a virtual-only workshop to maximize accessibility for participants and organisers who cannot travel internationally due to Covid restrictions. We will use Zoom, subtitled for accessibility, for real-time discussions and presentations, with Miro acting as a virtual whiteboard on which we record notes and viewpoints. We will set up a Slack channel for asynchronous text chat before, during and after the workshop. Relevant information will be available on the workshop website before, during and after the workshop.

6 ASYNCHRONOUS ENGAGEMENT

While our synchronous engagement will be in Zoom, we will simultaneously use Slack and Miro for asynchronous discussion and as a fallback if Zoom is unavailable for anyone at any time.

7 WORKSHOP STRUCTURE

This will be a one-day workshop, running between 11 am and 4:30 pm, consisting of four sessions separated by breaks. A longer break will take place after session 2.

7.1 Session 1: Building Community (1 hour)

Each participant (including organizers) will present their research and position on emotion in HCI for between 2 and 5 minutes, with time for brief questions. Selected participants who represent particular approaches may be invited to speak for longer to explain their approach.

7.2 Session 2: Taking Stock (1.5 hours)

This session begins with a full-group discussion to discern communities who have taken distinct approaches to emotion research in HCI. Participants will join breakout rooms corresponding to these approaches and discuss for 30 minutes to identify the goals, methods, and phenomena of interest for that community. Groups will then report back allowing the workshop to make an initial map of the terrain of emotion research in HCI.

This will then form the basis of a semi-structured, full-group discussion to articulate the state of emotion research in HCI.

Motivating questions may include: Is there a single program of emotion research in HCI or is it best thought of as multiple threads operating in parallel? If there are parallel threads, do they relate to and inform each other? What aspects of emotion are being
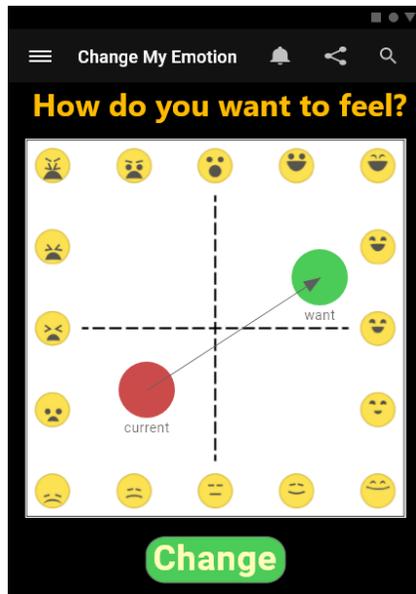
Figure 2: Speculative design sketch of technology for shaping emotion

investigated in HCI? What knowledge is being produced? What theories and methodologies guide emotion research in HCI, and are these native to HCI or imported from other disciplines? Are there theories of emotion that HCI could more usefully exploit? How is technology design being informed by emotion research in HCI?

Examples of emotion in technology use, such as those listed in section 1.2, will be used to stimulate discussion.

7.3 Session 3: Imagining Futures (1.5 hours)

This session begins with full-group discussion of emerging technologies and trends relevant to emotion in HCI. The goal is to make a representative list that we will then use as the basis for "collaborative speculation" [22] on future technologies and their possible impacts. For example, technologies are being designed with the goal of giving people more power to shape, communicate, recognize and understand the emotions they and others experience. Currently these have limited power, but what might more powerful versions look like, and how might they impact users? One imagined technology is sketched in Figure 2

Though technology research is often presented with an emphasis on intended benefits, our discussion will be sensitive to potential negative impacts, in the spirit of [39] who explored ways for technology researchers to identify unintended consequences of their work.

Motivating questions for this session include: What future scientific and technological developments might impact emotion research in HCI? What benefits might they bring, and what could go wrong? How might society be shaped by technologies that enable greater control over emotion?

We will end this session by breaking into small groups to generate scenarios and seeds to stimulate future conversations about emotion in HCI.

7.4 Session 4: Making Plans (half an hour)

In this brief final session we will discuss short and long term plans and collaborations. These are listed below and will be refined on the day.

8 POST-WORKSHOP PLANS

8.1 Short-term plans: Publish summary of workshop

Initially, our website and Miro board will remain online and available to participants, acting as a repository of the outcomes of the workshop that participants can draw upon as they develop further outputs.

We will collectively author a workshop summary, to be published hopefully in *Interactions*. We will discuss with the editors in advance of the workshop so that we have clear guidelines for the article.

8.2 Long-term plans: Publish journal special issue, support future collaborations

The long term plan is to publish an edited book or journal special issue. We will discuss this with publishers and editors in advance of the workshop, and one of our goals during the workshop will be to develop a call-for-papers and a suggested set of topics and authors.

Contribution to this publication will not be limited to workshop participants. Rather, participants will collectively design the contents and call-for-papers. We will advertise via mailing lists and personal invitation after the workshop.

We intend the workshop and its outputs to support future research collaborations and grant applications.

9 250-WORD CALL FOR PARTICIPATION

Emotion has been studied in HCI for two decades, with specific traditions interested in sensing, expressing, transmitting, modelling, experiencing, visualizing, understanding, constructing, regulating, manipulating or adapting to emotion in human-human and human-computer interactions. This CHI 2022 workshop on the Future of Emotion in Human-Computer Interaction brings together interested researchers to take stock of research on emotion in HCI to-date and to explore possible futures. Through group discussion and collaborative speculation we will address questions such as: What are the relationships between technology and emotion? Can emotions be designed for, and where is this likely to be applied? What are the implications of emotion research for the HCI discipline, for technology design, and for social and individual wellbeing?

We welcome participants who have studied or designed for emotion or have a position on emotion research in HCI and who wish to influence future research directions. Participants should submit a short paper about their research or their position on emotion in HCI. Papers will be made public on our workshop website and may be developed for a planned special issue.

To maximise inclusion and accessibility, the workshop will be completely online, using Zoom, Miro, Slack and a website for synchronous and asynchronous discussion. At least one author of each accepted submission must attend the workshop, and all participants must register for both the workshop and at least one day of the CHI

2022 conference. For more details please see the workshop website at https://cis.unimelb.edu.au/hci/emotion-workshop .

ACKNOWLEDGMENTS

REFERENCES

[1] Blythe, M. A., Overbeeke, K., Monk, A. F. & Wright, P. C. (Eds.) (2004). Funology. *Norwell, MA: Kluwer Academic Publishers*, 91-100.

[2] Bødker, S. (2006). When second wave HCI meets third wave challenges. In *Proceedings of the 4th Nordic conference on Human-computer interaction changing roles - NordiCHI '06*, 1–8

[3] Brave, S. & Nass, C. (2007). Emotion in human-computer interaction. In *The HCI handbook* (pp. 103-118). CRC Press.

[4] Calvo, R. A. & Peters, D. (2014). Positive computing: technology for wellbeing and human potential. MIT Press.

[5] Collins, E. & Cox, A. L. (2014). Switch on to games: Can digital games aid post-work recovery?. *International Journal of Human-Computer Studies*, *72*(8-9), 654-662.

[6] Coyle, D., Linehan, C., Tang, K., & Lindley, S. (2012). Interaction design and emotional wellbeing. In CHI'12 Extended Abstracts on Human Factors in Computing Systems (pp. 2775-2778).

[7] Crane, E. A., Shami, N. S. & Peter, C. (2007). Let's get emotional: emotion research in human computer interaction. In *CHI'07 extended abstracts on Human factors in computing systems* (pp. 2101-2104).

[8] Daher, K., Capallera, M., Lucifora, C., Casas, J., Meteier, Q., El Kamali, M., El Ali, A., Gross, G., Chollet, G. Khaled, O. & Mugellini, E. (2021). Empathic Interactions in Automated Vehicles# EmpathicCHI. In Extended Abstracts of the 2021 CHI Conference on Human Factors in Computing Systems (pp. 1-4).

[9] Doherty, G., Coyle, D. & Matthews, M. (2010). Design and evaluation guidelines for mental health technologies. *Interacting with Computers*, *22*(4), 243-252.

[10] El Ali, A., Perusquía-Hernández, M., Denman, P., Abdelrahman, Y., Hassib, M., Meschtscherjakov, A., Ferreira, D. & Henze, N. (2020). MEEC: First Workshop on Momentary Emotion Elicitation and Capture. In Extended Abstracts of the 2020 CHI Conference on Human Factors in Computing Systems (pp. 1-8).

[11] Eschler, J., Burgess, E. R., Reddy, M. & Mohr, D. C. (2020). Emergent self-regulation practices in technology and social media use of individuals living with depression. In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems* (pp. 1-13).

[12] Feder, S. (2021) Your iPhone already tracks your steps. What if it tracked your mood, too?. *Popular Science*.

[13] Fitzsimmons, C. (2021) 'It looks a lot like addiction': Kids battle technology dependence in lockdown. *The Age*.

[14] Friehs, M. A., Dechant, M., Vedress, S., Frings, C., & Mandryk, R. L. (2021). Shocking advantage! Improving digital game performance using non-invasive brain stimulation. *International Journal of Human-Computer Studies*, *148*, 102582.

[15] Gross, J. J. (2015). Emotion regulation: Current status and future prospects. *Psychological Inquiry*, *26*(1), 1-26.

[16] Hancock, J. T., Landrigan, C. & Silver, C. (2007). Expressing emotion in text-based communication. In *Proceedings of the SIGCHI conference on Human Factors in Computing Systems* (pp. 929-932).

[17] Hassenzahl, M., Platz, A., Burmester, M. & Lehner, K. (2000). Hedonic and ergonomic quality aspects determine a software's appeal. In *Proceedings of the SIGCHI conference on Human Factors in Computing Systems* (pp. 201-208).

[18] Höök, K. (2018). *Designing with the body: Somaesthetic interaction design*. MIT Press.

[19] Kamenetz, A. (2021) Facebook's own data is not as conclusive as you think about teens and mental health. NPR

[20] Klein, J., Moon, Y. & Picard, R. W. (2002). This computer responds to user frustration: Theory, design, and results. *Interacting with Computers*, *14*(2), 119-140.

[21] Kramer, A. D. (2012). The spread of emotion via Facebook. In *Proceedings of the SIGCHI conference on human factors in computing systems* (pp. 767-770).

[22] Light, A. (2021). Collaborative speculation: Anticipation, inclusion and designing counterfactual futures for appropriation. Futures, 134, 102855.

[23] Lopes, P., Chuang, L. L. & Maes, P. (2021). Physiological I/O. In *Extended Abstracts of the 2021 CHI Conference on Human Factors in Computing Systems* (pp. 1-4).

[24] Mandryk, R. L., Inkpen, K. M. & Calvert, T. W. (2006). Using psychophysiological techniques to measure user experience with entertainment technologies. *Behaviour & Information Technology*, *25*(2), 141-158.

[25] Mark, G., Iqbal, S., Czerwinski, M., & Johns, P. (2015). Focused, aroused, but so distractible: Temporal perspectives on multitasking and communications. In Proceedings of the 18th ACM Conference on CSCW & Social Computing (pp. 903-916).

[26] McCarthy, J. & Wright, P. (2004). Technology as experience. *interactions*, *11*(5), 42-43.

[27] Norman, D. A. (2004). *Emotional design: Why we love (or hate) everyday things*. Basic Civitas Books.

[28] Orlowski, J. (Director) (2020) *The Social Dilemma*. Netflix.

[29] Peter, C., Crane, E., Fabri, M., Agius, H., & Axelrod, L. (2008). Emotion in HCI–Designing for People. People and Computers XXII Culture, Creativity, Interaction 22, 189-190.

[30] Petta, P., Pelachaud, C. & Cowie, R. (Eds.). (2011). *Emotion-oriented systems: the HUMAINE handbook*. Springer.

[31] Ricci, G. (2020). Pharmacological human enhancement: an overview of the looming bioethical and regulatory challenges. Frontiers in Psychiatry, 11, 53.

[32] Rooksby, J., Morrison, A. & Murray-Rust, D. (2019). Student perspectives on digital phenotyping: The acceptability of using smartphone data to assess mental health. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems* (pp. 1-14).

[33] Rozgonjuk, D. & Elhai, J. D. (2019). Emotion regulation in relation to smartphone use: Process smartphone use mediates the association between expressive suppression and problematic smartphone use. *Current Psychology*, 1-10.

[34] Scangos, K. W., Khambhati, A. N., Daly, P. M., Makhoul, G. S., Sugrue, L. P., Zamanian, H., Liu, T., Rao, V., Sellers, K., Dawes, H., Staff, P., Krystal, A. & Chang, E. F. (2021). Closed-loop neuromodulation in an individual with treatment-resistant depression. Nature Medicine, 27(10), 1696-1700.

[35] Sengers, P., Liesendahl, R., Magar, W., Seibert, C., Müller, B., Joachims, T., Geng, W., Martensson, P. & Höök, K. (2002). The enigmatics of affect. In *Proceedings of the 4th conference on Designing Interactive Systems* (pp. 87-98).

[36] Slovák, P. & Fitzpatrick, G. (2015). Teaching and developing social and emotional skills with technology. *ACM Transactions on Computer-Human Interaction (TOCHI)*, 22(4), 1-34.

[37] Slovák, P., Wadley, G., Coyle, D., Thieme, A., Yamashita, N., Lederman, R., Schutt, S. & Doces, M. (2015). Developing skills for social and emotional wellbeing. In Proceedings of the 33rd Annual ACM Conference Extended Abstracts on Human Factors in Computing Systems (pp. 2397-2400).

[38] Ståhl, A., Höök, K., Svensson, M., Taylor, A. S., & Combetto, M. (2009). Experiencing the affective diary. *Personal and Ubiquitous Computing*, *13*(5), 365-378.

[39] Sturdee, M., Lindley, J., Linehan, C., Elsden, C., Kumar, N., Dillahunt, T.,Mandryk, R. & Vines, J. (2021). Consequences, Schmonsequences! Considering the Future as Part of Publication and Peer Review in Computing Research. In Extended Abstracts of the 2021 CHI Conference on Human Factors in Computing Systems (pp. 1-4).

[40] Tag, B., Webber, S., Wadley, G., Bartlett, V., Goncalves, J., Koval, P., Slovak, P., Smith, W., Hollenstein, T., Cox, A. & Kostakos, V. (2021). Making Sense of Emotion-Sensing: Workshop on Quantifying Human Emotions. Proceedings of the 2021 ACM International Symposium on Wearable Computers (pp. 226-229).

[41] Tamir, M. (2016). Why do people regulate their emotions? A taxonomy of motives in emotion regulation. *Personality and Social Psychology Review*, *20*(3), 199-222.

[42] Torous, J., Wolters, M. K., Wadley, G., & Calvo, R. A. (2019). 4th Symposium on Computing and Mental Health: Designing Ethical eMental Health Services. In Extended Abstracts of the 2019 CHI Conference on Human Factors in Computing Systems (pp. 1-9).

[43] Wadley, G., Smith, W., Koval, P. & Gross, J. J. (2020). Digital emotion regulation. *Current Directions in Psychological Science*, *29*(4), 412-418.