From UX to Engagement: Connecting Theory and Practice, Addressing Ethics and Diversity

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Abstract. In the field of Human-Computer Interaction (HCI), engagement bears critical significance, not just for informing a design and implementation of the interface, but also for creating improved and advanced interfaces that can adapt to users. While the idea of user engagement is passively being researched in a range of domains, it has been used to various related but diverse concepts. For instance, engagement is the vital element of an effective HCI design. The primary goal of this paper is to introduce relevant research questions related to the engagement domain. The paper studies engagement from four different perspectives: (i) Theory: identifying key issues that aid in building a pluralism of engagement frameworks, (ii) Practice: developing novel methodologies for user engagement and reliable assessment tools, (iii) Ethics: discussing the ethical aspects of engagement especially for designers and developers of humane technologies, (iv) Diversity: investigating individual differences to develop personalized engaging designs and understanding user diversities to provide equal opportunities for user engagement. The discussion will lead to opportunities for the potential researchers to acquire relevant knowledge, assess the mechanisms of engagement and evaluate the current design frameworks.

Keywords: Engagement, frameworks, user experience, user interface, ethics, user diversity, Human-Engaged Computing

1 Introduction

Understanding engagement is a multidisciplinary and interdisciplinary challenge for many technology researchers and designers, a kind of profound knowledge they all

seek for. The term engagement itself has been applied in diverse settings, from games [1] to social networks [2] to the academic arena [3]. Engagement happens in the utmost complexity of the virtual worlds, but also in a simplicity of the text-based communication.

As stated by Ren [4], "engagement is the state of consciousness where a user is completely immersed in and involved in the activity at hand". At present, HCI researchers and developers have been designing and inventing technologies that engage users for diverse purposes. Engaging users is significant for designers of different products and services of every kind, where a lack of engagement can diminish the efficiency and meaningfulness of interaction between users and technologies. This need to understand users' experiences has motivated a focus on user engagement across computer science. However, to date, there has been limited reviews of how HCI and computer science research interprets and employs the engagement concept. Questions persist concerning its conception, abstraction, and measurement [5].

Engagement is necessary to maintain the meaningfulness and efficiency of the interaction occurring between computers and users. However, engaging/disengaging users with/from technologies is an arduous and potentially a counterproductive endeavor. It can be challenging when a lot of users stop being 'in' the interaction after a few trails out of frustration due to its poor design or absence of motivation. Stopping the interaction means the user seeks for alternative ways to serve their purposes becoming engaged elsewhere. In addition, the ability to be engaged can be hindered upon a user's diverse cognitive and physical differences where they are unable to use a system or technology properly such is the case with very young children. In contrast, other users cannot stop using technology, finding themselves addicted to it impacting their day-to-day life (e.g. gaming and internet addiction [6]). This disequilibrium in the engagement between the computers and users may result from a need of understanding engagement and it could have critical consequences on general well-being of societies. This is even more so the case in diverse use cases, where further reflection is needed to distrapulate the term and involvement with engagement. For instance, the UK government has been pondering upon bringing in new legislations around technologies for children following the French policy to ban smartphones in schools.

This article addresses the challenges of this concept by determining key factors that help development of engagement frameworks (theories), novel approaches to user engagement and effective assessment techniques (practice), ethical considerations (ethics) and individual differences to meet user diversity and provide equal opportunities to all users, including those belonging to minority backgrounds (diversity).

2 Related Work

Engagement is a multifaceted concept that includes both engaged interactions on a micro level and engaged human-technology relations on the macro level. Here micro level is related to the interaction design while macro level has broader perspective about general relationship between human and computer. Research on the micro level often follows "an interaction paradigm" whilst exploration on the macro level tends to adopt "a practice paradigm" [7]. With tech and computing products evolution for many objectives, engagement incorporated "user" next to it. For example, in video games, the user engagement is taken as a preceding stage to presence and immersion [8]. Van Vugt et. al [9] has later assessed engagement with the virtual reality by gauging it as a concept between the distance and involvement. In various other fields such as the development and use of information systems, the user engagement also consists of a sense of involvement, both physically and cognitively [10]. To provide a more nuanced answer to Shneiderman's call that "much work [needs] to be done" to connect macro-HCI and micro-HCI practices [11], Sun approaches engagement from the junction of macro-HCI and micro-HCI with global social media design cases [12]. Here the macro-HCI practice refers to critical design considerations such as agency, identity, values, ideology, structure, power, dominance, and hegemony on a macrosocial level to achieve *engagement* and *empowerment*. The micro-HCI practice refers to design implementations to achieve *efficiency*, *effectiveness*, and some aspects of *engagement*, with a focus on concrete tasks and different modes of interactions. From the communication and media perspective, macro vs. micro also is associated with the structuration process [13].

Engagement has been considered as an emotional [14], behavioral [15] and cognitive [16] association between computer and the end-user. On the other hand, O'Brien and Toms [17] associated engagement with resilience, challenge, and perceived control by the user. Additionally, engagement has also been related to gratification [18] and visual appeal [19]. Besides, there are also studies that considered engagement beyond User Experience (UX) qualities. For instance, beside the hedonic aspect of engagement (i.e., related to pleasure), Lukoff et al. [20] emphasize the eudaimonic aspect of engagement (i.e. related to self-actualization and fulfillment) to study the meaningfulness of engagement.

Lastly, Ren [4] proposed the Human-Engaged Computing (HEC) framework. HEC is a study of the synergized interaction between humans and computers, as well as phenomena around the interaction. It encompasses all aspects of interactions between and within humans and technologies [21]. HEC targets the enhancement of the synergy between humans and technologies through leveraging engagement. HEC demonstrated a holistic view to understand engagement to apply it into interaction design for enhancing human inner capabilities including human softer skills such as mindfulness, focus, creativity, empathy, and self-regulation [22].

As the above conversation denotes, engagement is a multifaceted identity, involving aspects of user experience, physical and cognitive functions, user perceptions and synergism. However, there are many facets of engagement that remain unclear, and yet, there are open questions that need to be addressed.

3   Open Questions on Engagement

The primary goal of this paper is to introduce relevant research questions and future research directions related to the engagement domain. To this end, we review engagement from different angles such as by connecting theory and practice and to address design issues of ethics and diversity concerning technology engagement. These elements chosen overlap the above mention topics being applicable to all facets (see Fig. 1).

ENGAGEMENT

Theory	Practice	Diversity	Ethics
HEC	Methodologies e.g., gamification	Diversity Factors	Value Research
Macro vs. Micro	Overarching Metric	Power Distribution	Meaningful Engagement
User states e.g. flow, mindfulness	Level of Engagement	Marginalized Users	Engagement and Addiction
Definition	Longitudinal Aspect	Demographic Variables	Legislation

Fig. 1. Open Questions on Engagement.

3.1 Theory

Traditional HCI considers engagement as the number of clicks, the amount of time a user spent with a product, or even as an affective user state. Despite the traditional perspective, here we see engagement as a holistic consideration of interacting with technology, where it emphasizes the meaningfulness of the interaction, values that technology can add to users, and the longer-term benefits that users can get from technology. However, it is not always clear what terms like 'meaningful' mean to the various users; especially within the diverse user space [23]. Therefore, we need to

think about identifying key issues that aid in building a pluralism of engagement frameworks [4]. Thus, we pose these following queries:

- How existing theories or philosophies can be integrated to deepen the understanding of human engagement?

- How the relationships between different aspects of human experiences such as emotion, cognition, behavior, and consciousness should be reframed into frameworks for engagement?

- How should we reconcile different understandings of engagement across the macro and micro levels?

- How should we understand the state of "engaged human" through well-known user states such as flow state (i.e., absorption in the task) or mindful state (i.e., being aware of the present moment)?

3.2 Practice

Developing novel practical techniques and methodologies for engaged users and providing reliable metrics for assessing engagement are highly required. Accordingly, we are interested in following questions:

- How can the existing methodologies in HCI (e.g. Gamification, Persuasive Design) be reframed to develop novel engaging methodologies?

- How to evaluate engagement by proposing an overarching metric that included various facets of engagement (behavior, emotion, cognition, consciousness)? And, how different measurement methodologies such as usage and performance metrics (e.g. experience sampling method, gaze tracking), psychophysiological measurements (e.g. EEG, skin conductivity), and qualitative metrics (e.g. questionnaire, interview) can support the mentioned engagement dimensions?

- How to develop a new metric that can assess engagement from the observable level (i.e., usage metric) to more experiential level (i.e., absorption, immersion), and to the extreme level (i.e., addiction)?

- What is the longitudinal aspect of engagement? How can we evaluate engagement from the perspective of further effects of engagement on a person's life (e.g., decision making) rather than UX level?

3.3 Ethics

Public attention to ethical technology design is on the rise. As technologies hijack the human mind [24] and displease users [25], social initiatives such as Time Well Spent [26] have emerged, and different studies [27, 20, 19] have been conducted to mitigate the perceived detrimental effects of technologies. This detrimental effect has been coined 'dark patterns' in UX/Interaction Design. However, there is still limited work to explore ethical design issues from the aspect of engagement, and it is still critical to raising awareness among researchers, designers, and end users. Here, we see a conflict of interest between overall social good and revenue-driven businesses. Therefore, we would emphasize "ethics for designers and developers", where the people involved within the end-product need to take more responsibility regarding the technologies during design and even after shipping the product.

- How previous theories and studies in Value Research and Value Sensitive Design can be linked to engagement proposing ethics guidelines for designers in this area?

- Is treating engagement as either a meaningful or meaningless approach appropriate? What are the criteria for these categorizations and how are these measured, especially with diverse users? And indeed, is this something that needs to be measured?

- How can engagement lead to addiction? And, what are the solutions that can promote mindful, voluntary engagement? (e.g., design frictions [19])

- Should the tech industry, similar to the pharmaceutical industry, require obtaining an approval before releasing a product in the market? What are the opportunities and threats of such legislation?

- What are the ethical dimensions of engagement that should be the focused upon, beyond responsibility?

3.4 Diversity

Whilst Niksirat et al. [28] have already demonstrated that individuals' experiences such as flow state highly differ based on various factors like gender or culture, there is still much more variables that have not been investigated. Designing for the diverse users and domains focuses design for specific classes of specialized users and these all classes include sub-classes of children, adults, elderly and individuals having cognitive, visual, physical and hearing impairments [29]. The user diversity is further extended to industries like games, healthcare and aerospace. The solutions are being designed in view of addressing user diversity since it has become a core factor to ensure effective engagement. To recognize diversity, the designer considers the kind of user frequenting the system, ranging from different skill levels, to users from

diverse backgrounds and different skill sets and abilities. Every kind of user expects the interaction with the technology to accommodate their wants and desires; novice and physically/mentally impaired users possibly needing more structured guidance and specialised technologies, while experts need speed and more advanced options. Accommodating both these styles on the same page is challenging but important to address diversity within this space.

However, by looking at what engagement means for diverse users this force typical assumptions that we hold, such as meaning behind engagement and their typical measurements, to be questioned [30]. This questioning includes both what a user values, and how we know what a user values, and the best way to quantify and scope engagement. By looking at the interchange between these methods, ethics and the interchangeability between diverse users this can bring new understanding into HCI and wider associations [31]. As such, engagement here is not about labeling the user with the formed appellation but instead growing the terminology upon what engagement is through these different perspectives, and how we design for this towards diversity being inherently a preposition.

Thus, engagement for diversity can be considered from two points of view. First, studying the effect of individual characteristics such as age, gender, expertise, and personality on engagement can help researchers for developing personalized engaging technologies [32]. Second, addressing issues regarding the accessibility and meaning of engagement for users from different cultures, ethnicities, socio-economic status can help designers to reach their product to the wider audience, while it can also offer more power to users from relatively deprived communities.

- What individual differences could affect people's engagement with computing technologies? How can we tailor the design to users considering their unique characteristics?

- How can we create technologies that both provide access to marginalized users and allow opportunities for them to engage? What are the current hindrances? And what have we been doing?

- What are the different considerations between engagement and empowerment in this case?

- How do demographic variables such as language and income level can affect the engagement? And how can we tackle those barriers to move beyond this?

- When including and engaging diverse users, what are the safeguards in place to both regulate and allow for engagement?

4.   Raising Awareness

Technology is a double-edged sword. While increasingly pervasive technologies create unlimited opportunities for a better quality of life, their domination can cause a disruptive effect on societies. This could be in form of depression after excessive use of social media (i.e., hyper connectivity) [33] or lack of focus after getting too many smartphone distractions [34]. In addition, recent tech scandals have raised serious concerns about the abuse of technology (e.g., a couple was raising a virtual child in an online game that they neglected their baby leaving her to starve to death) [35]. This article aims to raise awareness about challenges that researchers should attack for the future design to develop healthy, meaningful, and safe engagement.

5.   Conclusion

This article provides a grounding for the interpretation and measurement of engagement across HCI in terms of theory, practice, ethics, and human diversity, which may allow us to fret less about what engagement 'is' and to instead focus on the value it provides to diverse users. We have examined the theoretical grounding of definitions of engagement and located these interpretations within an HCI, and interaction. The conception of engagement is very often tied to measurement, and so we suggest instead to examine the choice of subjective and objective measures and motivations for their adoption. By individuating strategies for the design of engaging user experiences, we aim towards identifying opportunities for employing the concept within modern design projects. Finally, we annotate the areas for future work, as well as current trends across the engagement literature based on previous works related to user diversity in HCI settings.

References

1. Cheung, G. K., Zimmermann, T., & Nagappan, N.: The first hour experience: how the initial play can engage (or lose) new players. In Proceedings of the first ACM SIGCHI annual symposium on Computer-human interaction in play, 57-66 (2014)
2. Freyne, J., Jacovi, M., Guy, I., & Geyer, W.: Increasing engagement through early recommender intervention. In Proceedings of the 3rd ACM conference on Recommender systems, 85–92 (2009)
3. Jacques, R.: Engagement as a Design Concept for Multimedia. Canadian Journal of Educational Communication, 24, 49–59 (1995)
4. Ren, X.: Rethinking the Relationship between Humans and Computers. IEEE Computer 49, 8, 104–108 (2016)
5. Doherty, K., Doherty, G.: Engagement in HCI: Conception, Theory and Measurement. ACM Computing Surveys. 51. 1-39 (2018)
6. Ng, B.D. and Wiemer-Hastings, P.: Addiction to the internet and online gaming. Cyberpsychology & behavior, 8(2), pp.110-113 (2005)

7. Kuutti, K., Bannon, L. J.: The turn to practice in HCI: towards a research agenda. In Proceedings of the 32nd annual ACM conference on Human factors in computing systems. ACM, 3543–3552 (2014)

8. Brown, E., Cairns, P. A.: A grounded investigation of game immersion. CHI Extended Abstracts, 1297–1300 (2004)

9. Van Vugt, H. C., Konijn, E. A., Hoorn, J. F., Keur, I., & Eliëns, A.: Realism is not all! User engagement with task related interface characters. Interacting with Computers, 19 (2), 267–280 (2007)

10. Kappelman, L., & McLean, E. R.: User engagement in the development, implementation, and use of information technologies. In System Sciences, 1994. Proceedings of the Twenty-Seventh Hawaii International Conference on (Vol. 4, pp. 512-521). IEEE (1994)

11. Shneiderman, B.: Claiming success, charting the future: micro-HCI and macro-HCI. Interactions, 18 (5). 10-11 (2011)

12 Sun, H.: Global Social Media Design: Bridging Differences Across Cultures. New York, NY: Oxford University Press. (In Print)

13. Giddens, A.: *The Constitution of Society*. Berkeley, CA: University of California Press (1984)

14. Laurel, B.: Computers as theatre. Addison-Wesley (2013)

15. Attfield and et al.: Towards a science of user engagement (position paper). In WSDM workshop on user modelling for Web applications, 9–12 (2011)

16. Chapman, P. M.: Models of engagement: Intrinsically motivated interaction with multimedia learning software. Ph.D. Dissertation. University of Waterloo (1997)

17. O'Brien, H. L., Toms, E. G.: What is user engagement? A conceptual framework for defining user engagement with technology. Journal of the American society for Information Science and Technology 59, 6 (2008), 938–955 (2008)

18. O'Brien, H. L.: The influence of hedonic and utilitarian motivations on user engagement: The case of online shopping experiences. Interacting with computers 22, 5, 344–352 (2010)

19. Anna L Cox and et al.: Design frictions for mindful interactions: The case for micro boundaries. In Proc of the CHI Conference. ACM, 1389–1397 (2016)

20. Lukoff, K., Yu, C., Kientz, J., Hiniker, A.: What Makes Smartphone Use Meaningful or Meaningless? Proceedings of the ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies 2, 1, 22 (2018)

21. C. Law, E. L., Silpasuwanchai, C., Ren, X., Bardzell, J., Clemmensen, T., and Liu, Y.: Leveraging and Integrating Eastern and Western Insights for Human Engagement Studies in HCI. Proceedings of the 33rd Annual ACM Conference Extended Abstracts on Human Factors in Computing Systems. 2433-2436. ACM (2015)

22. Salehzadeh Niksirat, K., Silpasuwanchai, C., Mohamed Hussien Ahmed, M., Cheng, P., & Ren, X.: A Framework for Interactive Mindfulness Meditation Using Attention-Regulation Process. In Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems (pp. 2672-2684). ACM. (2017)

23. Hirskyj-Douglas, I. and Read, J. C.: The ethics of how to work with dogs in animal computer interaction. In Symposium on Animal-Computer Interaction. In: Proceedings Measuring Behaviour Vol. 16, 434-439 (2016)

24. Eyal, N.: Hooked: How to build habit-forming products. Penguin (2014)

25. Rainie, L., Smith, A., Duggan, M.: Coming and going on Facebook. Pew Research Center's Internet and American Life Project (2013)

26. Harris, T.: Time Well Spent. Retrieved from http://humanetech.com (2018)

27. Mark, G., Czerwinski, M., Iqbal, T. S.: Effects of Individual Differences in Blocking Workplace Distractions. In Proceedings of the CHI Conference on Human Factors in Computing Systems. ACM, 92 (2018)

28. Salehzadeh Niksirat, K., Park, K., Silpasuwanchai, C., Wang, Z., & Ren, X.: The relationship between flow proneness in everyday life and variations in the volume of gray

matter in the dopaminergic system: A cross-sectional study. Personality and Individual Differences, 141, 25-30 (2019)

29. Peters, C., Asteriadis, S., Karpouzis, K., Sevin, E. de.: Towards a real-time gaze-based shared attention for a virtual agent. International Conference on Multimodal Interfaces (ICMI), Workshop on Affective Interaction in Natural Environments (AFFINE), Chania, Crete (2008)

30. Hirskyj-Douglas, I., Lucero A.: On the Internet, Nobody Knows You're a Dog… Unless You're Another Dog. In 2019 CHI Conference on Human Factors in Computing Systems Proceedings at CHI (2019)

31. Hirskyj-Douglas, I., Read, J.C., Juhlin, O., Väätäjä, H., Pons, P. and Hvasshovd, S.O.: Where HCI meets ACI. In Proceedings of the 9th Nordic Conference on Human-Computer Interaction (p. 136). ACM (2016)

32. Kulev, I., Pu, P., and Faltings, B.: A Bayesian Approach to Intervention-Based Clustering. ACM Transactions on Intelligent Systems and Technology (TIST) 9, 4 (2018)

33. De Choudhury, M., Counts, S. and Horvitz, E.: Social media as a measurement tool of depression in populations. In Proceedings of the 5th Annual ACM Web Science Conference, 47-56 ACM (2013)

34. Westermann, T., Möller, S. and Wechsung, I.: August. Assessing the relationship between technical affinity, stress and notifications on smartphones. In Proceedings of the 17th International Conference on Human-Computer Interaction with Mobile Devices and Services Adjunct, 652-659. ACM (2015)

35. The Guardian: Girl starved to death while parents raised virtual child in online game. Retrieved from https://theguardian.com/world/2010/mar/05/korean-girl-starved-online-game (2010)