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Measuring engagement in video game-based environments: Investigation of the User Engagement Scale

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ABSTRACT

This research investigated the use of the User Engagement Scale (UES) as a psychometric tool to measure engagement during video game-play. Exploratory factor analysis revealed four factors (Focused Attention, Perceived Usability, Aesthetics, and Satisfaction) as compared to the six found in the original development of the UES. In the context of video game-play, a revised UES (UESz) demonstrated better psychometric properties than the original UES defined by six subscales, including enhanced reliability. Further validity analysis included comparisons with the Flow State Scale (FSS), showing the complementary nature of the two scales and what constructs both scales might be measuring in a video game context. Criterion validity analysis demonstrated that UESz was more predictive of game performance than the FSS. Findings related to both the UESz and FSS were discussed relative to an overarching framework of hedonic and utilitarian qualities of game-play.

1. Introduction

While cognitive theories and constructs continue to dominate much of the research in human–computer interaction, affective dimensions of the user experience have increasingly gained the attention of researchers (cf., Picard, 2010). In particular, the intersection of affective and cognitive dimensions are being studied as key underlying constructs to help explain the rapid rise of popularity of video games and their efficacy for generating extended task-oriented behaviour (Przybylski, Rigby, & Ryan, 2010). For many researchers, gaming is of particular interest because of its potential use as a guiding design heuristic in learning-based environments (e.g., Mayo, 2009; Whitton, 2011).

This increased interest in the intersection of affective and cognitive psychological dimensions of user experience with video games has carried over to other computational environments. At this nexus, engagement has been recognized as a key factor in understanding general user behaviour and overall efficacy of goal or task-oriented behaviour within computer-based environments; including work-oriented information retrieval tasks, social networking tools (e.g., Facebook™), games, traditional educational environments, and hybrid environments such as game-based learning (Boyle, Connolly, & Hainey, 2011; Faiola, Newlon, Pfaff, & Smyslova, 2012; O'Brien and Toms, 2008). Evaluation and research on these types of computer-based environments have included measures of engagement, yet it is recognized that better tools are needed to help define and measure this construct (cf., Attfield, Kazai, Lalmas, & Piwowarski, 2011).

The goal of this study is to extend and refine existing work in defining user engagement as it relates to computer and game-based environments. This study focuses on extending the ongoing work being conducted by the team of O'Brien and Toms (2008, 2010, 2012) on developing a self-report instrument of user engagement. Their work is extended by investigating the use of their User Engagement Scale (UES) in the context of game-based environments. Additionally, this study continues the work on validating and refining the instrument and its underlying constructs.

1.1. Theoretical framework

In the past couple of decades, two related frameworks of engagement have been developed in the contexts of school (academic) settings and in human–computer interaction. School-based engagement is the broader of the two, encompassing an individuals' engagement with academic activities in school but influenced by factors both within and outside of school. Work by Appleton, Christenson, Kim, and Reschly (2006), Fredricks, Blumenfeld, and Paris (2004) have developed a sophisticated, multifaceted view of engagement that can be conceptualized at many different levels. Their complementary work demonstrates that family, community, culture and educational context are all important antecedent

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factors mediating engagement. Fredricks et al. (2004) describes factors related to engagement that are measurable at different contextual levels: school, classroom, and individual levels. A complementary approach by Appleton et al. (2006) identifies facets of engagement related to academic (time on task), behavioural (classroom participation), cognitive (strategizing), and psychological (belonging) settings. Both researchers note that engagement can happen in the context of group-social interaction and at the individual level. From this research comes an understanding that engagement can be effectively studied and measured at the individual level as individuals conduct cognitively demanding task-oriented activities. Performance is frequently considered as an outcome measure in cognitive tasks and is mediated by affective dimensions. Thus, engagement becomes an important factor to measure if performance is to be understood, because it helps explain the critical mediating role that affective dimensions play in cognitive tasks.

Of particular interest to this current study, Appleton, Fredricks and other allied researchers helped define where engagement resides with regards to a broad spectrum of cognitive and affective dimensions or states such as motivation and self-efficacy (cf., Sharek, 2012). They note that self-determination theory (Ryan & Deci, 2000) helps explain how intrinsic motivation—driven by factors such as the need for competence—is an important precursor for engagement (Boyle et al., 2011; Przybylski et al., 2010). However, while engagement is certainly related to motivation, it can be considered a separate construct (Appleton et al., 2006; Przybylski et al., 2010). One can conceive engagement as a series of (state-like) temporal interactions during task while motivation is a more (state or trait-like) global personal orientation towards the learning/task (Bempechat & Shernoff, 2012). The interaction between the two can form a feedback loop where the experience with the task can shape the more state-like elements of self-efficacy and motivation which in turn influences the user's desire to re-engage with a task (Sharek, 2012).

A second line of research has developed around understanding engagement in individual, task-oriented endeavors using computer-based tools (e.g., O'Brien and Toms, 2008). This work has developed a conceptual model of engagement in the context of human–computer interaction, primarily around tasks related to information search and retrieval, but also encompassing activities such as online shopping and video games (O'Brien and Toms, 2010). O'Brien and Toms have developed a model of engagement that is both a process and a product of interaction. It represents a cyclical experience of engagement and reflection on this interactive experience that helps shapes decisions about future engagement (O'Brien and Toms, 2010). While O'Brien and Toms (2008) provide a comprehensive review of the different theoretical sources of their identified facets of engagement, the work of Hassenzahl, Diefenbach, and Göritz (2010) can be used to provide a very succinct lens by organizing these experiences and motivations for engagement into two categories, or qualities, of the user experience. First, there are pragmatic qualities related to the usefulness and usability of the system. Second, there are the hedonic qualities of motivation, stimulation, and challenge for the user. The pragmatic qualities of utility/usefulness and usability have a long, established history in research in human–computer interaction (cf., Shneiderman, 1998) and form the backbone of well-established frameworks such as the Technology Acceptance Model (Bourgonjon, Valcke, Soetaert, & Schellens, 2010; Venkatesh & Bala, 2008). Positive responses by the user to both the usability and usefulness of a computer-based system for a task are seen as key prerequisites for user engagement (O'Brien and Toms, 2010).

Hassenzahl et al.'s (2010) hedonic qualities sit at the centre of what has become the areas of engagement that engender the most interest among researchers looking at video games and game-based learning environments. It is the hedonic qualities of games that are seen as the key elements that explain the perception of high engagement by users (Malone & Lepper, 1987; Przybylski et al., 2010). One facet of this quality is the perceived aesthetics of the computer-based environment (Skelly, Fries, Linnett, Nass, & Reeves, 1994; Vorderer, Klimmt, & Ritterfeld, 2004). Aesthetics works at many different levels to both motivate initial interaction with a system, enjoyment while using it, and (perhaps) the perceived overall usability of the system. The notion of "play" encompasses many of the other facets of the hedonic quality of human–computer interaction, especially as they relate to game-based environments (Rieber, 1996; Stephenson, 1967). While play is often thought of as a physical activity, it can also represent interaction with virtual spaces. Also relevant is that while play can be task-oriented, these tasks can just as (or more) easily be driven by hedonic rather than pragmatic qualities of the experience. Though play in both physical and virtual spaces is typically thought of as an activity or behaviour, what is most relevant to engagement is perhaps the user's perceived experience while at play and their response to this experience.

Flow Theory (Csikszentmihalyi, 1990) is used by O'Brien and Toms (2008, 2010), along with numerous other researchers (e.g., Boyle et al., 2011; Sherry, 2004), to describe what an individual experiences during play and, thus, is a central theoretical frame for understanding user experience in game-based settings and as a means for explaining user engagement in such environments. Flow can be thought of as a deep immersive experience that results from an individual engaging in a task that has an appropriate balance of challenge relative to a user's skill level (Csikszentmihalyi, 1990; Faiola et al., 2012; Sherry, 2004). Flow and game play are often linked in contexts where the user finds a familiar formal structure (of the game) but novel content created by the system design and user choice within the system (Sherry, 2004). The connection here can be found within the larger framework of motivation and engagement where the user will leverage their familiarity and past experiences of the formal structure to determine whether the challenge being presented to them is both achievable and desirable. From this flow experience is a positive affective response—enjoyment and satisfaction—that leads an individual to both reflect positively on the experience and, typically, want to re-engage with it again (Sharek, 2012). Despite the connections that many have found between Flow Theory, as conceived by Csikszentmihalyi (1990), and game-based environments, researchers have noted that the connections between the two are often deceptively simple on the surface and decidedly complex in direct application in research (cf., Weibel, Wissmath, Habegger, Steiner, & Groner, 2008). Indeed, while flow and enjoyment reported in game play may be highly correlated, they might be considered separate constructs to be measured and characterised individually (Boyle et al., 2011; Weibel et al., 2008).

1.2. Measurement

This emerging framework for understanding engagement leads to the use of multiple measurement paradigms and approaches to measuring data arising from users in task-oriented contexts. Given that the larger framework of engagement encompasses both behaviours in physical and virtual spaces and the resulting psychological states, it is appropriate that researchers have employed varied and often multiple measurement approaches. On the behavioural side, direct observational measures have been used to characterise overt behaviour in educational and other settings (Admiraal, Huizenga, Akkerman, & Dam, 2011). In the context of computer-based activities, in addition to direct observation of activity, trace/log data from interaction from the system is also employed (Lehmann, Lalmas, Yom-Tov, & Dupret, 2012). To