Chapter 4

Digital Games: The SECRET of Alternative Health Realities

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Introduction

Digital games are video games, computer games, online games, mobile games, simulations, and virtual worlds played on arcade units, console systems, handheld devices, personal computers, or the Web. Can they help manage pain, reduce infections, cope with post-traumatic stress disorder, and boost efficacy to practice healthy behaviors? We seek to answer such questions in this chapter.

In 40 years, digital games have become one of the largest and most profitable global media industries and play an important role in the everyday life of millions of people all over the world, cutting across age, gender, and socioeconomic status. Although games are often seen as frivolous or harmful, more people have started to value their potential for making positive changes. Game designers have been collaborating with content experts to foster learning and promote health since the mid-1990s (Lieberman, 2009). As design strategies and evidence of effectiveness are fast accumulating in the "Games for Health" literature in recent years, health game projects are attracting more public attention, substantial funding resources, and enthusiastic research efforts (Ferguson, 2012). Annual conferences have been held in North America since 2004 and in Europe since 2011. A peer-reviewed journal *Games for Health: Research, Development, and Clinical Applications* was launched in 2012.

In this chapter, we first briefly point out the distinct media attributes of digital games relevant to health communication. We then explicate, with recent cases, the major functions of health games summarizing them in an acronym SECRET (see Figure 1). Finally, we conclude with lessons learned for intervention design and evaluation as well as implications for future projects.

Why "Digital Games" for Health?

At least five media attributes of digital games can be strategically positioned for health promotion and behavior change: two on the "game" aspect (i.e., fun nature and experiential play), two on the "digital" aspect (i.e., multimodality and interactivity), and another turbocharging feature (i.e., narrative engagement). 1. Games are *fun*; at least they are supposed to be. Player participation is voluntary. So by nature, games are intrinsically motivating and rewarding as players overcome challenges and complete missions (McGonigal, 2011). 2. Games involve *experiential play*, allowing players to self-direct their explorations and discoveries; therefore, they offer a more powerful form of user engagement than the vicarious experience offered by radio and television programs (Wang & Singhal, 2009). 3. Digital games are *multimodal,* converging multiple sensory stimuli ranging from 3D modeling to body sensors to create immersive virtual environments (Lieberman, 2013). Multimodality also makes digital games easily scalable to more people through multiple platforms with large amounts of information compressed and transmitted in short time periods. 4. Digital games are *interactive* between the player and the virtual environment, artificial intelligence-based agents, avatars controlled by human actors, and other players. Successful games can easily reach a global community of tens of millions of players, a massive human resource that can be strategically leveraged for public good (McGonigal, 2011). 5. *Narrative engagement* is the turbocharged sauce of digital games. Although characters and storylines may not be found in all games, and the role of narrative in digital games has been debated, when they are included it enhances the play experience, making it more compelling and memorable (Wang, Shen, & Ritterfeld, 2009).

Taken together, these attributes of digital games allow players to explore new horizons, experiment with different actions, and experience their consequences in a safe space. Games offer a wide-ranging variety of stimulation, interaction, challenge, and choice, providing countless opportunities for players to contemplate alternative perspectives and realities. These possibilities have significant implications for health promotion and behavioral change.

How Can Digital Games Help with Health Promotion?

Past scholarship has included comprehensive literature reviews and game applications for specific health issues. Building on the previous efforts, an

extended overview is provided in this section on the major functions of health games, summarized in the acronym SECRET. Recent examples of each function, backed by empirical research, are provided when possible.

Figure 1. Specification of the Acronym SECRET

Social connectivity and support
Exercise of the body and mind
Crowdsourcing for problem-solving
Rehearsal of real life scenarios in a safe space
Education of medicine and public health
Treatment of illness and diseases

Social Connectivity and Support

The stereotypical loner image of gamers has relegated the social aspect of game play to the back burner. Although games were mostly perceived as a threat to individual well-being in their early days, health game research more recently has demonstrated their potential in enhancing communication about illness and engendering social support (Lieberman, 1997). For instance, *Wellness Partners* is a social game designed by an interdisciplinary team at the University of Southern California to promote physical activity among middle-aged adults and their family and friends. A Facebook-like web interface allows users to share with their alters both public updates and private messages about their physical activities as well as setbacks. Players accumulate points as rewards for such reporting which can be redeemed to collect virtual gifts and engage a virtual character in animated wellness activities. The physical activities reported by the players are presented in tag clouds. A larger-sized font in the tag clouds represents more frequently reported physical activities. Preliminary findings suggest that participants were enthusiastic about this type of health game application that marries personal social networking with fun gaming elements for healthy lifestyles (Gotsis, Wang, Spruijt-Metz, Jordan-Marsh, & Valente, 2013). During casual game play, participants gained new insights about their family members and friends, allowing them to offer timely social support, while improving their own exercise habits in conjunction with others. A significant increase in self-reported exercise frequency was found among all participants, especially those who were alters, in groups with larger age variation, and started with

the game version as opposed to the control version. A significant decrease in BMI was found among the primary participants.

SuperBetter (http://superbetter.com) is a social game invented by Jane McGonigal to engage individuals on an epic journey to improve their physical, mental, emotional, and social well-being. Collaborating with experts in neuroscience, positive psychology, and medicine, the SuperBetter design team incorporated gaming elements to build compelling quests, provoke positive emotions, strengthen social connections, and improve personal resilience. Players can invite family, friends or people with similar experiences ("Allies") to help them define their personal goals ("Quests"), barriers ("Bad Guys"), motivators ("Power-ups"), and rewards ("Achievements"). *SuperBetter* thus serves as a self-management tool and a structured social support platform for family and friends to help a loved one during a time of crises. Several clinical trials are currently underway to evaluate its effectiveness in recovery from traumatic brain injury, to enhance weight loss and fitness, and to fight clinical depression.

Exercise of the Body and Mind

A big concern about excessive game play centers on sedentary habits as players tend to sit in front of a computer or a game console for hours at a time. To counter that, games have been developed to promote physical activity and cognitive functionality. Such digital games are called exergames (Lieberman, 2006). If *Dance Dance Revolution* started the first wave of exergames, the more recent sports and fitness series on Nintendo Wii, Microsoft Xbox 360 Kinect, and PlayStation Move have revolutionized the genre of exergames. Companies like Gamercize (http://gamercize.net) are developing new exergames to target specific population groups such as schoolers and office workers. Exergames invariably require the players to engage in a certain degree of body movements in a certain time period in order to progress. With the technological development and market penetration of intuitive controllers, sensors, and tracking devices, the literature on exergames is rapidly growing. A recently published meta-analysis notes that playing exergames promotes light-to-moderate intensity physical activity and can significantly increase heart rate, oxygen consumption, and energy expenditure compared to sitting on a couch (Peng, Lin, & Crouse, 2011).

Digital games are also targeted to sharpening the mind. As populations in many countries age, games are tackling the physical and psychological well-

beings of senior citizens. *ElderGames*, an initiative funded by the European Union, employs digital games to help seniors in Europe improve their physical and mental health. Gaming environments are incorporated into real-life technology and senior recreational centers, and serve as a preventive and therapeutic tool for early health diagnosis, facilitating social interactions, and improving the quality of life for the elderly. Game customization guidelines have been developed based on prior research as well as specific aging challenges in the participating European countries (Gamberini et al., 2006). Digital games can help the elderly to maintain cognitive acuity, participate in social activities, and fulfill personal recreational needs. Further, a number of game applications in recent years use brain wave sensors to engage players of all ages in game play. *Mindflex* (http://mindflexgames.com) by Mattel is a fine example. Players wear an EEG headset with sensors embedded in the headband that enables them to use their mind to control a blue styrofoam ball as it hovers over multiple obstacles. Players can control the pace of the game and compete with themselves or with one other player.

Crowdsourcing for Problem-Solving

Some of the greatest games are puzzle games. Digital games are more than mere digital versions of traditional puzzle games. They take problem-solving up several notches with the possibility of engaging a global community and leveraging vast human creativity and collective intelligence. For example, *Foldit* (http://fold.it) is a multiplayer online game that invites players, including amateur non-scientist gamers, to solve puzzles related to the scientific research of protein structure (Cooper, Khatib, Treuille, Barbero, Lee, Beenen, et al., 2010). Biochemists and computer scientists at the University of Washington created this game, hoping the massive online game players could help them discover scientific breakthroughs by experimenting with the gazillion possible folding structures of protein. For over a decade, scientists could not decipher the structure of *retroviral protease* (an enzyme critical in HIV multiplication patterns), so they posed this intractable challenge to the 60,000 players in the game. Players worldwide competed to solve the puzzle and in a matter of 10 days they were able to generate new models of sufficient quality that may help biochemists develop antiretroviral drugs for HIV/AIDS.

What is most intriguing about *Foldit* is that many of the players who made this discovery did not have any background in biochemistry. Seth Cooper, the lead designer of *Foldit* noted: "People have spatial reasoning

skills—something computers are not yet good at. Games provide a framework for bringing together the strengths of computers and humans" (quoted in Moore, 2011). Following the success of *Foldit*, scientists at Carnegie Mellon University and Stanford University developed *EteRNA* (Check for more details: http://eterna.cmu.edu/content/EteRNA) to capitalize on the powerful crowdsourcing capacity of digital games to uncover new ways of folding life's fundamental building blocks RNA molecules.

In addition to finding solutions directly related to health promotion and sciences, digital games can also elicit innovative ideas for solving social problems. *EVOKE* (http://urgentevoke.com) was developed by Jane McGonigal and the World Bank Institute as a 10-week crash course in changing the world. The game uses a graphic novel (as a textbook) to broach a weekly global crisis and teach players essential skills such as creativity, collaboration, entrepreneurship, and sustainability to tackle intractable world problems such as hunger, poverty, and access to clean water. The game attracted 8,000 players in 120 countries within the first week of its launch in March 2010. Players are encouraged to propose innovative solutions to urgent problems, report on their activities through blogs and videos, and take actions in the real world. *EVOKE* was the winner of the Games for Change Festival's 2011 Direct Impact Award.

Rehearsal of Real Life Scenarios in a Safe Space

Avatars often appear in digital games as the user's digital self-representation. Alternations of self-avatars in virtual reality can transform human behaviors—a phenomenon called the "*Proteus Effect*" (Yee & Bailenson, 2007). Lab experiments found that female participants who experienced a high level of presence in their self-avatars were more likely than those who experienced a low level of presence to imitate the self-avatar and suppress unhealthy eating behavior (Fox, Bailenson, & Binney, 2009). In addition, when participants could see their self-avatars lose weight through exercise in the virtual environment, they voluntarily performed significantly more physical activity in real life (Fox & Bailenson, 2009). The *Proteus Effect* research suggests that intentionally alternating certain attributes of a self-avatar's appearance can change the player's health perceptions and behaviors.

Digital games are also increasingly being adopted to address sensitive health topics such as safe sex and HIV/AIDS because they can provide peo-

ple at risk opportunities to rehearse the decision-making processes through realistic scenarios in the game. *Nightlife* is a downloadable single-player adventure game targeting heterosexual, young African-American men to promote condom use, HIV/STI testing, and to reduce risk through oral sex and mutual masturbation (Snyder, Farrar, Biocca, & Bohil, 2010). The game allows the player to customize his self-avatar and make safer or riskier choices in exotic scenarios. The player is also given the option to visit a virtual clinic and the scripts are designed to be engaging and non-preachy. Preliminary results from a national randomized controlled trial suggest that within two days of download, *Nightlife* players rated higher on behavioral intentions to get tested for HIV than those in the control condition. In the follow-up post-test three to four months later, *Nightlife* players who voluntarily played *Nightlife* more often than others were more likely to have been tested (Snyder & Farrar, 2012).

Another approach to changing risky sexual behavior is called Socially Optimized Learning in Virtual Environments or SOLVE (Miller, Christensen, Godoy, Appleby, Corsbie-Massay, & Read, 2009). The premise is that effective learning takes place in social situations and decision-making processes are mediated by emotional responses to environmental triggers that mark them as "good" or "bad" situations. These triggers create affective biases to guide future decision making. Applied to HIV-prevention scenarios related to men having sex with men, research on SOLVE suggests that the use of interactive technologies in virtual gaming environments to rehearse choices in potentially risky scenarios is far more effective than traditional approaches, and has significantly higher predictive power of future risk-taking behavior (Read, Miller, Appleby, Nwosu, Raynaldo, Lauren, et al., 2006).

Education of Medicine and Public Health

Almost from the advent of commercially available digital games, applications have been developed to foster learning (Lieberman, 2009). The Entertainment Software Rating Board even has a separate rating category for *edutaiment* games. The initial round of health games was designed to educate pediatric and adolescent patients about disease and coping (Lieberman, 1997). In the past decade, with immersive virtual environments and mobile applications coming of age, health educators have grasped the true potential of gaming technologies for teaching, training, and interacting with medical students and health workers. Once *Second Life,* one of the best-known virtual

worlds with 3D modeling tools, was launched in 2003, health organizations began developing simulated environments for medical, health, and patient education and skills training (Beard, Wilson, Morra, & Keelan, 2009). Medical doctors and health professionals can also organize virtual meetings and discuss patient cases in *Second Life*.

New applications similar to *Second Life* have been burgeoning. *Visualand* is a medical virtual reality based in Hungary that allows users to upload and share visual and audio files for free (Meskó, 2011). *Pharmatopia* (http://pharm.monash.edu.au/education/epharm/pharmatopia.html) is a virtual classroom created by the Faculty of Pharmacy and Pharmaceutical Sciences at Monash University in Australia to provide an immersive environment for problem-based pharmacy training. *Webicina* (http://webicina.com) is a web-based social media platform that aggregates resources on more than 80 topics for patients and medical professionals with free services in 17 languages. *Prognosis* is a free mobile game that uses an interactive cartoon-based narrative to engage players to investigate, deduce, and diagnose complex clinical cases. *Prognosis* is specifically designed to help doctors, nurses, and medical students prepare for standard exams and recall key clinical insights.

Increasingly, medical program directors and medical students are acknowledging the value of digital health games. A survey of family medicine and internal medicine residency program directors (N = 434) found 92% of the respondents supporting the use of games as an educational strategy; 80% reported already using games in their programs (Akl, Gunukula, et al., 2010), indicating great future potential in this area. Another study of medical students at the University of Michigan and University of Wisconsin-Madison (N = 217) found that 80% of the respondents believed that video games can have educational values and 77% would readily employ a multiplayer online healthcare simulation to develop health workers' skills in interacting with patients (Kron, Gjerde, Sen, & Fetters, 2010).

Treatment of Illness and Diseases

Digital games have been employed as tools for medical treatment, pain/discomfort distraction during treatment, treatment compliance, and self-care management. For example, a major barrier to traditional clinical treatment of PTSD is the patient's unwillingness or inability to recall or imagine the trauma-relevant event. A PTSD virtual reality exposure therapy system *Virtual Iraq/Afghanistan* was developed to overcome this problem. Using a

head-mounted display along with a set of multisensory tracking devices, a PTSD patient can be immersed in a digitally constructed virtual environment that resembles a combat-related trauma scenario with realistic visual, auditory, olfactory, and tactile stimuli (Rizzo, Difede, Rothbaum, & Reger, 2010). During a treatment session, the therapist can use a separate clinical interface to monitor the patient's physiological and psychological parameters and adjust the emotional intensity of the scene as per the patient's directions. A number of randomized controlled trials are underway for *Virtual Iraq/Afghanistan*, and initial clinical assessments have found statistically significant reductions in PTSD symptom severity measures (Reger, Holloway, Candy, Rothbaum, Difede, Rizzo, et al., 2011).

Digital games have also been used as a therapeutic tool. Therapists have used *Guitar Hero* and Nintendo Wii series to engage patients in otherwise repetitive and tedious practices. Other programs have used games for physiotherapy such as movement recovery and muscular dystrophy, and occupational therapy such as repetitive strain injuries (Jung, Yeh, McLaughlin, Rizzo, & Winstein, 2009). Health games seem to be especially useful in pain management. Numerous studies have documented how game use can distract from the sensation of pain, particularly for children and youth (Griffiths, 2005). Handheld video games also have proven effective to modulate pain of pediatric and adolescent patients from burns and alleviate them from the discomfort of cancer treatment. *Re-Mission* (http://re-mission.net) is a third-person shooter game that allows young cancer patients to role-play a nanobot named Roxxi, and navigate through a 3D simulated human body to destroy cancer cells, battle bacterial infections, and learn to manage treatment-engendered adverse effects. Multi-site, randomized clinical trials of *Re-Mission* have been conducted with 375 cancer patients aged 13–29. Cancer-related knowledge, self-efficacy to communicate about cancer, treatment adherence behavior, and self-management of side effects increased significantly for *Re-Mission* players (Cole, Kato, Marin-Bowling, Dahl, & Pollock, 2006; Kato, Cole, Bradlyn, & Pollock, 2008). A more recent study of *Re-Mission* revealed that the interactivity experienced during gameplay helped activate players' brain circuits associated with incentive motivation, contributing to positive self-perceptions (Cole, Kato, Marin-Bowling, Dahl, & Pollock, 2012).

What Are the Lessons Learned in Health Games Research?

Clarify Purposes

Any health game project is an interdisciplinary endeavor requiring teamwork. Game designers and developers need to work closely with health professionals and researchers from start to finish. Clear purposes need to be established every step of the way including an iterative process to test out design ideas, game prototypes, and research instruments. Aligning these purposes with intended experiences and outcomes would help improve the effectiveness of game interventions.

Refine the Application

Digital games are based on advanced digital technologies and technical difficulties can hinder play and learning experience. This means all digital game projects should be extensively pretested and closely monitored during implementation for technical errors and abnormal behavioral modifications. Game refinements or adjustments should not be limited to player access or loading time, but also features associated with player's privacy protection and database security.

Base on Theories

The design and evaluation of health games must be guided by coherent theories and established principles. For example, uses and gratifications theory can be used to help game designers and researchers understand players' motivations; elaboration likelihood model and framing theory can help tailor the health messages to the target gamer characteristics; the notion of "presence" can reveal players' psychological state during game play. Theories can also guide subsequent scientific inquiries and hypothesis testing during summative research.

Develop Rigorous Research Design

Systematic reviews on health game research have found that most published evaluation studies are lacking rigor and vigor in research design. In order to make a quality causal argument about game effects on health outcomes, researchers need to conduct randomized controlled trials (when possible), include adequate control groups, recruit sufficient numbers of participants based on a priori power analysis, conduct baseline assessment to compare

with post-intervention outcomes, and use valid, reliable, and objective measures. When evaluating a game intervention against other options, the control condition should ideally have similar attributes except the delivery method (i.e., the game).

Report in Details

Past game research has not sufficiently provided detailed descriptions of the game intervention or research procedures, exacerbating the challenge to conduct meta-analysis and develop systematic understanding of the field. In order to develop a body of high quality literature, researchers need to report concrete information about the game, the players, the standard procedural elements, and intended as well as unintended outcomes including negative effective and unexpected events and challenges.

Recommended Readings

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