Measuring the User Engagement Process[1]

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ABSTRACT
Engagement is a quality of user experience that facilitates more enriching interactions with computer applications. It is defined by a core set of attributes: aesthetic appeal, novelty, involvement, focused attention, perceived usability, and endurability. The ability to engage users influences the products they purchase (e.g. cell phones), the websites they use, and the decisions they make regarding what they will use in future and what they will recommend to others. Engagement is clearly an important component of the user experience, but like other components, it is somewhat intangible, and therefore difficult to measure and evaluate. This workshop paper outlines previous research that has focused on the evaluation of engagement as an outcome of experience. We propose that focusing on measuring the process of engagement is a crucial direction for future research. In order to assess whether or not users are engaged while using an application and what aspects of the system engage them, we must employ mixed methodologies to capture the cognitive, affective, and behavioural components of the experience. But which methods are most appropriate, and how can they be used in concert? Addressing these questions will allow us to understand the nature of engagement and inform design.

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Engagement, user experience, measurement, evaluation.

ACM Classification Keywords
H5.m. Information interfaces and presentation (e.g., HCI).

INTRODUCTION

In today's wired world, people use computers for more than purely utilitarian purposes. They derive pleasure from the entertainment, tactile, and affective components of the user experience. Regardless of whether a user is shopping, searching websites, using a handheld information appliance, or taking a distance education course, the success of the interaction is as tied to their level of engagement as it is to system usability and performance outcomes. Successful human-computer experiences are defined by users' ability to meet their personal objectives and motivations in using technology, but also their willingness to use the application in future. Thus success is intricately linked to users' level of engagement. Educators, online retailers, software designers, and researchers alike need to be conscientious about "designing for engagement" [8]. But what is this construct we call engagement, and how do we measure it in the context of human-computer interactions?

THE NATURE OF ENGAGEMENT

Engagement is a quality of users' experience with a computer application. Engagement has been defined as both the act of emotionally involving someone or the personal state of being in gear [6]. Researchers have defined engagement narrowly as a set of attributes (i.e. attention and intrinsic motivation [10]; motivation [12]; perceived control [11] or the observable physical interaction between the user and the system [9]. It has also been suggested that "continued use" is indicative of being engaged [10]. Until recently, however, definitions of engagement were not consistent. O'Brien's work sought to unify the research in this area by constructing a theoretical framework of engagement and empirically testing potential attributes to arrive at six core ingredients: aesthetic appeal, novelty, focused attention, involvement, perceived usability, and endurability [15].

ENGAGEMENT AS OUTCOME AND PROCESS Engagement may be viewed as both an outcome of experience and a process during an interaction. After an experience, a user may say, "That was engaging" and discuss aspects of the encounter that were particularly so. Engagement may also be described as a process. A theory of engagement, developed by O'Brien, articulates five distinct stages: a point of engagement that initiates the engaging episode, a period of sustained engagement, disengagement, non-engagement, and, potentially, reengagement) [15; 16]. These stages correspond to Wright and McCarthy's "The Threads of Experience" [13] because they contain elements sensory, spatiotemporal, and emotional [16]. In this way, engagement may be defined as both a tangible aspect of an experience, and as a process within the broader experience framework. In related past work, one of the authors (O'Brien) focused on the measurement of engagement as an outcome. Engagement was defined operationally and conceptually by a set of potential attributes, which were refined and assessed for reliability and validity through a rigorous process of scale development and evaluation in e-commerce environments. From this series of steps, a structural model emerged consisting of the "key ingredients" or attributes of engagement. These were Aesthetic Appeal, Novelty, Focused Attention, Felt Involvement, Perceived Usability, and Endurability (i.e. willingness to use an application

again or recommend it to others) [15; 16]. This work articulated engagement as a construct with six distinct yet interrelated attributes and put forward a scale to assess whether or not a system is engaging post-use. This research was successful in devising a means to measure engagement as an outcome, but it did not address the measurement of the engagement process. The importance of process is foremost in HCI research. The investment of time and effort in the collection of physiological [14], eye tracking [21], and behavioural (e.g. mouse clicks, keystrokes) data during human-computer studies underscores the need to understand what is taking place during a users' interaction with a system, in addition to the behavioural, affective, or cognitive outcome of that experience.

The conceptualization of engagement as a process [15; 16] provides a foundation for unraveling the dynamic interaction between a computer user and an application. Moving forward, however, we need to explore ways to measure the engagement process in order to: a) understand more about users' experiences of engagement when they interact with technology (e.g. how engagement is influenced by information content and design features, as well as other interactive elements, whether visual, haptic or auditory) and b) use this to develop design guidelines for constructing engaging user interfaces. The emerging research questions that the HCI community will need to address in the area of engaging user experiences are:

1. How do we identify the stages of engagement within the broader context of an interaction with technology?

2. What methods are appropriate and meaningful for studying the engagement process? How specific are these methods to the primary modality of interaction?

3. How do measures of the engagement process and outcome correlate?

4. How can the measurement of engagement be used to inform design guidelines?

MEASURING ENGAGEMENT

To date, the measurement of engagement has involved selfreport measures, namely questionnaires [3; 10; 22]. Some researchers have used performance indicators, not as measures of engagement, but as correlates of engagement.For example, [3] employed pre-and post-task measures to examine changes in users' affective and cognitive states over the course of interacting with an educational application. Chapman and colleagues [4] studied the relationship between a brief engagement questionnaire and performance metrics, such as time on task and knowledge of system content (i.e. multiple-choice quizzes). Other researchers have articulated the idea of using multiple measures to study engagement [2] but did not indicate how to triangulate these measures to say something meaningful about engagement. As a result, there are gaps in the research regarding how to measure engagement as a process that need to be attended to.

Measurement in HCI

The measurement of human-computer interactions has typically centered on usability, defined as search effectiveness (i.e. ability to find the information sought, the user's judgment of the relevance or merit of search results), search efficiency (e.g. time to complete the search task), and user satisfaction (i.e. users' affective assessment of the task outcome). Some of the techniques associated with measuring how people use and perceive computer applications include transaction logs, psychometric measures, surveys, interviews, think-aloud/think-after protocols, and participant observation [20]. For instance, Oliver and Pelletier [17] articulated the physical or behavioral layer of human-computer interactions using observational techniques rooted in Activity Theory, but their techniques did not tap into the cognitive and affective layers of experience.

All of these techniques measure important elements of human-computer interactions, but have some drawbacks when used alone. For example, transaction logs, mouse clicks, and numbers of steps in the navigational process may account for what users are doing, but not what they are thinking or feeling. It has been argued that researchers should employ multiple methods to gain an in-depth understanding of human behaviours [20], and that merely collecting different types of data is not sufficient. The notion of triangulation is not a new approach to research, but should be performed systematically. It is not enough to gather a large amount of data; rather we need to examine the ways in which those methods reinforce and validate each other in order to see the engagement process more holistically.

Recently, researchers have begun to use physiological measures, such as galvanic skin response and heart rate, to investigate fun with video games [14], and eye tracking to explore usability and attention to interface elements, e.g. menus and images [21]. Such indicators have also been employed to measure one aspect of engagement (namely affective response) in real-time during a diversity of interactions, both to inform the ongoing interaction (e.g. in 3 learning applications [4] and human-robot interaction [1] and to assess users' preference for certain design features [20]. Performance indicators and physiological metrics have the advantage of recording users' physiological reactions or behaviors over the course of an interaction with a system. Yet while these metrics answer the question of what is taking place and the users' endogenous physiological states, they do not address users' expressed cognitive or emotional dispositions, both of which are critical to understanding engagement. Thus, usability metrics, biometrics, and eye tracking data will be more powerful when examined in concert with users' self reports and other observational data.

However, it is not enough to use multiple methodologies at the same time; rather, we must be able to select the bestmethods for the task at hand and have a concrete understanding of how they complement each other. Thus, it is important to augment their behavioral approach with selfreport, biometric, eye tracking, and usability data to capture the behavior, cognitive, and affective elements of the interaction.

OBJECTIVES

In focusing on the measurement of the engagement process during human-computer interactions, we will be able to make strides in our understanding of human experiences with technologies and operationalize what it means to "design for engagement" [8]. To this end the following objectives are key:

- Determining how to measure users' stages of engagement (e.g. disengagement) when they perform a computer related task
- Developing methodologies to identify users' stages of engagement both in real-time and post analysis
- Examining the information content, interactive elements, and design features associated with each stage in the engagement process
- Examining the engagement process in a variety of applications. For example, do the attributes of engagement manifest themselves differently depending on goal and nature of the application, e.g. whether we are investigating video games versus digital libraries?
- Examining the role of sensory modality. Do different modalities contribute to engagement in different ways? For example, does a primarily haptic interaction follow a different time course or path than primarily visual interactions?
- Beginning to prototype experiences whose time course *builds* engagement.

How do we begin to meet these objectives? We propose an iterative approach to research in this area, focusing first on identifying applications within a specific domain that are of varying degrees of engagement and developing measurement techniques, and then proceeding to examine the generalizability of the methodologies in additional domains. Such a project might take the following form:

1. Identify applications (e.g., cell phones, educational technologies, etc.) and having expert and non-expert evaluators rate them as low, moderate, or high, as measured by the engagement scale [15] and interviews.

2. Based on the findings of step 1, using a sample of the applications rated as low, moderate, or high to conduct preliminary user studies. The purpose of the study would be a) to identify periods during the interaction or aspects of the content, design, and interactivity that are more engaging than others, thereby mapping "shifts" in the engagement process, and b) to employ a variety of methodologies (e.g. observational techniques, think after protocols, and behavioural measures, e.g. mouse clicks, patterns of navigation) and determine which techniquees contribute best to the study of engagement.

3. Conduct further studies with users to validate the proposed methods in different domains, formats, devices, etc. Investigations that target these objectives will contribute to an understanding of human-computer experiences and will determine what methods and metrics best tap into these experiences. A systematic, methodological approach will elucidate the relationship between outcome and process measures and how to correlate these results.

CONCLUSION

The ability to measure the engagement process will lead to recommendations for the design of engaging systems. For a society that is faced with growing information demands and complexity, but is also seeking meaning, pleasure, and engagement in technology interactions, this is a formidable yet worthy goal.

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