Guest Editorial

Persuasive Technology in Biomedical Informatics

Persuasive Technology (PT) was first defined in 2003 by BJ Fogg [1] as the scientific discipline that studies characteristics and attributes of technologies, particularly Information Technologies (ITs) to support behavior change without coercion. Since its inception, PT has become a vibrant, emerging scientific discipline with applications in multiple domains including environmental sustainability [2,3,4], information systems [5], health care [6,7,8], and others.

A major reason for the interest in Persuasive Technology over the last 30 years is that technologies, particularly Information Technologies such as the web, smart phones, and other consumer electronics devices, have become ubiquitous, indispensable, and have gained powerful capabilities to assist humans in cognitive activities. The recent resurgence of artificial intelligence methodologies has enabled computers, including smart phones, to perform mental tasks such as facial recognition that have hitherto been regarded as the exclusive province of humans. Computer games, augmented reality, and virtual reality can underlie the development of compelling environments for simulation and rehearsal (two of Fogg's original principles) of health-promoting behaviors such as cessation of drug addictions [9], coping with social environments that promote the use of addictive substances [10], and care of individuals with Post Traumatic Stress Disorder [11]. As a further example, the Internet of Things, when embodied in smart and connected health systems, enables continuous monitoring and feedback of physiological parameters, even from remote locations [12]. These data can provide valuable information to individuals to sustain health-promoting behaviors. Self-monitoring is also one of the seven principles formulated by Fogg.

Over the last ten years PT, as a scientific discipline, has evolved considerably in terms of methodology and scope. In 2008 Oinas-Kukkonen and Harjumaa extended Fogg’s work in the Persuasive Systems Design (PSD) model to facilitate and guide the design and development of systems that support behavior change [13]. PSD places emphasis on understanding the persuasion context, i.e., the system comprising the various players involved in the persuasion activity such as the person who is its target, and the persuading medium, which could be a
technological artifact. PSD identifies 28 design principles grouped in four support categories. Here, Fogg’s original seven principles are designated “Primary Task Support”. These are supplemented by “Dialog Support, “System Credibility Support”, and “Social Support”, each of which includes seven attributes. Subsequently Oinas-Kukkonen [14] defined an informatics construct called a Behavior Change Support System (BCSS) as “an information system designed to form, alter or reinforce attitudes, behaviors, or an act of complying without using deception, coercion or inducements” [14]. For convenience we use here the umbrella term “Persuasive Technology”.

Persuasive Technology has proved to be of interest to biomedical informaticians because behavior change plays a vital role in health and medicine. People who have no specific illnesses may wish to maintain or improve wellness through their cessation of unhealthy habits, loss of weight, or an increase in physical activity [15]. The growing aging population, and those with chronic illnesses, including mental and behavioral illnesses, may need to modify their lifestyles to follow clinician instructions for diet, exercise, and medication adherence. Medical caregivers such as community health workers in developing countries may be able to provide better care by modifying their existing practice to follow evidence-based guidelines [16,17] on mobile platforms. Persuasive Technology can provide medical informaticians with a systematic conceptual framework, based on an increasing body of evidence, to architect, design, develop, and analyze IT-based interventions, including the human-computer interface. Such a framework is often very useful given the complexity of healthcare and the myriad Information Technology options available that can potentially provide candidate solutions.

To start the special issue, Cabrita et al [18] review current methodologies that enhance the ability of older adults to live healthy and active lives, a topic that is receiving increasing attention due to the steady growth of older populations worldwide. To maintain health, the ability for independent living, and to overcome the effects of age-related conditions, it is often necessary for such populations to follow evidence-based behaviors relating to diet, exercise, and medication adherence. The authors present a survey of PT methods that support healthy and active aging.
Fogg’s behavior change model suggests that motivation is an important factor driving behavior change to achieve desired health objectives, such as improving personal appearance. Such motivation can arise out of a *pivotal experience* that strongly affects the individual and drives them to implement personal behavioral changes to achieve desirable goals. The Special Communication by Bhattacharya *et al.* investigates factors leading up to such pivotal experiences and describes the roles of PSD and PT to develop design spaces that can catalyze the appearance of such pivotal experiences [19].

A simple and effective means for increasing physical activity is walking. Manufacturers of activity-tracking devices such as FitBit suggest that walking 10,000 steps every day promotes health in multiple ways. For most individuals, transiting from a largely sedentary lifestyle to such an active one is a behavior change objective that, while desirable, can be difficult to achieve. Hekler *et al.* describe a personalized dynamic systems model for predicting physical activity that includes principles of Persuasive Technology as variables in the model [20].

Currently a plethora of low-cost self-monitoring devices and mobile technologies are available that can potentially assist behavior change. Dragoni and colleagues describe a general purpose architecture for adaptive delivery of persuasion messages supporting adoption of healthful behaviors in the workplace [21]. Their PerkApp system combines real-time monitoring with adaptive feedback in the form of context-sensitive messaging that encourages healthful behavior change.

Karppinen *et al.* [22] present a qualitative study of a web-based behavior-change support system, based largely on PSD, to encourage at-risk individuals to follow healthful behaviors designed to eliminate or mitigate metabolic syndrome and support long-term weight loss. A major goal here is to sustain behavior change by encouraging the formation of healthy habits. Lally and Gardner [23] have proposed that healthy habits are formed and internalized in stages. Karppinen *et al.* synthesize PSD with Lally and Gardner’s framework by identifying PSD elements that can enhance the ability of individuals to achieve these stages.
From a methodological point of view, these papers span a spectrum from qualitative studies to mathematical analysis based on dynamic systems. The health topics covered (i.e., healthy aging [18], increasing physical activity [20], encouraging healthy behaviors as a component of occupational welfare[21], control of metabolic syndrome[22]) are of considerable interest currently, and expected to remain so due to the growth of the aging population, increasing rates of obesity, and the complex issues surrounding the required behavior changes. Personal motivation, as a prime factor in initiating and sustaining behavior change [19] is receiving increased attention in all these contexts. Thus, the papers in this special issue comprise a cross-section of methods and topics that represent current interests as well as future directions in the growing discipline of Persuasive Technology and Health Care.

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References


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