



## Psychometric modeling of the pervasive use of Facebook through psychophysiological measures: Stress or optimal experience?



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### ABSTRACT

Social network sites have been studied extensively with an aim to understand users' experience during their use. Facebook is the most frequently used social network site, with more than one billion active users. However, despite 819 million of active Facebook users currently accessing it using their mobile device, only a limited number of studies have investigated their experiences with Facebook. Our goal was to objectively verify in an experimental setting the subjective experience of users accessing Facebook through a PC and through a smart phone, which has a higher pervasiveness. Psychophysiological correlates of 28 subjects were measured using wearable biosensors, which record signals through an electrocardiogram; a 14-channel Electroencephalogram; facial Electromyography; an Electrooculogram, and a chest Respiration strip. An accurate signal processing permitted to compute twenty psychophysiological measures for the statistical analysis. The results showed significant patterns in arousal, valence, attention, and anxiety, indicating a subjects' engagement during Facebook navigation, which was also more evident during the mobile session, suggesting an optimal experience during the pervasive use of Facebook. Some hypotheses and the directions for future studies are presented, in particular, the suggestion to make further studies with higher ecological validity, outside the lab, to assess the ubiquitous use of Facebook.

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### 1. Introduction

Social networking sites (SNSs), such as Facebook, LinkedIn, Google+, and Twitter, are becoming increasingly prevalent in many aspects of communication, interaction, human behavior, and even personality (Cheung, Chiu, & Lee, 2011; Orr, Ross, Simmering, Arseneault, & Orr, 2009; Riva, Wiederhold, & Cipresso, 2015a, 2015b; Ross et al., 2009).

SNSs increase individuals' visibility and availability within their social network (Boyd & Ellison, 2007; Riva, 2010). According to Boyd and Ellison (2007), social networking sites could be defined as web-based services that enable users (1) to create a personal profile with different privacy level, (2) to structure a list of other users with whom they share a connection, and (3) to view and analyze their behavior within the system and their list of connections.

People navigate through SNSs anywhere a computer is available to connect, including their homes, workplaces, or in public places. Furthermore, the recent development and diffusion of mobile platforms enhance the possibility to connect to the Internet and navigate through social networks (Ran & Lo, 2006). In particular, most contemporary SNSs have developed pages to navigate through mobile devices, and many of them have developed specific applications to improve mobile experiences (for example, <http://www.facebook.com/mobile/> for Facebook mobile App, <http://www.linkedin.com/static?key=mobile> for LinkedIn, and <http://www.google.com/mobile/+/>, for Google+). The most used SNS, as of June 30, 2013, is Facebook, with more than one billion active users (1.15 billion monthly active users at the end of June 2013); furthermore, there are about 819 million monthly active users (June 2013 data) currently accessing Facebook through their mobile devices (<http://newsroom.fb.com/company-info/>).

Navigating through SNSs using the PC and a mobile platform has two main differences: (1) mobile platform can be multifunctional, taking advantage of contextual affordances more than a

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PC (Wood, 2011), and (2) mobile platform is – by definition – ubiquitous (Zhou & Lu, 2011). Thus, mobile scenarios enable functions that cannot be used with a standard personal computer. In particular, one mobile device, the mobile phone, has played a fundamental role in everyday life. Mobile phones have quickly evolved from only voice and text-based devices, which enable minimal user-device interaction, to personal digital assistant, with digital camera, GPS, navigator, MP3 and video player, interactive agenda, clock and alarms, instant messaging, and Internet browser (Barkhuus & Polichar, 2011).

In this study, we were interested in examining subjects' experience during SNSs use, thus, we focused on three main aspects of time-space continuum of subjects' states: physiological arousal, emotional valence, and sustained attention.

According to the classic valence-arousal model (Lang, 1995; Russell, 1979), to identify affective states of subjects during an experimental session, we can consider the two dimensions of "activation", namely, physiological arousal and emotional valence. Valence and arousal dynamics have been used extensively in psychophysiological research as an objective way to measure affective states during a mediated experience (Backs, da Silva, & Han, 2005; Bradley & Lang, 2000; Cipresso et al., 2012; Codispoti, Surcinelli, & Baldaro, 2008; Gruhn & Scheibe, 2008; Keil et al., 2002; Morris, 1995; Rubin, Rubin, Graham, Perse, & Seibold, 2009; Salimpoor, Benovoy, Larcher, Dagher, & Zatorre, 2011; Salimpoor, Benovoy, Longo, Cooperstock, & Zatorre, 2009; Tajadura-Jimenez, Pantelidou, Rebecz, Vastfjall, & Tsakiris, 2011). More recently, an extensive research has been done to discern different emotions by the means of cardiovascular measures (Cacioppo, Tassinary, & Berntson, 2007; Rainville, Bechara, Naqvi, & Damasio, 2006), confirming the results that can be obtained using specific pattern of the cardiovascular indexes (Magagnin et al., 2010; Mauri, Cipresso, Balgera, Villamira, & Riva, 2011; Mauri et al., 2010).

The third dimension used to assess the Facebook experience was the attention. According to Draper, Kaber, and Usher (1998), the presence occurs when more attentional resources are allocated to the computer-mediated environment.

If we are able to demonstrate that users are engaged during an experience and that during the same experience, their level of attention (Schupp et al., 2007) to the resource is high, then we can affirm that their sense of presence is high and this increases an optimal experience of subjects through an higher involvement (Riley, Kaber, & Draper, 2004; Riva, Davide, & Ijsselstein, 2003).

Thus, we assessed the experience by studying the physiological arousal, emotional valence, and sustained attention and by identifying, like in the classic valence-arousal model, the affective states to assess an experience effect due to a higher level of attention (Fig. 1).

### 1.1. The psychophysiological assessment

As before stated several psychophysiological studies have widely extended the accuracy of the interpretation of the measures considered. Briefly, *physiological arousal* can be measured using Beta Waves observed using electroencephalogram (EEG) and galvanic skin response (GSR), using heart rate extracted from cardiovascular activity through Electrocardiogram (ECG) or Blood Volume Pulse (BVP), and using respiration signal (RSP). *Emotional valence* can be measured using Alpha wave asymmetry on frontal channels of electroencephalogram (EEG), self-reports, facial expression identification, eye-blink startle, and facial EMG corrugator and/or facial EMG zygomatic. It has been broadly demonstrated that the facial EMG corrugator is one of the best measures of emotional valence (Blumenthal et al., 2005).

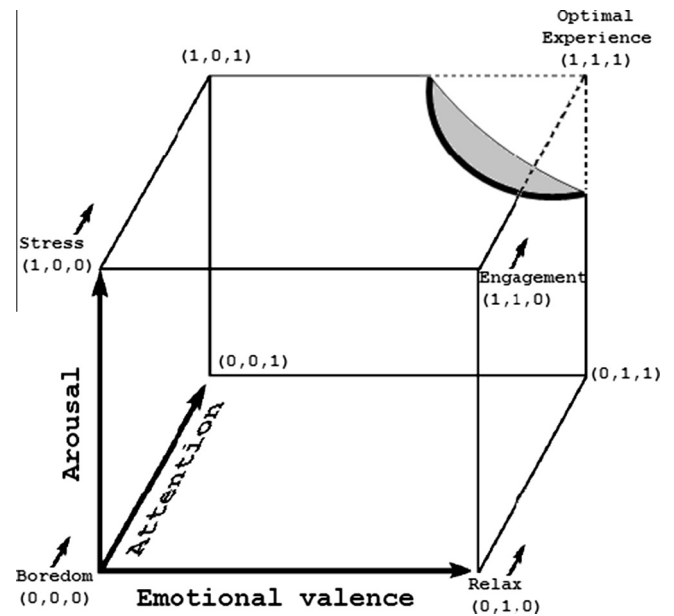


Fig. 1. Experience representation in the tridimensional space defined by physiological arousal, emotional valence, and attention.

Attention can be measured using Slow Alpha waves extracted from electroencephalogram (EEG), self-reports, Eye Tracking, Posture, and Behavioral analysis.

### 1.2. Research questions

Our study aim at investigating the pervasive use of Facebook by using psychophysiological measures. In particular, the following two research questions (RQ) emerges:

**RQ1:** Can Facebook navigation leads to an engagement state, aside from platform used and the related levels of pervasiveness?

To answer this question, we used standard psychophysiological measures. We need to consider that the more the subjects will be engaged and attentive, the more likely they will be to achieve an optimal state characterized by positive valence, high arousal, and high attention. Thus, we were interested in objectively identify specific pattern of users' affective state in the Arousal-Valence-Attention space while experiencing Facebook navigation trough a PC and a mobile platform.

**RQ2:** Can Facebook navigation through the mobile be more effective, leading to a higher pervasiveness able to induce an *optimum state*?

According to Favela and Colleagues (Favela, Tentori, & Gonzalez, 2010) two aspects should be evaluated in the experimental design of ubiquitous technologies, ecological validity and pervasiveness. Our study design considered the results of their research, specifically the results regarding the pervasiveness of the navigation using a PC or a mobile. In fact, our study is related to a pervasive dimension between classic laboratory experiment and *in vivo* experiment at the highest level of pervasiveness. Favela and colleagues identified this kind of experiment as an *ex vivo* study. Actually, the use of mobile, even if in a laboratory setting, gives a number of tools and capabilities that make the social networking experience more pervasive compared to a classic PC use (Coyne, 2010; Wood, 2011). Thus, our study aimed to compare a PC session, as a low pervasive one, with a Mobile session, that has a higher level of pervasiveness for the subject.

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