

USING A COMPUTER GAME TO PROMOTE A HEALTHY LIFE STYLE  
TO COLLEGE STUDENTS:  
KNOWLEDGE GAIN AND ATTITUDINAL CHANGE

by

Wei Peng

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## **DEDICATION**

To my parents, who always support me.

To Yiyi, who always encourages me.

PREVIEW

## ACKNOWLEDGEMENTS

I have been struggling with my dissertation topic for a year before I finally decided to take the risk to develop a health intervention game. This study would not have been possible without the support of my advisor Margaret McLaughlin. She strongly supported my idea and encouraged me through every phase of this study. It is also she who admitted me to this fine school, guided me throughout my graduate study, and finally pushed me into the scary yet rewarding process of job hunting.

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## ABSTRACT

The dietary habits and physical activity level of young adults between the ages of 18 and 24 have increasingly drawn researchers' attention. The current dissertation study developed a computer game-based healthy lifestyle promotion program to target young adults, especially college students. In collaboration with a dietitian and two programmers, this RightWay Café game was developed based on Social Cognitive Theory, Health Belief Model, and Theory of Reasoned Action. This dissertation study examined the effect of using a computer game to teach nutrition and weight management knowledge, and to change psychosocial determinants of behavioral change regarding leading a healthy lifestyle. Two experiments were conducted. Experiment 1 (N = 40) was a randomized controlled study, which demonstrated that playing the RightWay Café game was effective in increasing nutrition knowledge, self-efficacy, perceived benefit, and intention to lead a healthy lifestyle. The game also had long-term effects on these psychosocial determinants of behavioral change regarding leading a healthy lifestyle. To investigate the underlying mechanism of how the computer game works, experiment 2 (N = 80) adopted a 2 by 2 design with the experience mode (game playing vs. game watching) and role similarity (playing or watching a similar role vs. playing or watching a dissimilar role) as the two

between-subjects factors. Playing the game was more effective than watching the playback of other people's game playing to increase self-efficacy and intention to lead a healthy lifestyle, even though the contents the participants received were comparable. Identification with the role in the game was the mediator for the playing effect. In addition, playing or watching a similar role was more effective than playing or watching a dissimilar role. This study extended Social Cognitive Theory into the virtual experience domain. The summative evaluation of the RightWay Café game also demonstrated that computer game could be an effective tool for health intervention. Theoretical and practical implications of the current dissertation study are discussed.

PREVIEW

## CHAPTER I: INTRODUCTION

Decades of research has demonstrated that poor eating habits may lead to increased risk of chronic disease (National Research Council on Diet and Health, 1989; U.S. Department of Health and Human Services, 2000; World Cancer Research Fund and American Institute for Cancer Research, 1997). Specifically, people who consume too much dietary fat, too little fiber, and not enough fruits and vegetables are at risk of heart disease, stroke, diabetes, and cancer (Block, Patterson, & Subar, 1992; Steinmetz & Potter, 1996). Healthy eating contributes to an overall sense of well-being, and is fundamental to the prevention of a number of conditions, including heart disease, diabetes, high blood pressure, stroke, cancer, dental caries, and asthma.

Adequate consumption of fruits and vegetables, meeting recommended intake within energy needs by adopting a balanced eating pattern, and limiting the intake of saturated fats and cholesterol are recommended in several U.S. dietary guidelines (U.S. Department of Agriculture, 2005; U.S. Department of Health and Human Services, 2005). A national “5-A-Day for Better Health” campaign was launched in 1991 to promote daily consumption of at least five servings of fruits and vegetables. Recent studies show that the typical American diet still falls short of these recommendations (Li et al., 2000). Making

behavioral changes necessary to change eating habits is not easy to achieve. However, even small percentile changes in eating behavior can have an important effect on public health and impact millions of people.

Besides healthy eating, one of the ten leading health indicators of Healthy People 2010 (U.S. Department of Health and Human Services, 2000) is physical activity. Among the U.S. population, physical inactivity and unhealthy eating habits are underlying factors for the estimated 300,000 deaths each year (McGinnis & Meyer, 1995). For the 70 million Americans with one or more types of cardiovascular disease, lack of exercise is the most prevalent cardiac risk factor. In addition, for the 107 million U.S. adults with high cholesterol, the 65 million with hypertension, the 70 million who are obese and the 20 million with diabetes (Centers for Disease Control and Prevention, 2006), regular exercise and dietary modification are recommended as the initial management for their diseases. Even a modest increase in physical activity may significantly lower the risk of coronary disease (Paffenbarger et al., 1994) and favorably modify cardiac risk factors (Goldberg & Elliot, 1994). However, the exercise level of the American people is far from being satisfactory. Although it is recommended that adults should participate in 30 minutes or more of moderate-intensity physical activity on most, preferably all, days of the week, 60% of Americans do not participate in regular exercise (U.S. Department of Health and Human Services, 1996).

The dietary habits and physical activity level of young adults between the ages of 18 and 24 have increasingly drawn researchers' attention. Current research reveals that young adults do not follow healthy dietary practices. They tend to consume excessive amounts of total fats, saturated fat, and cholesterol (Georgiou & Arquitt, 1992; Hampl & Betts, 1995). Empirical studies also found that young adults have inadequate intakes of essential micronutrients, such as calcium, iron, zinc, folate, vitamins A, B6, and C (Zive, Nicklas, Busch, Myers, & Berenson, 1996), as well as inadequate consumption of fruits and vegetables (Ma & Betts, 1998; Song, Schuette, Huang, & Hoerr, 1996). According to the National College Health Assessment, only 7.3% college students eat at least the five servings of vegetables and fruits recommended by the USDA dietary guideline (The American College Health Association, 2004).

Besides their unhealthy dietary practices, what is more disturbing about young adults is the alarming numbers of obese and overweight young people and the high prevalence of eating disorders among colleges students. It is no longer just an issue about how a healthy lifestyle will benefit them in their later life. Their current unhealthy lifestyle has already produced short-term detrimental effects. According to the National Collegiate Health Risk Survey (Centers for Disease Control and Prevention, 1995), 1 in 5 college students is overweight. A survey of 1,642 undergraduate men and women indicated that 9% of the women and 5.2% of the men reported binge eating once per week (Wolff & Wittrock,

1998). Diagnosed eating disorders in various samples of college women have been reported to be 1.3% to 5% (Kurtzman, Yager, Landsverk, Wiesmeier, & Bodkurka, 1989; Heatherton, Nichols, Mahamedi, & Keel, 1995; Schotte & Standard, 1987). Actually, some researchers have identified college as an environmental risk factor for the development or exacerbation of disordered eating patterns (Compas, Wagner, Salvin, & Vannatta, 1986), in part because the transition to college setting is the first time young adults really start to manage their meals and weight on their own. As young adults make the transition from high school to college, their physical and social environments change, which inevitably leads to changes in lifestyle. The prevalence of risk behaviors, such as unhealthful dietary practices and physical inactivity tend to increase (Baronowski, Cullen, & Basen-Engquist, 1997; Evans & Sawyer-Morse, 2002). Further, this age group is in the transition from adolescence to adulthood and has the potential to influence the health status of the next generation. As lifestyle habits adopted during this period are likely to be maintained into future life, healthy eating and regular physical activity should be encouraged as early as possible (Krebs-Smith et al., 1995). Although it is ideal that nutrition intervention should occur during early childhood and adolescence, a college campus may still be a critical setting for the development and maintenance of healthy dietary behaviors. There is an urgent need to raise the awareness of

healthy eating, change attitudes towards healthy eating, and modify dietary habits among young adults, especially college students.

Based on the previous facts, the current dissertation study developed a healthy lifestyle promotion program to target young adults, especially college students. To keep pace with this generation, a computer game-based intervention program was designed. The formal features of computer games promise effectiveness in health intervention, health education, and health promotion. On the one hand, as the most popular form of entertainment, computer games embody many of the features that entertainment education programs (Singhal, Cody, Rogers, & Sabido, 2004) possess. On the other hand, due to their interactive nature, computer games also inherit many of the formal features of interactive technologies for health intervention. In fact, interactive media have been found to be effective for health intervention, e.g., for diabetes self-management (Brown et al., 1997; Lieberman, 1997), asthma education (Bartholomew et al., 2002), preventive alcohol education (Reis, Riley, Lokman, & Baer, 2000), smoking prevention (Tingen, Grimling, Bennett, Gibson, & Renew, 1997), sex education (Goold et al., 2006; Read et al., 2006), self-maintenance of healthful diet change (Brug, Campbell, & Van Assema, 1999; Brug, Steenhuis, Van Assema, & De Vries, 1996; Campbell et al., 2004; Campbell, Honess-Morreale, Farrell, Carbone, & Brasure, 1999; Irvine, Ary,



Grove, & Gilfillan-Morton, 2004), and promotion of physical activity (Bull, Kreuter, & Scharff, 1999).

Despite all the potential benefits of using computer games for health intervention, very few intervention programs have adopted this approach (Lieberman, 1997; Thomas, Cahill, & Santilli, 1997; Read et al, 2006). Among those programs that have employed game elements in the intervention, only a few empirical studies have conducted summative evaluations. Therefore, the major goal of this dissertation study is to develop a computer game-based nutrition education and weight management intervention program and examine its effectiveness for young adults. Specific objectives are discussed as follows.

Many healthy lifestyle promotion programs focus either on physical activity or dietary practice. As research has suggested that there may be additive or even synergistic effects if health promotion interventions are designed to focus on both healthy eating and regular exercise at the same time (Gillam et al., 2001; Wilcox, Parra-Medina, Thompson-Robinson, & Will, 2001), one of the objectives of the current study is to integrate both healthy eating and physical activity, though with an emphasis on healthy eating.

One of the reasons why people are not motivated to change their dietary habits is that they are not aware how many vegetables, fruits, and fat they consume daily and how many should be the right amounts for them to consume (Brug, Hospers, & Kok, 1997; Glanz, Brug, & Van Assema, 1997). Therefore,

making people aware of their intake levels should be the the first step to behavioral change. The second objective of the current study is to increase young people's awareness of the recently revised food pyramid by USDA, the serving sizes of six basic food categories (grains, vegetables, fruits, milk, meat & beans, and oils) and to teach them other relevant nutrition knowledge.

Any actual behavioral change starts from the change of attitude towards the behavior and the intention to change the behavior (Ajzen, 1985; Ajzen & Fishbein, 1980). The third objective of the current intervention is thus to increase favorable attitudes towards healthy eating and physical activity and to influence psychological determinants of behavioral change, e.g., self-efficacy and intention.

The last objective of the study is to understand what features of the computer game-based intervention are most effective in teaching nutrition knowledge and influencing attitudes and behavioral change intentions. One of the most distinctive features of game playing is the ability to engage the players in action. The game simulates a virtual environment in which the player needs to actively make decisions. In other mediated preventions, e.g., watching an entertainment education TV drama, people simply passively observe. Although research has shown that vicarious experience and social modeling are effective in influencing people's awareness of a problem and their attitudes and behavioral change intentions, it is believed that direct experience is more effective (Bandura,

1997). In this study, I will examine whether the virtual direct experience enabled by game playing is truly more effective than vicarious experience and social modeling afforded by watching an entertainment education program. If so, what are the specific factors that influence the effectiveness of the virtual direct experience? Does playing a role in the game increase the effectiveness of the virtual direct experience? Is it because game playing increases people's sense of presence and the increased presence makes the virtual direct experience seem to be more comparable to real mastery experience? If so, is playing a role similar to oneself more effective than playing a dissimilar role? What is the underlying mechanism? Is it because playing a similar role increases people's identification with the role?

The current dissertation attempts to answer the above questions by conducting two experiments concerning the effectiveness of using a newly developed computer game to increase nutrition knowledge, favorable attitudes towards healthy eating and physical activity, and behavioral change intentions to lead a healthy lifestyle. Chapter 2 discusses the theoretical frameworks for the study. Chapter 3 introduces the development and detailed description of the newly developed computer game—RightWay Café. Hypotheses, methodology, and the results of experiment 1 are reported in chapter 4. Experiment 1 is a randomized controlled study to investigate the effect of using the RightWay Café game to increase knowledge and change attitudes and behavior. A second

experiment (experiment 2) investigating the underlying mechanism of how games are effective in a health intervention is reported in chapter 4. Experiment 2 employs a 2 (game playing vs. game watching) by 2 (similar role vs. dissimilar role) design. Potential mediators—presence and identification—are examined. The final chapter, chapter 6, provides a general discussion and various implications of the current study.

PREVIEW

## CHAPTER II: REVIEW OF LITERATURE

### Using Computer Games for Entertainment-Education

Entertainment-Education (E-E) is the “process of purposely designing and implementing a media message to both entertain and educate, in order to increase audience members’ knowledge about an educational issue, create favorable attitudes, shift social norms, and change overt behaviors” (Singhal & Rogers, 2004, p. 5). Health-related information, such as technical health, preventative skills, and community mobilization skills, is embedded in the E-E programs to reach thousands of otherwise hard-to-reach individuals, especially in developing countries. The various formats of E-E programs include soap opera, radio drama, music video, street theatre, etc.

Traditional E-E programs have proven to be effective health interventions all over the world (Singhal & Rogers, 2004). A plethora of studies has examined and demonstrated the effectiveness of these E-E programs for HIV prevention (Glik, Nowak, Valente, Sapsis, & Martin, 2002; Vaughan, Rogers, Singhal, & Swalehe, 2000), immunization promotion (Glik et al., 1998), diabetes management (Brown et al., 1997), and other health preventions in developing countries (Mohammed, 2001; Papa et al., 2000; Sood, 2002; Sood & Rogers, 2000; Sypher, McKinley, Ventsam, & Valdeavellano, 2002).

Computer and video game playing is now emerging as one of the most popular forms of entertainment in the U.S. Half of all Americans play computer and video games. Considering the fact that 38% of the frequent video game players and 30% of the frequent computer game players are under 18 years old (ESA, 2006) and 65% of college students are regular computer or video game players (PEW, 2003), computer and video games are the perfect medium for entertainment education targeting young people. Due to their popularity and the potential to reach the population in an entertaining way, researchers start to explore the possibility of using computer and video games as an E-E platform. For instance, a computer game called “Life Challenge” has been demonstrated to increase skill and self-efficacy regarding safer sex negotiation for adolescence (Thomas, Cahill, & Santilli, 1997). This program uses a time travel adventure game format to provide information and non-threatening skill practice to turn down unsafe sex. Users record and play back their responses as they “negotiate” with their chosen partners in the game. Pre-test and post-test comparison showed that participating adolescents significantly increased their knowledge on safe sex and their self-efficacy of engaging in safe sex. Another game-like sex education program was developed and evaluated by Read and his associates to reduce risky sexual behaviors among men who have sex with men (Read et al., 2006). In this interactive program, participants assume a character’s identity in socially engaging and emotionally realistic narratives to make decisions at various risky

decision points and to learn how to negotiate safe sex with other characters. In the game, supportive and humorous peer coaches also encourage situated learning of self-regulatory and behavioral skills. Longitudinal evaluation demonstrated that combined with peer counseling this interactive, game-like program reduced risky anal sex behaviors and increased protected anal sex behaviors more than a peer-counseling-alone control condition. Lieberman (1997) also introduced several computer games for health intervention. One of the games is called *Rex Ronan—Experimental Surgeon*. Players assume the identity of Dr. Rex Ronan, a surgeon who shrinks into nano-size and travels to nine parts of a smoker's body to blast way phlegm, tar, plaque, and precancerous cells, all caused by smoking. Players must maneuver Dr. Ronan in and around realistic body organs, identify the unwanted despots, and ultimately conquer the patient's nicotine addiction while also trying to avoid evil micro-robots. A newly released game, *Re-Mission* ([re-mission.net](http://re-mission.net)) adopted a similar concept. This 3D shooter game with 20 levels takes the player on a journey through the bodies of young patients with different kinds of cancer. Players control a nanobot named Roxxi who destroys cancer cells, battles bacterial infections, and manages realistic, life-threatening side effects associated with the disease. Randomized controlled trials have demonstrated the effect of *Re-Mission* on treatment adherence, cancer-related knowledge, self-efficacy, and quality of life among teenagers and young adults with cancer (HopeLab, 2006).

## Formal Features of Computer Games to Facilitate Knowledge Gain and Attitudinal and Behavioral Change

Computer games have great potential for health intervention and health education thanks to their unique formal features. On the one hand, as the most popular form of entertainment, computer games embody many of the features E-E programs possess. On the other hand, due to the interactive nature, computer games also inherit many of the formal features of interactive technologies for health intervention.

As an entertainment education program, game playing is fun. The fun element in computer games can trigger people's intrinsic motivation to pay close attention to the program and engage themselves with the program, which can increase the efficacy of the program (Malouf, 1987; Okolo, 1992). Besides, one of the goals of the intervention is to teach nutrition knowledge. Empirical studies have demonstrated that the fun element in computer games is effective in increasing the retention rate of subject matter knowledge (Moreno & Mayer, 2000; Nelson, 1995; Randel, Morris, & Wetzal, 1992; Ricci, Salas, & CannonBowers, 1996).

In addition, role playing is an indispensable element of games. Previous research has shown that role playing is a powerful mechanism to influence people's social judgment, attitude, and behavior (Janis & King, 1965). When