



## Examining the generalizability of the User Engagement Scale (UES) in exploratory search

Heather L. O'Brien <sup>a,\*</sup>, Elaine G. Toms <sup>b</sup>

<sup>a</sup> School, University of British Columbia, 1961 East Mall, Vancouver, British Columbia, Canada

<sup>b</sup> School of Information, The University of Sheffield, Regent Court, 211 Portobello, Sheffield S1 4DP, United Kingdom

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### ABSTRACT

The user experience is an integral component of interactive information retrieval (IIR). However, there is a twofold problem in its measurement. Firstly, while many IIR studies have relied on a single dimension of user feedback, that of satisfaction, experience is a much more complex concept. IIR in general, and exploratory search more specifically, are dynamic, multifaceted experiences that evoke pragmatic and hedonic needs, expectations, and outcomes that are not adequately captured by user satisfaction. Secondly, questionnaires, which are typically the means in which user's attitudes and perceptions are measured, are not typically subjected to rigorous reliability and validity testing. To address these issues, we administered the multidimensional User Engagement Scale (UES) in an exploratory search environment to assess users' perceptions of the Perceived Usability (PUs), Aesthetics (AE), Novelty (NO), Felt Involvement (FI), Focused Attention (FA), and Endurability (EN) aspects of the experience. In a typical laboratory-style study, 381 participants performed three relatively complex search tasks using a novel search interface, and responded to the UES immediately upon completion. We used Principal Axis Factor Analysis and Multiple Regression to examine the factor structure of UES items and the relationships amongst factors. Results showed that three of the six sub-scales (PUs, AE, FA) were stable, while NO, FI and EN merged to form a single factor. We discuss recommendations for revising and validating the UES in light of these findings.

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### 1. Introduction

Assessing search systems usually takes a systems-based approach that uses standard information retrieval measures such as precision, recall, and cumulative gain (Järvelin, 2011) to evaluate the output from the system; in interactive information retrieval, evaluation is extended to encompass aspects of user interactivity, where elements of the interaction are measured, including number of queries used and the mean size of a query; performance measures such as number of relevant documents retrieved; and usability measures such as ease of use, effort and preference, among a host of metrics (Kelly, 2009). But how is the user *experience* assessed? In studies of interactive information retrieval, user experience is rarely addressed except in post task questionnaires that inquire about user satisfaction, which is generally evaluated using a single Likert-scaled question: "How satisfied were you ...?" (see reports from the Interactive Track at TREC and INEX as examples). This one-dimensional approach is a limited and imprecise assessment of the rich, multi-dimensional experience that is so typical of user interactivity with any digital product including search engines and exploratory search systems.

\* Corresponding author. Tel.: +1 604 822 6365; fax: +1 604 822 6006.

E-mail addresses: [h.obrien@ubc.ca](mailto:h.obrien@ubc.ca) (H.L. O'Brien), [e.toms@sheffield.ac.uk](mailto:e.toms@sheffield.ac.uk) (E.G. Toms).

Increasingly, researchers are looking to experience-based frameworks as a means of understanding Human Information-Interaction (HII) (O'Brien, 2011b). The concept of user experience (UX) gained prominence in e-commerce and was further popularized in human computer interaction by Norman (2002). UX, defined as “a person's perceptions and responses that result from the use or anticipated use of a product, system or service” (ISO, 2008), represents a more holistic way of approaching people's interactions with technologies than usability:

An experience is an episode, a chunk of time that one went through—with sights and sounds, feelings and thoughts, motives and actions; they are closely knitted together, stored in memory, labelled, relived and communicated to others (Hassenzahl, 2011, p. 8).

UX examines the *quality* of information interactions from the perspective of the user. Like usability, UX is outcomes-based, but this outcome may be tangible (e.g., using your smartphone to text a friend) or intangible (e.g., sharing a joke with and feeling connected to that friend). UX also places an emphasis on process. Several researchers have emphasized the idea of “plot” or “story” to describe the way in which an interaction with a system unfolds over time and the affective, cognitive, physical and social aspects of experience (Laurel, 1993; McCarthy & Wright, 2004).

If we begin to view IIR as an experience, then we must re-examine how we measure information searching and retrieval, moving beyond standard metrics of efficiency, effectiveness and user satisfaction to incorporate measures of fulfilment, play and engagement (McCarthy & Wright, 2005). This concept is especially important in exploratory search, which emphasizes learning, discovery, creativity and problem solving (White & Roth, 2009). Exploratory search centres around a complex information need that changes as the searcher encounters and incorporates new information within an information space for the purposes of knowledge acquisition and personal growth. Given the richness of exploratory searching, traditional IIR metrics must be complemented by measures that address learning, discovery, enjoyment and engagement (White & Roth, 2009). In addition to developing such measures, we must also ensure that they are rigorously tested and meet standards of reliability, validity and generalizability in order to accurately reflect the user experience.

The focus of our work has been to define and measure user engagement. User engagement “explain[s] how and why applications attract people to use them” (Sutcliffe, 2010, p. 3). We have found that engagement is a quality of user experience that depends on several factors, including the aesthetic appeal, novelty, and usability of the system, the ability of the user to attend to and become involved in the experience, and the user's overall evaluation of the salience of the experience (O'Brien and Toms, 2008). Engagement depends on the depth of participation the user is able to achieve with respect to each experiential attribute.

The multidimensional nature of user engagement makes it challenging to measure. While we are very comfortable measuring concrete events, such as the number of errors a user makes when interacting with a system or how long it takes to find the answer to a factual search query, we are less firmly seated when it comes to activities for which there are no visible or physical outcomes. Since only the user can evaluate the level of engagement experienced during an interaction with a system, a subjective approach is needed in the development of measures for this construct. We elected to develop a questionnaire, which takes assessment “. . . away from the usual product-centred towards a more experiential evaluation” (Hassenzahl, 2011, p. 56). Based on an extensive literature review, a qualitative study with users of four types of technologies (video games, e-shopping, e-learning, and web searching), and two large-scale survey studies conducted in the e-shopping domain (O'Brien and Toms, 2008; O'Brien and Toms, 2010a), we developed the User Engagement Scale (UES). The UES is a 31-item questionnaire that taps into six dimensions of experience: Aesthetic Appeal, Novelty, Focused Attention, Felt Involvement, Perceived Usability, and Endurability (i.e., the users' overall impression of the experience).

As part of the scale development and evaluation process, we are interested in generalizing the UES to different research environments, including exploratory search, with the ultimate goal of producing a reliable and valid instrument that can assess user engagement in IIR settings. In the work reported here, we administered the UES to a large group of searchers who interacted with an exploratory search interface to perform decision-making tasks. In the following sections, we elaborate on issues inherent in the measurement in IIR, exploratory search, and user engagement, describe the current study, and present our findings. In light of our results, we discuss implications for the revision, validation, and use of the UES.

## 2. Literature Review

### 2.1. Measurement in interactive information retrieval and exploratory search

There are four basic classes of measures commonly employed in interactive information retrieval (IIR): contextual, interaction, performance, and usability (Kelly, 2009). Contextual measures include demographic and socio-cognitive variables (e.g., topic familiarity and search experience), as well as the nature of the search or work task and the setting in which the information interaction occurs. Interaction measures are collected during an IIR session, and are based on users' search strategies (e.g., query construction, number of queries) and their interactions with retrieved documents. Performance measures, such as precision and recall, and usability measures, which gauge users' perceptions of the system and their interactions with it, are outcome oriented and used to evaluate the success of an IIR session (Kelly, 2009). Several researchers have examined the relationship between these four classes of measures. For example, Su (1992) found that usability measures (e.g., users' confidence and satisfaction with the completeness and precision of the retrieved results), along with

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