



Developing culturally relevant design guidelines for encouraging healthy eating behavior

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ABSTRACT

Unhealthy eating behavior is a major contributing factor to the onset of several diseases and health conditions (e.g., obesity, type 2 diabetes). It is therefore not surprising that health interventions aimed at modifying dietary behavior have been identified as the cornerstone treatment for many health conditions. Interventions that use persuasive technology can be effective for motivating healthy eating behavior, and recent years have witnessed an increasing number of persuasive technologies with the purpose of promoting healthy eating behavior or attitude by manipulating various determinants of healthy behavior. However, these applications generally take a one-size-fits-all approach that is biased toward individualistic cultures. To resolve this problem, we propose culturally relevant design approaches for tailoring persuasive technology interventions to collectivists and individualistic cultures. Our guidelines are based on a large-scale survey of 554 participants' (collectivist=306 and individualist=247) eating behavior and associated determinants – identified by Health Belief Model – to understand how healthy eating behavior relates to various cultural groups and sub-groups. We developed two models of healthy eating behavior for the collectivist and individualistic cultural groups identified by Hofstede, and an additional eight models to investigate the moderating effect of gender and age on healthy eating behavior. We then explored the similarities and differences between the models and developed persuasive profiles of motivators of healthy eating behavior for each group. Additionally, we proposed two approaches for designing culturally relevant persuasive applications based on our results. The first is a one-size-fits-all approach that will motivate the majority of the population, while not demotivating any user. The second is a personalized approach that will best motivate a particular cultural group. Finally, to make our approaches actionable in persuasive intervention design, we map the theoretical determinants of healthy eating behavior as identified by Health Belief Model to common persuasive system design strategies.

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1. Introduction

Obesity is a major health concern worldwide and is due in large part to individuals taking in more energy through food than is expended through physical activity. Eating behavior is, therefore, an important factor to consider in any intervention targeting obesity. Research has shown that good eating habits can prevent or at least reduce the risk of obesity, heart disease, and diabetes (Wansink, 2006). It is, therefore, not surprising that behavior interventions aimed at modifying dietary behavior have been identified as the cornerstone treatment for these conditions (Lau et al., 2007).

Persuasive technology (PT) aims to bring about desirable change in attitude and behavior without using coercion or deception (Fogg, 2003) and has proven effective at stimulating behavior change in various domains including health (Choi et al., 2005; Khaled et al.,

2006; Ahtinen et al., 2008). A number of PT applications have been developed for promoting healthy eating behaviors (Choi et al., 2005; Ahtinen et al., 2008); however, these applications generally take a one-size-fits-all approach, rather than tailoring the content and strategies to individual users or user groups (Kaptein et al., 2010). For example, although unhealthy eating behaviors and the associated health implications present a global challenge, most of the existing research about PT has been carried out based on cultures from the developed world (e.g., American culture), which are typically individualistic (Khaled et al., 2006). Therefore, existing technologies for promoting healthy eating behaviors might not match the needs of users in collectivist cultures, characteristic of many developing countries.

The realization that the one-size-fits-all approach may not be sufficient to motivate healthy behavior change has led to a growing interest in ways of tailoring interventions to various users and user groups. For example, previous work has shown that a user's personality is an important determinant of motivation and persuadability (Hu and Pu, 2010; Kaptein et al., 2010). Further work showed a relationship between the user's personality and the success of different PT strategies (Halko and Kientz, 2010). Although a few PT systems have been designed with a specific cultural group in mind

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(e.g., Khaled et al., 2006), the influence of various cultural groups – as identified by Hofstede (1996) – on persuasive design and choice of persuasive strategy has largely been ignored. However, research has shown that individualism and collectivism (Hofstede, 1996) greatly influence a user's opinion regarding their ideal body image and belief about the diet–disease connection (Makino et al., 2004). Therefore, it is possible that members of collectivist and individualist cultures will respond differently to various healthy eating determinants, persuasive strategies, and applications, and that persuasive interventions will be more effective when they are culturally appropriate for the population under consideration.

In this paper, we propose culturally relevant design approaches for tailoring PT interventions to collectivist and individualist cultures. Our design guidelines are based on the mixed-methods' study of 554 participants' (collectivist=307 and individualist=247) eating behaviors and associated determinants. The collection of primary survey data was followed by a 10-min interview with 20 randomly selected participants (collectivist=10 and individualist=10). We employed Structural Equation Modeling (SEM) to explore the interaction between the various determinants of healthy eating behavior and to develop the model of healthy eating determinants for each cultural group. We also explored the moderating effects of gender and age group on the model. Our study is based on the determinants (*perceived susceptibility, perceived severity, perceived benefit, perceived barrier, cue to action, and self-efficacy*) identified by the Health Belief Model (HBM) (Rosenstock, 1966), one of the oldest and the most widely employed models of health behavior promotion.

Our models show significant differences between the participants from collectivistic cultures and those from individualistic cultures. The participants from individualistic cultures showed greater perception of susceptibility, severity, barrier, and self-efficacy. With respect to gender differences within each cultural group, collectivist males and females differ in their perception of severity, susceptibility, barrier, and benefit, while individualist males and females differ significantly in their perception of severity and self-efficacy. Similarly, exploring various age groups within each cultural group shows that collectivist younger and older adults differ in their perception of severity, barrier, and self-efficacy while individualist younger and older adults differ in their perception of susceptibility, severity, and cue to action. These differences suggest the need to tailor various PT theories and their associated strategies based on cultural groups (collectivism and individualism). Thus, guidelines for persuasive interventions based on the understanding of the various cultures' health beliefs are needed for effective tailoring of interventions to each cultural group.

To make our findings actionable for designers of persuasive technology interventions, we developed an intervention mapping that linked the determinants to associated intervention design strategies and objectives using the suggestions of Michie et al. (2008). Following our findings that collectivists and individualists show significant differences in the impact of various determinants on their healthy eating behavior, we proposed culturally relevant design approaches for healthy eating interventions.

Our main contributions are as follows: First, we conducted a cross-cultural evaluation of the influence of the determinants identified by HBM on healthy eating behavior and the moderating effect of age and gender, creating 10 unique models for different populations of users. Second, we propose data-driven and culturally relevant (individualist or collectivist) design approaches for developing PT interventions that motivate healthy eating. We also tailor these guidelines to reflect the moderating effects of age and gender and develop personalized persuasive profiles of what motivates different cultural, gender, and age groups. Third, one of the constraints with many theoretical frameworks for intervention development is their abstract nature – there is little

information on how the theoretical constructs can be translated to system design. To make our guidelines actionable in PT intervention design, we compiled and categorized a list of PT strategies and mapped the HBM determinants to appropriate PT intervention design strategies. Finally, we discussed the differences between individualist cultures and collectivist ones from the perspective of PT for healthy eating interventions, based on the results of our mixed-methods' study. To the best of our knowledge, this study is the first to examine the combined effects of culture, gender, and age on healthy eating and to develop culturally relevant guidelines that are immediately actionable for designers and developers of healthy eating intervention technologies.

2. Background

In this section, we present an overview of culture with focus on how it informs behavior. This is followed by a review of human–computer interaction (HCI) in a cultural context and culturally relevant persuasive technology. We conclude by reviewing human food interaction, various motivations for eating, behavior change theories, and persuasive technologies for motivating healthy eating.

2.1. Culture and human behavior

Culture plays an influential role in shaping people's attitudes and behaviors (Khaled et al., 2006). Its effects reflect in almost all areas of human endeavor including the way an individual communicates and interacts with technology. As a result, there is a growing research interest on various ways of developing computer applications to be culturally relevant (Khaled, 2008; Reinecke, 2010; Kimura and Nakajima, 2011). However, there is no universally accepted definition of culture as a concept. One of the earliest definition of culture was given by Sir Edward Tylor who defined culture as a “complex whole which includes knowledge, belief, art, morals, law, custom, and any other capabilities and habits acquired by man as a member of society” (Tylor, 1920). A more recent definition of culture has been given by Hofstede (1997), who conceived culture as “the collective programming of the mind which distinguishes the members of one group or category of people from another”. Finally, in a more general sense, culture has been loosely conceptualized as being based on shared values (Reinecke, 2010). It is acquired and transmitted from one generation to another, and it is shared and practiced by a group of people (Hughes et al., 1993; Kreuter, et al., 2003). Culture informs a group's behaviors, values, norms, and practices and provides rules that govern how to behave (Khaled et al., 2006).

Recent attempts to investigate empirically the differences in cultures based on the value system shared by various groups identified five finite and crucial cultural dimensions (Hofstede, 1996), which include: *collectivism versus individualism, femininity versus masculinity, long-term versus short-term orientation, power-distance, and uncertainty avoidance*. At present, much of the cross-cultural research has been focused on the individualism and collectivism dimensions. Research has shown that the individualism and collectivism dimensions account for most of the variance in global differences (Hofstede, 1996; Khaled et al., 2006; Triandis, 1995). Thus, in this paper we rely on these two important and well-researched dimensions: *individualism* and *collectivism* to study cultural differences in healthy eating determinants.

A major distinguishing factor between *individualist* and *collectivist* cultural orientations is the relationship that individuals perceive between one's self and one's in-groups. In an *individualist* culture, there are loose ties between individuals and people are expected to look after themselves and their immediate families at the very most. Compared to people in collectivist cultures, people

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