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**Design Perspectives on Diabetes Management Games**

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**Design Perspectives on Diabetes Management Games**

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## **Dedication**

For my family.

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# **Design Perspectives on Diabetes Management Games**

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For decades, there has been scholarly interest in the use of serious digital games to assist individuals suffering from diabetes with the self-management of that disease. However, previous research in this area has not effectively integrated the knowledge of the expert game designer. This dissertation aims to further understandings of design approaches to serious games for diabetics by confronting both the arguments of the diabetes games literature and the diabetes games themselves with the experiences and opinions of expert game designers. The arguments of the diabetes games literature were synthesized into a design template composed of twenty-four interrelated desirable elements. This template was then used by three focus groups consisting of a total of twelve expert game designers to both evaluate six diabetes self-management games and respond to the assertions of the diabetes games literature. The findings from these three empirical studies indicate both that the diabetes games themselves are of uniformly unsuitable quality and that the diabetes games literature is rife with what the expert game designers consider to be problematic assumptions. The problems identified by the focus groups include those that fundamentally cripple the functionality of the game artifact, those that are embedded in a game's rules and themes, and those to those that exist at superficial levels. Furthermore, the focus groups had an overall negative reaction to the arguments about games that they found to be deeply embedded in the design template's elements. Tensions exist, however, between the reasons for the diabetes games literature's demand for certain game features

and the beliefs of the expert game designers. The findings strongly suggest that additional research is necessary and that an interdisciplinary effort, including both health care professionals and expert game designers, is necessary for the development of new, superior design scenarios for diabetes self-management games.

## Table of Contents

List of Tables .....	xiii
List of Illustrations.....	xiv
Chapter 1: Introduction.....	1
The Author’s Experience with Game Design .....	3
Dissertation Goal and Motivation .....	4
Chapter Descriptions.....	4
Chapter 2: Literature Review.....	4
Chapter 3: The Design Template and Focus Group Methodology .....	5
Chapter 4: Empirical Findings from Three Diabetes Games Focus Groups .....	5
Chapter 5: Conclusion.....	6
Chapter 2: Literature Review.....	7
An Overview of Diabetes Mellitus .....	7
The Prevalence of Diabetes .....	8
Managing Diabetes .....	9
Barriers to the Management of Diabetes .....	11
Digital Games and Self-Management.....	13
The Layers of Digital Games.....	13
Meaningful Choice.....	14
Depth.....	18
Well-Realized Game Environments .....	23
Digital Games and their Situation in the Social World.....	26
Serious Games .....	30
Games and Health.....	32
Frameworks for Designing Health Games.....	37
Digital Games and Diabetes.....	43
Digital Diabetes Games Discussed by Scholarly Literature .....	45
Conclusion .....	54



Chapter 3: The Design Template and Focus Group Methodology .....	57
Description of the Development of the Template’s Questions .....	61
1) How well does the game teach basic diabetes knowledge?.....	61
2) How well do characters, if present, serve as models for positive or negative behaviors?.....	62
3) How empathetic is the game towards diabetics? .....	63
4) How well does the game allow users to practice skills related to diabetes management? .....	63
5) How well does the game present the consequences of health behaviors on diabetes? .....	64
6) How well does the game reward players for practicing self- management skills?.....	64
7) How well does the game promote discourse about diabetes?.....	65
8) How well does the game suggest that people can effectively manage diabetes?.....	65
9) How well does the game engender peer support?.....	66
10) How well does the game balance fun and education? .....	66
11) How aesthetically pleasing is the game? .....	67
12) How strong, if present, is the game’s narrative?.....	67
13) How clearly does the game communicate what is happening in the game world?.....	68
14) How easy is the game to pick up and play? .....	68
15) How well does the game provide the players with clear goals? .	69
16) How well does the game provide users with appropriate feedback? 69	
17) How clear is the relationship between the game’s themes and the game’s mechanics? .....	70
18) How strong is the sense of progression provided by the game? .	70
19) How sufficient are the game’s challenges?.....	71
20) How well-designed, if they are present, are the characters?.....	71
21) How much choice are the players given? .....	72
22) How much do player decisions affect future gameplay? .....	73

23) How much does the game reach into the real world? For example, does it have social networking features that link users? .....	73
24) How replayable is the game? .....	74
Description of the Focus Group Methodology .....	74
Data Analysis .....	79
Chapter 4: Empirical Findings from Three Diabetes Games Focus Groups .....	81
Chapter Overview .....	81
Diabetes Games Examined by the Focus Groups .....	82
Focus Group 1 .....	82
Focus Group 2 .....	86
Focus Group 3 .....	91
Overview of the Template Responses from the Focus Groups .....	97
Findings from the Focus Groups .....	99
I. Foundations .....	100
Feedback .....	100
The Balance of Fun and Education .....	104
The Practice of Diabetes Self-Management Skills .....	105
Teaching Diabetes Knowledge .....	108
II. Game Design Issues .....	112
Themes and Mechanics .....	112
Peer Support .....	115
Choice .....	116
Characters .....	122
The Depiction of Health Consequences .....	125
Animals as Main Characters .....	127
Maintaining Player Interest .....	128
Symbols and Game Worlds .....	129
III. Issues with the Template Overall .....	131
Design Perspectives .....	131
Abundance of Choice versus Meaningful Choice .....	136

Assuming Players are Learning the Intended Lesson .....	137
Lessons from the Empirical Findings .....	139
1. Proper feedback and clarity are essential .....	140
2. The template contains problematic assumptions .....	140
3. The health consequences of behaviors for diabetics are unclear in the tested games .....	142
4. Animals should not be the main characters .....	143
5. Pre-existing game designs take on new meanings when repurposed for serious diabetes games .....	143
6. Players should learn actual diabetes management skills, not just how to succeed at a game .....	144
7. Genre tropes threaten to confuse players and frustrate persuasion	145
8. Things only get interesting when something goes wrong.....	146
9. Poor balance between fun and education.....	147
10. Choices should be meaningful, not just plentiful.....	147
11. Lengthy instructions and manuals are not effective at teaching diabetes knowledge.....	148
Chapter 5: Conclusion.....	149
Revised Design Template .....	151
Foundational Elements.....	151
Second-Order Elements .....	152
Significance of the Study .....	153
Limitations of the Study.....	154
Directions for Further Research.....	156
Appendix A: Design Template .....	158
Appendix B: Templates Scored by Focus Groups.....	160
<i>Coco's Cove</i> Template Scores .....	160
<i>Diabetes Dash</i> Template Scores .....	162
<i>The Diabetic Dog Game</i> Template Scores.....	164
<i>Equalize: Dependency</i> Template Scores.....	166
<i>Ketones Attack</i> Template Scores.....	168

<i>Tina the Cat</i> Template Scores.....	170
References.....	172

## **List of Tables**

Table 1: Diabetes Game Elements from Literature .....	60
Table 2: Games Examined by the Focus Groups.....	82
Table 3: Focus Group Ratings of Template Elements .....	97

## List of Illustrations

Illustration 1: Setup of the First and Second Focus Groups .....	76
Illustration 2: Setup of the Third Focus Group .....	77
Illustration 3: <i>Diabetes Dash</i> Start Screen .....	82
Illustration 4: <i>Diabetes Dash</i> Gameplay .....	83
Illustration 5: <i>Ketones Attack</i> Start Screen .....	84
Illustration 6: <i>Ketones Attack</i> Gameplay .....	85
Illustration 7: <i>The Diabetic Dog Game</i> Gameplay .....	86
Illustration 8: <i>The Diabetic Dog Game</i> Manual .....	87
Illustration 9: <i>The Diabetic Dog Game</i> Shop .....	88
Illustration 11: <i>Equalize: Dependency</i> Splash Page .....	88
Illustration 12: <i>Equalize: Dependency</i> Gameplay .....	89
Illustration 13: <i>Equalize: Dependency</i> Driving Gameplay .....	90
Illustration 14: <i>Tina the Cat</i> Start Screen and Instructions .....	91
Illustration 15: <i>Tina the Cat</i> Gameplay .....	92
Illustration 16: <i>Tina the Cat</i> Food Selection .....	93
Illustration 17: <i>Coco's Cove</i> Start Screen .....	94
Illustration 18: <i>Coco's Cove</i> About Screen .....	95
Illustration 19: <i>Coco's Cove</i> Gameplay .....	96
Illustration 20: <i>Asteroids</i> Gameplay .....	114
Illustration 21: <i>Canabalt</i> Gameplay .....	120
Illustration 22: <i>Mass Effect</i> Gameplay .....	121

## **Chapter 1: Introduction**

Diabetes is a widespread, devastating, and growing problem. Diabetes is a chronic illness and diabetics face a constant and complex struggle to manage their condition. Most of the efforts to manage diabetes are conducted outside of the supervision of healthcare providers, by diabetics themselves. The necessity of constant self-management places a strain on individual diabetics. However, where self-management is insufficient, the health consequences are severe. Many people believe that digital games can help (Charsky, 2010; Van Eck, 2006).

Digital games are a pervasive form of modern entertainment. Studies and statistics have long suggested that digital media, including games, are displacing traditional forms of media consumption (Lowood, 2004). A recent study released by the Pew Research Center reported that about half of the American population, both men and women play digital games. This study also found that two thirds of young adults play digital games. These games are extremely popular with young men, with 77% of men ages 18 to 29 indicating that they play games. However, games are also popular with young women, as 57% of them play games (Duggan, 2015).

Serious games form a subset of the larger medium of digital games. Serious games, unlike most commercially produced games, are not merely intended to provide players with entertainment. Serious games are generally designed to educate or persuade the player. These games have been used for purposes such as education, military training, public policy advocacy, and health care (Charsky, 2010). In the subset of serious games focused on improving health, there exists a group of games that are concerned with the management of chronic diseases.

Serious games have been made that address a number of chronic illnesses including cancer, asthma, mental health issues such as depression and post-traumatic stress disorder, and diabetes. Serious games about diabetes provide us with a great opportunity to examine the design approaches applicable to games aiming to improve the health circumstances of persons suffering from chronic illness. Unlike most chronic conditions, such as cancer or mental disorders, the specific details of one person's diabetes are much like the another's. In other words, diabetes is a relatively stable system. However, if the disease is improperly managed, the health consequences are dire—blindness, kidney failure, nerve damage, heart disease, and limb amputation are all possible. The longer diabetes is improperly managed, the more severe those health consequences become. It is therefore critically important that young persons with diabetes are adept at self-management. Diabetes management involves goals, includes quantifiable aspects such as blood glucose levels, and revolves around actions taken by an individual. This means that diabetes can be modeled and simulated. Where situations can be modeled and simulated, there is room for abstraction and the introduction of game systems (Rollings & Adams, 2003).

My exposure to serious games created to help individuals with the self-management of diabetes arose through my work with Dr. William Aspray. Along with Dr. Barbara Hayes, Dr. Aspray had recently edited *Health Informatics: A Patient-Centered Approach to Diabetes*. One of the chapters in this book, "Diabetes Education and Serious Gaming: Teaching Adolescents to Cope with Diabetes," detailed both the use of games to assist with diabetes management and expressed concerns over whether or not those games had been well designed (Harris et al., 2010; Faiola & Kharrazi, 2010). When I examined the diabetes management games, I was left with an unfavorable opinion. I had a strong sense that something was amiss, but lacked a framework with which to interrogate these games. In an effort to understand them, I turned to the literature on diabetes management games. Over



the course of my examination of this literature, I was struck by what appeared to me to be the absence of an understanding of game design. I found that the literature is riddled with prescriptions and assumptions that, in the aggregate, might be undermining efforts to really confront the phenomenon of diabetes through game design in a meaningful way. By meaningful way, I mean a process of design that is a response to the actual phenomenon of diabetes rather than putting a diabetes theme on a clone of another, non-health centered, game design. I became very interested in testing both the claims made by the diabetes games literature and the quality of the diabetes self-management games with experience of actual game designers.

The intended audience for this dissertation are those individuals who are generally interested in the use of serious games for health purposes as well as those persons who intend to design such games. To this end, much of the interpretive work that follows, such as the explanations of the terms of art and concepts familiar to game designers, is done in the interest of making those terms and concepts accessible to non-experts interested in game design. In other words, this dissertation intends to contribute both by demonstrating the value of game design expertise to communities interested in serious health games as well as by offering insights that enrich future work.

#### **THE AUTHOR'S EXPERIENCE WITH GAME DESIGN**

In addition to being a doctoral candidate in information studies, I am also an experienced game designer. I have served as the writer and designer of multiple games. My experience in the area of game design and familiarity with the concepts and terms of art used by game designers allows me to speak with them about their craft at a level beyond that of the layperson. This experience is helpful both in that it allows me to converse with expert game designers as well as select appropriate persons for expert focus groups.

## **DISSERTATION GOAL AND MOTIVATION**

This dissertation seeks to understand whether or not actual expert game designers agree with the diabetes games literature. It is concerned about both what the expert game designers think about the assertions made by the diabetes games literature, what they think about the diabetes games currently available to Americans, and any suggestions that they have. It is about confronting the arguments of the literature with the design knowledge that arises from the actual practice making games to determine whether or not there are tensions between the two perspectives. Where there are tensions, this dissertation asks whether solutions such as superior scenarios for diabetes management games can be identified.

## **CHAPTER DESCRIPTIONS**

### **Chapter 2: Literature Review**

This chapter examines the literature related to a number of topics relevant to the issue of diabetes management games. It includes literature from the fields of human computer interaction (HCI), chronic disease management, health behavior, design, game design, serious games, persuasion. It begins by providing an overview of diabetes, as well as discussing the disease's prevalence and severity. It then proceeds to discuss the management of diabetes, as well as the barriers to management faced by persons suffering from the disease. Next, the chapter discusses digital games and disease self-management. This discussion begins with an examination of the interrelated layers of digital games and then moves to discuss serious games and their uses. After discussing serious games generally, the literature discusses elements possessed by serious health games before addressing digital games and diabetes. Finally, it concludes that there is substantial underdetermination in the literature regarding diabetes management games and that the voice of the expert game designer is absent.

### **Chapter 3: The Design Template and Focus Group Methodology**

Chapter 3 operationalizes the elements of a serious diabetes game that were derived from the literature presented in Chapter 2 in the form of a design template. This chapter explains how each of the 24 elements that constitute the template were derived from specific literature. It then discusses the use of the design template to test both diabetes self-management games and the literature's claims regarding the desirable elements of serious diabetes games against the practical experience of expert game designers through a series of three focus groups with expert game designers. Next, it then discusses the reasons for choosing a focus group methodology while detailing the manner in which the focus groups were conducted and recorded. Lastly, this chapter describes the data produced by the focus groups and the method by which that data was analyzed.

### **Chapter 4: Empirical Findings from Three Diabetes Games Focus Groups**

Chapter 4 presents the findings from the three focus groups of expert game designers. It discusses each of the games examined by the focus groups and presents the results of the focus groups in three parts. The first of these parts details foundational issues. The foundational issues refer to components of the games that are related to the functionality of the game. Included in this part are sections discussing issues with feedback, the balance of fun and education, the practice of self-management skills, and the conveyance of basic information about diabetes. The second part details issues that have to do with game design choices, such as themes and mechanics, choice, and characters. The third part discusses the expert game designers' responses to and criticisms of the template. This section details the template's assumptions as well as the tensions between the prescriptions of the diabetes games literature and the opinions of the expert practitioners. Lastly, this chapter enumerates the lessons that may be taken from the focus group findings and contrasts them with the assertions of the existing literature.

## **Chapter 5: Conclusion**

The conclusion provides an overview of what the contributions of this dissertation and discusses how the lessons from the findings suggest further avenues of research. A revised design template that the author derived from the lessons provided by the diabetes games focus groups is presented. It also discusses the limitations of this study.

## **Chapter 2: Literature Review**

This literature review begins with an overview of diabetes, discusses the prevalence of that disease, how that disease is managed, and examines the barriers to effective diabetes management.

### **AN OVERVIEW OF DIABETES MELLITUS**

Diabetes mellitus is a complex and serious chronic medical condition in which blood sugar (glucose) levels remain high for extended periods of time. The National Institute of Diabetes and Digestive and Kidney Diseases (NIDDKD), a department of the National Institute of Health (NIH), explains that diabetes can, lead to, among other things, heart attack, heart disease, stroke, high blood pressure, poor blood circulation, nerve pain, kidney problems, gum disease and loss of teeth, loss of vision and blindness, infections, and the amputation of the feet (NIDDKD, 2014). In a healthy body blood sugar levels are regulated by the pancreas which releases a hormone called insulin. Insulin helps the blood to carry glucose to cells, which then use it to produce energy. If insulin is not produced, or not sufficiently produced, glucose remains in the blood and causes problems (NIDDKD, 2013). Over time, diabetes causes a number of dire health conditions. The onset of these problems can be delayed or prevented by the proper management of diabetes.

There are two main types of diabetes. The underlying cause of type 1 diabetes is not known. Type 1 diabetes occurs when the cells that produce insulin in the pancreas are destroyed by the immune system—eliminating the body's ability to lower blood glucose levels. According to the Centers for Disease Control and Prevention (CDC) about 5% of diabetics are type 1 (CDC, 2014). Persons with type 1 diabetes do not produce enough insulin naturally and require artificial sources of insulin to survive. A type 1 diabetic

depends upon insulin delivered via a pump or an injection. Type 1 diabetes develops most often in children but it is possible for it to present in adults (NIDDKD, 2013).

Type 2 diabetes has historically developed primarily in adults but is beginning to present in youth as well. Around 90% to 95% of diabetics have type 2 diabetes (CDC, 2014). This type of diabetes is linked to a number of risk factors. The Mayo Clinic identifies these factors as excess weight, inactivity, family history, race, age, high blood pressure, gestational diabetes, and abnormal cholesterol and triglyceride levels. Type 2 diabetes begins when the body's cells do not use insulin properly, leading to an increased need for insulin. The insulin-producing beta cells in the pancreas eventually lose the ability to produce sufficient quantities of insulin (CDC, 2014). The risk of developing diabetes increases with age and, for reasons that are unclear, African Americans, Hispanics, American Indians, and Asian Americans are at higher risk (Mayo Clinic Staff, 2014).

### **The Prevalence of Diabetes**

Diabetes is a widespread and growing problem in the United States. The Centers for Disease Control's National Diabetes Statistics Report attests that 9.3% of the population of the United States, or 29.1 million people, are diabetic (CDC, 2014). About 1.25 million Americans have type 1 diabetes. This report estimates that in 2012 the direct and indirect costs of diabetes was \$245 billion (CDC, 2014). As of 2014, Diabetes is the seventh leading cause of death in the United States (CDC, 2014).

The United States is not alone in suffering increasing diabetes rates: diabetes is a global concern. The International Diabetes Federation's (IDF) 2014 key findings indicate that 387 million people currently have diabetes and that this number is expected to grow to 592 million by 2035 (IDF, 2014). While the number of persons with diabetes is increasing

in every country, 77% of diabetics live in low and middle income nations. Diabetes was responsible for 4.9 million deaths in 2014, or, one death every seven seconds (IDF, 2014).

### **Managing Diabetes**

Diabetics face a taxing and constant struggle to control their disease and prevent, or least delay, the onset of severe complications. This struggle is daily and life-long. Diabetics need to constantly monitor their condition and regulate it by controlling what they eat and drink, managing physical activity, and using medicines such as prescribed diabetes pills or insulin (CDC, 2007). It is the burden of the diabetic to consistently and diligently administer self-care.

It is important that diabetics regularly check and record their blood sugar levels. A diabetic monitors his or her blood glucose level by drawing a drop of blood and placing it onto a glucose meter test strip. The glucose meter then reads the blood glucose levels, returning a reading that would normally be in the target range of 70 to 130. If levels are above 180 for more than one or two hours it may indicate hyperglycemia. Hyperglycemia occurs when there is a lack of insulin in the body. This can happen when an individual doesn't take their medicine, eats too much, has an infection, doesn't get enough exercise, or is stressed. Low blood glucose levels are known as hypoglycemia and can be caused by taking too much diabetes medicine, missing or delaying meals, being more physically active than usual, or drinking alcoholic beverages. If a reading is not within the target range and cannot be controlled, it may lead to an emergency situation. Very low blood sugar levels can be dangerous, as severe hypoglycemia may cause an individual to pass out or have a potentially life threatening seizure. Diabetics at risk for severe hypoglycemia should carry food for emergencies, wear a medical identification bracelet, and carry a glucagon kit (NIDDKD, February, 2014). Glucagon kits allow people to aid a diabetic who has been

rendered unconscious by severe hypoglycemia by injecting a hormone that rapidly raises blood glucose levels.

Diabetics must pay special attention to diet and nutrition. A diabetic should eat regular meals to keep their blood glucose levels steady. It is recommended that he or she eat three meals and a snack or two every day at around the same time as this regularity helps to control blood sugar levels. Diabetics should avoid eating many sugary foods as well as fried foods (CDC, 2007). Keeping track of the amount of carbohydrates consumed is very important. The balance between the insulin in the body and the carbohydrates in meals determines how much blood glucose levels rise after food or drink are consumed. If a diabetic eats more carbohydrates than they usually do at a meal then his or her blood glucose levels will likely be elevated for several hours. The American Diabetes Association (ADA) explains that, while the actual amount of carbohydrates an individual should consume per meal depends on factors such as weight, activity level, medications, and blood glucose goals, a general guideline is 45-60 grams of carbohydrates per meal and 15-20 grams of carbohydrates per snack (ADA, 2009).

Regular physical activity helps to control diabetes. The Mayo Clinic recommends thirty minutes of moderate exercise most days of the week. Combinations of exercises, such as aerobic and resistance training are recommended (Mayo Clinic, August, 2014). The ADA explains that aerobic exercise helps the body to use insulin better and lowers blood glucose levels. Resistance training makes the body more sensitive to insulin and may lower blood glucose (ADA, 2015).

These sources tell us what must be done in order to effectively manage diabetes but they don't tell us anything about how well people actually perform self-management. To understand this, we must examine the literatures on the self-management of chronic medical conditions both in general and in the specific case of diabetes.



## **Barriers to the Management of Diabetes**

Persons with chronic illnesses do not always follow their prescribed medical regimens. Low adherence to regimens is a ubiquitous problem. Haynes et al. write that “typical adherence rates are about 50% for medications and are much lower for lifestyle prescriptions and other more behaviorally demanding regimens.” Even when patients do indicate that they have failed to comply with their prescribed regimen, “their estimates usually substantially overestimate their actual adherence.” Patients misrepresent their behavior to health care providers for a number of reasons: forgetfulness, fear of confrontation, and a desire to please are merely a few possible explanations (Haynes, et al., p. 2880). The authors argue that adherence to long-term medical regimens requires combinations of educational information, counseling, reminders, rewards and recognition, and social support from the patient’s family and friends. Lack of compliance is not only harmful to the patient, but also strains the health care system as the consequences lead to the “progression of the disease, exacerbation of the disability, unnecessary prescription of more potent and/or toxic drugs, more frequent medical emergencies, and ultimately, failure of treatments” (Sawyer & Aroni, 2003, p. 2).

Although adherence to prescribed medicinal and behavioral patterns are crucially important to the effective management of diabetes, patients often fail to comply. Winnick, et al. write that “there are a host of factors that affect medication compliance, but key among them include social and economic circumstances, particularly health literacy, patient belief systems, acceptability and palatability of the medication, and adverse effects of the medication (Winnick, et al., 2005, p. 718). An understanding of the illness is important, but understanding alone is not enough to insure proper management. Keers, et al. report that, while educational programs increase a patient’s knowledge about diabetes, most of the educational programs focus on disease knowledge and glycemic control while

psychological aspects and coping receive less attention. Lack of knowledge is not the primary reason for the ineffective self-management of diabetes (Keers, et al., 2004). Rather, the failure of an individual to take proper care of his or her diabetes is affected by factors such as social support, family functioning, stressful life events, and other psychosocial elements (Schwartz, et al., 1991). Additional factors, such as mental health status, demographic factors such as age, race, and socioeconomic status, all influence on daily self-management. For example, young adults experience a developmental transition from adolescence to young adulthood and their health behaviors may shift during this time. In one study, as few as 8% of emerging adults demonstrated optimal blood glucose monitoring across the behavior domains of frequency of testing, eating frequency, exercise frequency, and metabolic control (Hendricks, et al., 2013). Increases in patient empowerment through multidisciplinary treatment programs, such as one focused on improving a patient's attitudes and motivation led to improvements in the patient's self-management (Keers, et al., 2006).

Adolescent diabetics are a particularly vulnerable population. Medication compliance rates among urban adolescents are very low, perhaps as low as 5% to 15%. (Winnick, et al., 2005). One study of diabetic adolescents found that compliance with their prescribed medical regimens decreased with age (Bond, et al., 1992). Researchers have attempted to understand the reasons for this lack of compliance. For example, there have been attempts to identify correlations between personality traits and diabetes management among type 1 diabetics. Wheeler et al. note that while there is a predominant pattern of predictive association between "self efficacy and family values and adherence," studies examining associations of Type A personality traits and the locus of control have produced inconsistent results. However, the authors found positive associations with adherence for the personality traits of conscientiousness, extraversion and agreeableness, while negative

associations were found for neuroticism, anger, and depression (Wheeler, et al., 2012, p. 67). While parents and healthcare providers might apply pressure to adolescents to practice good glycemic control, those actors may “unwillingly quash the adolescents’ motivation for managing the disease. This pressure may foster resistance and passivity, which may hinder self-management skill development” (Husted, et al., 2014, p. 2).

## **DIGITAL GAMES AND SELF-MANAGEMENT**

Digital games are widely believed to be helpful tools for diabetic self-management. This section will discuss the literature related to this point below. Before moving to that body of literature, this review first discusses the literature related to digital games generally. It then proceeds to discuss serious games and health games before addressing digital games for diabetes.

As the literature below discusses, games have been shown to be effective interventions for the management of certain aspects of chronic diseases. However, as the literature also shows, the effectiveness of the interventions is related to the quality of the game. While the importance of a game’s quality is considered to be important, the literature on health and games does not itself discuss what makes a game good. For this reason, we must turn to literature that explains games and the elements that determine their quality.

### **The Layers of Digital Games**

Digital games are composed of many different types of elements that work together to create an engaging experience. They are complicated artifacts, possessing a number of layers. For example, even simple games possess game mechanics, aesthetic layers, technological layers, narrative layers, and interaction layers that are all interwoven. Games that successfully employ all of these layers do so through careful design and may be

understood to possess characteristics that are generally desirable across almost all types of games.

### ***Meaningful Choice***

Meaningful choice is generally acknowledged as being not only a key characteristic of good games but also as a cornerstone of interactivity. In game design scholarship much is explicitly written about the subject of the player's meaningful choices and their role in shaping the game artifact. In his 2003 book *On Game Design*, veteran designer Crawford explains that "choice lies at the heart of interactivity" (Crawford, 2003, p. 23). Schell also describes meaningful choices as the "heart of interactivity" and argues that, "A good game gives the player meaningful choices. Not just any choices, but choices that will have a real impact on what happens next, and how the game turns out." (Schell, 2008, pp. 179-180). In so writing, these authors affirm the centrality of the concept of player-controlled malleability of the game artifact to effective game design. Game design scholars Salen and Zimmerman speak to this point, explaining that, "The goal of successful game design is meaningful play" (Salen & Zimmerman, 2005, p. 60). "Meaningful play" emerges not from the game itself but rather from "the interaction between the players and the system of the game" (Salen & Zimmerman, 2005, p. 60). The authors describe the process of play as a series of choices made on the part of the player "within a game system designed to support meaningful kinds of choice making" (Salen & Zimmerman, 2005, p. 60). The meaning that arises from play is best understood as being the product of the interaction of the game's systems and the decisions made by players who interact with those systems.

Salen and Zimmerman argue that player choices, within the game system, are meaningful where they have mechanical impact on the states of objects within the game. In other words, meaningful choices are those choices that affect the structure of the game.

These authors articulate this point, explaining that choice-making is only meaningful where “every action taken results in a change affecting the overall system of the game” (Salen & Zimmerman, 2005, p. 60). Gee, a scholar of linguistics and semantics who often writes about games, helps us to understand the role of meaningful choices in a game, arguing that because the player’s choices matter, each player “takes a different trajectory through the game world” (Gee, 2006, p. 175). If the consequences of decisions made by a player are predetermined, then that player will not be able to make a unique path through the game world. Meaningful choice gives a player agency, but creates a substantial design problem. Care must be taken to craft balanced game mechanics that engender real choices. Speaking to the importance of balance, Schell explains that if one choice is clearly mechanically superior to all others, such as a tool that is objectively better than all of the other tools afforded to the player, then it is as if the player has no real choice to make (Schell, 2008, p. 180).

By making meaningful decisions within the game system, the player has agency to shape his or her experience of a game artifact to his or her liking. In a 2008 article, HCI researchers Crowley et al. note that there are important differences between usability and playability, writing that, “Entertainment outweighs productivity as the primary motivating factor behind game-play” (Crowley, et al., 2008, p. 2). The HCI literature acknowledges that limiting the player’s options with mechanical systems while still facilitating meaningful choice is a difficult design problem. For example, HCI and education scholars Law et al., write that “The large degree of freedom, enabled by digital game environments, renders it extremely difficult to tailor the games to the end users’ personal learning experiences and preferences, and to provide end users with purposeful and unobtrusive advice” (Law, et al., 2008, p. 20).

Some additional concepts from the HCI literature inform the subject of player's involvement in shaping a game artifact through meaningful choices. There is some similarity between the role of the player of a game and the role of the user in user-centered design. However, unlike in user-centered design, where "user involvement is most efficient and influential in the early stages of system development," the involvement of the player usually happens after the game artifact's formal development has been completed (Kujala, 2003, p. 1). A better analogue is found in the HCI literature on end-user development which, "seeks to *empower users* with the ability to *tailor* computer systems to their specific needs, by customizing the systems' appearance and behavior, or by adding and assembling new functionality" (De Souza, et al., 2006, pp. 401-402). End-user development speaks to the concept of the player shaping the game artifact through choice-making subsequent to the production of the game.

Further parallels to issues relating to how the player shaping a game artifact through meaningful choice-making are found in the literature on mass customization. Mass customization is a technique used by businesses that offloads some of the product design work traditionally done by manufacturers onto consumers. Under a mass customization system, consumers are able to tailor a product to their specific needs or tastes. In this case, the customization is performed before the product is actually manufactured. This spares the business the hardship of designing and manufacturing large numbers of variants of a product and affords consumers more choice and greater control over their purchasing decisions. Franke and Piller, scholars of business and economics, explain that, through mass customization, "the customer is integrated into the value chain of the supplier," and that, "the product becomes a co-production, and the customer a prosumer that adds value to the product" (Franke & Piller, 2003, p. 579). In the case of digital games, the customer is given some measure of freedom in shaping his experience through his ability to make

meaningful choices within the game's system. Where games support meaningful choices that lead to dynamic experiences, they may be understood to be similar to mass customization in that both processes allow for consumers to add value to a product by making decisions about what aspects of it they find desirable. Sotamaa, a game scholar, agrees with this assessment, writing that designers who allow players to have a real impact on the game world will, "find players eager to create their own content. These actions can be supported and managed with providing access to tools that allow players to manipulate and enhance their own gaming experience" (Sotamaa, 2007, p. 461).

The contributions from the HCI literature and the mass production literature may be understood, in part, as forming a continuum which describes the role of the user in adding value to a product. In the case of user-centered design, the user is most profitably involved in the early stages of a product's development. In mass customization, the user adds value by indicating which features they would or would not like at the last possible point in the production process before the artifact's elements become fixed. End-user development contemplates the addition of value by the user after the artifact's production. The player's ability to shape a game artifact through meaningful choice has the greatest similarity to end-user development. That said, the main difference between these two concepts is that where end-user development contemplates the expansion of the system through user-implemented additions of desired features or functionality, the player of a game is constrained by the limits of the game's systems. The constraints of the game's systems scaffold the player's ability to customize their experience of the game by making meaningful choices. In this way, the player adds value to the artifact through a process of interaction that is related to but distinct from the concepts offered by HCI and mass customization.

## *Depth*

The subject of depth is informed by literature from the fields of design, game design, and HCI. A game possesses depth where the interactions of the game's systems and the player's choices are capable of producing many different outcomes. The relationship of the game's mechanics to the player's decisions creates the formal system of the game. Crowley et al. speak to this point, explaining that, "mechanics give rise to the dynamics of the player / game interaction, and understanding them is correspondingly important. To do this, we consider a rule-designed game as a formal system" (Crowley, et al., 2008, p. 4). The depth of this formal system is an important aspect of the game artifact as it extends the length of time that a player may find the system interesting. Because the primary purpose of a commercial game is to provide the player with entertainment, the depth of a game is linked to its usefulness. Design scholar Prown's writing helps to articulate the importance of depth when he argues that the source of an artifact's value is its usefulness—that artifacts are valuable so long as they are useful (Prown, 1982, p. 222). In this sense, the game's value to the player is partially contingent upon its depth.

Deep game systems, on their own, are not enough to sustain player interest: games must provide players with a challenge. Game systems, even those that produce many different outcomes, eventually become tiresome. A player will eventually master those systems and the entertainment value offered by the game artifact diminishes. The rate at which this occurs is offset by the implementation of challenge--games should gradually increase in difficulty as the player progresses. HCI and game scholars Sweetser and Wyeth speak to this point, writing that, "Player enjoyment is the single most important goal for computer games. If the players do not enjoy the game, they will not play the game" (Sweetser & Wyeth, 2005, p. 1). The authors further argue that games keep a player's attention through a "high work load" and note that "the tasks must be sufficiently



challenging to be enjoyable” (Sweetser & Wyeth, 2005, p. 1). This argument is expanded upon by these authors to explain that “the level of challenge should increase as the player progresses” and that, “games should provide new challenges at an appropriate pace” (Sweetser & Wyeth, 2005, p. 5). The creation of sufficiently challenging tasks within the game’s formal system is an act of design that helps to constitute the game’s formal depth—which is to say that the designer lays before the player a certain array of tasks to be completed. However, this explanation of depth is problematic in that it suggests that there is a specific and correct fashion in which an important aspect of a game should be defined and implemented. This author could find no widely agreed upon and firmly fixed definition of exactly what “correct” way of implementing challenge in a videogame is. For example, Schell explains that increases in player skill should be met with commensurate challenges. However, he notes that the specifics of how those challenges are embodied in the actual design of a game is a complicated question. Specifically, he argues that:

For traditional games, this challenge primarily comes from seeking out more challenging opponents. In videogames, there is often a sequence of levels gradually get more challenging. This pattern of levels of increasing difficulty is nicely self-balancing—players with a lot of skill can usually move through the lower levels quickly, until they come to the levels that challenge them. This connection between skill and the speed of finishing a level helps keep skilled players from getting bored. However, it is the rare player who is persistent enough to win the game, mastering all levels. Most players eventually reach a level where they spend so much time in the frustration zone that they give up on the game. There is much debate about whether that is a bad thing (many players are frustrated) or a good thing (since only skilled, persistent players can reach the end, the accomplishment is special). (Schell, 2008, p. 120)

What is suggested by Schell’s argument is that there does exist a consensus as to the “right” way to challenge players. In contrast to the position taken by Sweetser and Wyeth, Schell explains that there exists no necessarily correct answer regarding challenge and that the frustration of players is not necessarily a bad thing. He notes that the technique of gradually

increasing difficulty is a technique that is often used in videogames but suggests that there exists no true consensus on the subject of challenge. As such, it would seem that the proper implementation of challenge ultimately depends upon the goals of the game designer.

Games should guide the player to develop the skills necessary to overcome the challenges posed by the tasks the designer has set before him. Gee's writing is instructive on the subject of the game as system teacher. He explains that, "Good game designers are practical theoreticians of learning, since what makes games deep is that players are exercising their learning muscles, though often without knowing it and without having to pay overt attention to the matter" (Gee, 2006, p. 174).

The literature suggests that the techniques of HCI offer value where depth and challenge are at issue. The application of traditional user-centered design techniques is beneficial in crafting depth and challenge but those techniques do not entirely address the challenges specific to game design. Sotamaa explains that many of the design approaches that "emphasize the significance of players draw their inspiration from the tradition of user-centered design techniques" (Sotamaa, 2007, p. 457). These techniques include focus groups, usability testing, and participatory design. Sotamaa explains that, while these techniques are helpful, they do not in and of themselves address the particular issues faced by game designers. The reason for this, explains Sotamaa, lies in the voluntary nature of play: "Digital games are used voluntarily, they are expected to challenge the player and her skills, and games are not entirely about the ease of use but more about well-balanced difficulty. Therefore, the user-centered design methods need some tuning when applied to game design" (Sotamaa, 2007, p. 457).

Pagulayan et al. also discuss the differing degrees of utility offered by traditional user-centered design principles between productivity applications and digital games. User-centered design principles, "have not reached game makers to the degree that they have

influenced other electronic applications” (Pagulayan, et al., 2008, p. 742). They explain that, at their core, “productivity applications are tools” designed with the intention of allowing people to perform tasks (Pagulayan, et al., 2008, p. 742). In the case of tools, the focus of the “design and usability is to produce an improved product or result” (Pagulayan, et al., 2008, p. 743). In contrast, digital games are fundamentally different—they are not tools but are something akin “movies, literature, and other forms of entertainment” (Pagulayan, et al., 2008, p. 743). There is overlap between the design of productivity applications and digital games. For example, some problems, such as designing buttons or conveying process models, are addressed by a common set of design principles. Other principles, however, particularly those intended to ensure ease of use and consistency, do always not readily map onto games. The “complex relationship between challenge, consistency, and frustration,” is indicative of the difference between games and productivity software. Games deliberately oppose constraints, change over time, and resist the user’s intentions. Their outcomes are “more experiential than tangible,” which necessitates an evaluative focus on perceptions rather than task completion (Pagulayan, et al., 2008, p. 743).

In games, players voluntarily explore the depth of the game’s formal systems. Game designers face unique challenges in presenting the game’s features and systems, gradually escalating the difficulty and widening the game’s possibility space in a way intended to create immersion and pleasure. Shneiderman and Plaisant acknowledge this challenge in the context of a game’s interface. They note that competition in the entertainment software industry is fierce and explain that, due to the voluntary nature of play, “ease of learning, low error rates, and subjective satisfaction are paramount.” If they do not succeed quickly players are likely to abandon the game (Shneiderman & Plaisant, 2010, p. 16). Pagulayan et al. also acknowledge the importance of a simple, intuitive

interface, describing it as a “necessity” (Pagulayan, et al., 2008, p. 742). Shneiderman and Plaisant further note that choosing the “right” design (“functionality”) to satisfy players while “keeping costs low is difficult.” These authors suggest that novice game designers “are best served by a constrained, simple set of actions,” but points out that, “as users’ experience increases, so does their desire for more extensive functionality and rapid performance.” This statement implies that simple games engage users for lesser amounts of time than complex games. Shneiderman and Plaisant indicate that a “layered or level-structured design” is one way of “facilitating graceful evolution from novice to expert usage.” In such a design, users may move up to more complex game layers when they desire them. They liken such a design to the traditional search engine, which has basic and advanced functions. Finally, Shneiderman and Plaisant observe that another design approach lies in carefully trimming a game’s features to make a simple, elegant device such as an iPhone (Shneiderman & Plaisant, 2010, p. 16).

There are experiential dimensions to artifacts beyond those intended by the designer. People often use artifacts for purposes that designers did not intend. Accordingly, not all of the depth present in digital games is the product of the designer’s specific intention. McCarthy and Wright explain that people find their own paths though designed spaces, writing that, “Consumers appropriate the physical and conceptual space created by producers for their own interests and needs; they are not just passive consumers” (McCarthy & Wright, 2004, p. 11). These behaviors are situated in a social context. Miller, a design scholar, argues that, while functional purpose plays an important role, social forces also influence an individual’s decision to adopt or purchase an artifact (Miller, 1987, p. 223). Games gain informal depth from the behaviors that players bring to the formal system. For example, while the designer might have intended that a player use the tools

provided to him in a certain way, there is no guarantee that the he or she will actually do so.

### ***Well-Realized Game Environments***

The concept of the well-realized environment is informed by literature from HCI, design, and game design. Aesthetic and narrative elements work together to create the game's environment and facilitate player immersion in the virtual world. The environment, or "world," of a game requires a careful synthesis of different types of craft around a unified theme. Law et al. articulate the value of the well-realized environment, arguing that the player expects a certain standard of production value from a game before he will let himself invest in it (Law et al., 2008, p. 20). Design plays a crucial role in the creation of a game environment, as it acts as a bridge-builder and guides the realization of a virtual environment. Nobel laureate Herbert Simon, author of the seminal manuscript *The Science of Design*, describes the capability of design to facilitate communication and cooperation across different skillsets and disciplines, writing that:

Undoubtedly there are tone-deaf engineers, just as there are mathematically ignorant composers. Few engineers and composers, whether deaf, ignorant, or not, can carry on a mutually rewarding conversation about the content of each other's professional work. What I am suggesting is that they can carry on a conversation about design, can begin to perceive the common creative activity in which they are both engaged, can begin to share their experiences of the creative, professional design process." (Simon, 1996, p. 137)

Simon's articulation of the value of design speaks to the role that design plays in the case of game environments. Design facilitates discourse and coordination across disciplinary boundaries, which is important, as the creation of games often requires multiple specialized persons working in concert. Schön explains that the need to communicate across disciplinary boundaries is a frequent trait of design work, arguing that, "Characteristically, designing is a social process. In every major building project there are many different kinds

of participants: architects, engineers, building contractors, representatives of clients and interest groups, regulators, developers, who must communicate with each other in order to bring a project to completion” (Schön, 1988, p. 182). Schön’s insight informs the social nature of design in the multidisciplinary process of creating a game environment. Like building projects, games are also built by a diverse set of participants: artists, programmers, musicians, and writers typically work together to create various aspects the game.

Well-realized game environments are holistically designed to communicate to players the themes, rules, and state of the game. Gee writes that, “Good games help players to see and understand how each of the elements in the game fit into the overall system of the game and its genre (type). Players get a feel for the ‘rules of the game’—that is, what works and what doesn’t, how things go or don’t go in this type of world” (Gee, 2006, p. 183). Determining the elements and themes around which the game’s world should be arranged constitutes a design problem because the solution to the problem of how to create an environment is not present in the game’s systems. It requires that the designer bring something to the problem space that isn’t inherently present. Lowgren and Stolterman explain that design problems are characterized by “dilemmas,” which helps us to understand this point. They argue that, “A dilemma is not a problem in the logical sense, since it does not have one given solution” (Lowgren & Stolterman, 2007, p. 17). Dilemmas can only be solved by creative leaps, as, “The complexity of design and the nature of dilemmas make creativity fundamental. In a dilemma situation, there is no chance that we could simply find a solution hidden in the situation. Instead, a dilemma can only be resolved by a creative leap, by transcending the limitations of the present” (Lowgren & Stolterman, 2007, p. 17). In creating a game’s environment, the designer uses creativity to embody the rules and themes of the game in the form of distinct game world.

Narrative elements are often important parts of the game's environment: they provide the player with context and motivation. As noted above, narrative elements engage the player on a level that transcends the mechanical operation of a game's systems. Jenkins acknowledges this point, writing that "Game designers don't simply tell stories; they design worlds and sculpt spaces" (Jenkins, 2004, p. 121). Jenkins further argues that games often do not tell stories well, as many game designers are schooled only on technical disciplines such as computer science or graphic design and "need to be retooled in the basic vocabulary of narrative theory" (Jenkins, 2004, p. 120). Not all narrative elements in games are explicit—some may be embedded within the aesthetic elements that represent the world that hosts the game system. Jenkins argues that there are at least four ways in which environmental storytelling "creates the pre-conditions for immersive narrative experience," and explains that, "spatial stories can evoke pre-existing narrative associations; they can provide a staging ground where narrative events are enacted; they may embed narrative information within their mise-en-scene; or they provide resources for emergent narratives" (Jenkins, 2004, p. 123).

In shaping the game's environment, the designer has the opportunity to engage players emotionally via what Norman terms "visceral design." Effective visceral design, explains Norman, "requires the skills of the visual and graphical artist and the industrial engineer. Shape and form matter. The physical feel and texture of the materials matter. Heft matters. Visceral design is all about immediate emotional impact" (Norman, 2004, p. 69). While Norman is primarily speaking to the design of the physical, the instruction provided by this insight is relevant to the construction of the virtual. Visceral design is distinct from behavioral design, which Norman describes as being, "all about use," and "the aspect of design that practitioners in the usability community focus on" (Norman, 2004, p. 69). In the case of games, both visceral and behavioral design are intertwined as

the game designer must succeed at both in order to construct a well-realized game environment.

As the state of the game system changes, so too must elements of the game's environment change in order to inform the player of what is happening. Norman explains that, "An important component of understanding comes from feedback: a device has to give continual feedback so that a user knows that it is working, that any commands, button presses, or other requests have actually been received" (Norman, 2004, p. 76). He further explains that, "To be effective, feedback must enhance the conceptual model, indicating precisely what is happening and what yet needs to be done" (Norman, 2004, p. 77). It is not, however, sufficient that elements of feedback in games are merely functional. Rather, they must be designed in a fashion that reinforces the game's themes and facilitates user immersion. Sweetser and Wyeth describe feedback as an important game element and note that the player should receive constant and appropriate feedback that propels him or her toward accomplishing goals (Sweetser & Wyeth, 2005, p. 9). In this sense, the design problems posed by game feedback go beyond those problems traditionally remedied by established user-centered design techniques. Writing on the subject of user interfaces, Shneiderman argues that after "functionality and usability have been accommodated into the design," it is time to, "add the extra touches and flourishes that delight and amuse users" (Shneiderman, 2004, p. 49).

### ***Digital Games and their Situation in the Social World***

The subject of pre-existing relationships is informed by literature from HCI, persuasion, design, and game design. Games can leverage pre-existing relationships among players to add value to the experience of play. Many people play games to experience social interaction. Sweetser and Wyeth articulate this point, writing that, "People play games to



interact with other people, regardless of the task, and will even play games they do not like or even when they don't like games at all" (Sweetser & Wyeth, 2005, p. 4). Furthermore, a survey of people that play games conducted by Lazarro revealed that social elements are so important that, "Participants play games they don't like so they can spend time with their friends" (Lazarro, 2004, p. 5). Because the desire for social interaction is such a strong motivation for playing games, games should take measures to facilitate player to player interaction where appropriate. The design of a game should "support and create opportunities for social interaction" as "it is clearly a strong element of enjoyment in games" (Sweetser & Wyeth, 2005, p. 10). The social interaction that occurs as the result of a game artifact need not be limited to interactions within the game artifact—players may enjoy a game outside of the formal structure by, for example, talking about the game or watching others play (Sweetser & Wyeth, 2005, pp. 10-11). Complicated design problems are found where games leverage pre-existing social relationships to add value. Lowgren and Stolterman explain that design becomes "much more complex when we combine different materials that each have specific qualities. It becomes very difficult when the material is a composition of both technical artifacts and social systems" (Lowgren & Stolterman, 2007, p. 3). Designing games to support social play may be understood as a difficult problem comprised of both technological and social materials. This challenge, explain Lowgren and Stolterman, possesses "nearly infinite complexity" (Lowgren & Stolterman, 2007, p. 3).

In addition to being socially engaging, digital games have a shaping effect on culture. Lowgren and Stolterman explain that, "Our designed world is full of digital artifacts," that they have a "direct impact on our everyday lives," and that, "To design digital artifacts is to design people's lives" (Lowgren & Stolterman, 2007, p. 1). Games scholar Bogost explains that, "Games, like photography, like writing, like any medium—

shouldn't be shoehorned into one of two kinds of uses, serious or superficial, highbrow or lowbrow, useful or useless" (Bogost, 2011, p. 5).

Digital games have the capability to act as a persuasive technology. Tøring explains the concept of persuasive technology as being, "technology that attempts to change the attitudes or behaviors of both its end-users without coercion or deception." Tøring further writes that, "It has been established that computers have unique traits when used for persuasion, namely interactivity" (Tøring, 2008, p. 83). HCI researchers Fogg and Iizawa describe one example of the use of persuasive technology in by examining social networking sites. In the case of social networking sites, the companies' business models rely upon motivating users to "adopt specific target behaviors" such as registering, uploading a photo, and connecting to friends (Fogg and Iizawa, 35). Game scholars Khaled et al., explain that persuasive games utilize technologies which are designed to change a person's attitudes or behaviors. The persuasive elements of these technologies rely heavily upon their situation in a cultural context:

Culture is a pervasive factor in day-to-day life, and by extension plays a part in shaping the design preferences of game and persuasive technology designers. In making design decisions, designers constantly make culturally-based value judgments about what they personally find persuasive, what they believe their target audience finds persuasive, and which persuasion motivations to foreground within their designs." (Khaled, et al., 2009, p. 32)

However, what one population finds persuasive may not prove compelling to another. In this sense, the persuasive techniques of a given game artifact are both shaped and situated within the culture that produced it.

It is clear that a game's environment, when properly realized, can be powerfully persuasive. McCarthy and Wright argue that "Interaction with technology is now as much about how people feel as it is about what people do" (McCarthy & Wright, 2004, p. 9). The construction of the game environment implicitly influences the player's feelings about the

game world and his or her role in it. Digitally-mediated persuasion is, however, in its infancy when compared to the robust theories on written and oral persuasion (Tøring, 2008, p. 84).

Semiotics provides a useful lens with which to understand the construction of persuasive elements in the game environment. Jewitt and Oyama describe the process by which designers attach context and meaning to the otherwise abstract objects with a game's system. Writing about semiotic constructions of visual meaning, these scholars explain that, "Images can create particular relations with the viewers and the world inside the picture frame. In this way, they interact with viewers and suggest the attitude viewers should take towards what is being represented" (Jewitt & Oyama, 2001, p. 145). Gee also draws upon semiotics to explain the creation of "ambiance or sensory metaphor" within a game (Gee, 2007, pp. 84-85). Discussing the case of the visual design of *Castlevania*, a gothic medieval action game, Gee explains that the game marries "an abstract rule system about shapes, movements, and combinations with story elements...The assignment of meaning to each shape, movement, and combination in *Castlevania* helps to determine what they should look and sounds like, either in the game or in the player's mind." Speaking to the design of one of the characters, Gee writes that, "The Sword Lord looks the way he does because this object has been assigned the meaning of "Sword Lord" in a Dracula universe. There is, of course, still lots of room for what the Sword Lord can look like in detail but he's not likely to look like an ice-cream cone" (Gee, 2007, pp. 84-85). Through this process, players are told how to feel about the game's world and the entities and actions within it.

## **Serious Games**

“Serious Games” is a nebulous term that actually refers to a large subset of the digital games industry. Serious games are, succinctly, games that are created for purposes beyond simply entertainment. This subset of digital games encompasses an overlapping set of game genres including e-learning, edutainment, and virtual training programs (Susi et al., 2007, p. 2). These types of software products use the rubric of the game to impart skills, facilitate learning in virtual environments, and encourage certain types of social behavior. This use of games fits into a larger trend towards designing educational experiences that are more flexible and user-centered (Greitzer, et al., 2007).

Serious games have been made for such purposes as public policy advocacy, education, military training, and health care (Charsky, 2010). One scholar reports that multiple meta-analyses of the body of literature on the effectiveness of gaming as a learning tool have found that games both promote learning and reduce instructional time across a variety of disciplines for a variety of age groups (Van Eck, 2006). Such games include everything from cutting-edge military flight simulators to programs designed to help individuals cope with chronic health conditions. The unifying aspect of the definition of serious games is not found in their form so much as it is in the evidence of intentionality in their production. Thus, on the surface, many serious games may resemble games made for solely entertainment purposes. It bears noting, however, that serious games often lack the streamlined design and polish of their entertainment-oriented counterparts (Van Eck, 2006).

Many educators and policymakers see merit in the employment of games and game-influenced design in educational software (Amory, et al., 1999; Sitzmann, 2011; Squire, 2011). Some advocates of serious games take things a step further. They view serious games as not only a tool for digital game based learning but also as an instrument through

which messages of social, political, or ethical importance may be transmitted. These advocates champion the integration of game elements in software designed to change a user's everyday behaviors. Examples of such software include augmented reality games, such as the 2016 hit *Pokemon Go*, which transpose a game-styled narrative over physical environments that are not constructed with gameplay in mind. In extreme cases, a casual observer may have difficulty distinguishing typical activities from what is construed as "play" within the framework of the game. Some of these proponents of activist software go so far as to argue that meaningful games layered over everyday life can "fix" problems present in our socially constructed reality (McGonigal, 2011). Some serious games, particularly those designed to be played in tandem with everyday life activities, challenge preconceptions of public and private space. In so doing, they draw into question the proper orientation of game-influenced design within the public space (Strenros & Montola, 2009). These types of questions regarding the proper orientation of games within society surround not only the physical attribute of the "gamespace" but also its place within the theoretical structure of a learning environment.

While there are many who champion the cause of serious games, others urge caution. It has been demonstrated that games can teach, but it should not be assumed that a game will be successful simply by virtue of its pedagogical intentions. Designing systems that enable meaningful learning on the part of the user is a complex process that necessitates a balance of game design theory, cognitive psychology, and theories of learning. The symbol systems employed in multimedia learning environments determine what types of skills are employed. Rather than cultivating new skills, the user instead focuses and cultivates skills that already exist and are drawn out through interaction (Brown, 2005, p. 929). Similarly, another study explains that just because it looks like a game is teaching doesn't mean that it really is, as the "implementation of multimedia-based

training features may give the impression of engaging the student in more active forms of learning, but sophisticated use of multimedia features does not necessarily produce the desired effect” (Greitzer, et al., 2007, p. 2). Such observations strongly suggest that the mere implementation of technology will not in and of itself result in effective digital game based learning.

The sections above discuss both the desirable elements possessed by well-designed games and the situation of games, including games that address serious issues. However, those sections do not tell us how games actually assist people with medical problems. To understand this, we must turn to the literature on games and health.

## **GAMES AND HEALTH**

This section examines the literature about the use of games to assist in the treatment of medical conditions but excludes those studies specifically about diabetes games. The games about diabetes will be discussed in their own section of this literature review.

As discussed above, videogames are capable of stimulating learning and have been used to aid in the development of skills for individuals with special needs such as language skills, math skills, reading skills, and social skills (Griffiths, 2002). As education tools, games have the potential to surpass the utility of traditional educational methods. Lieberman writes that, “Although pamphlets, videos, or health education classes can provide a great deal of didactic content, a compelling interactive game exposes players to essential content thousands of times. It gives players unlimited opportunities to rehearse new skills and receive personalized feedback on health choices made within the game” (Lieberman, 2001, p. 27). Advocates of serious games focused on health issues argue that games can play an important role in improving health by being present when health care providers cannot. Such games improve the reach of the health care provider and are in some

ways a form of telemedicine. Where a doctor may not have time to discuss all of the implications of a condition or explain all of the reasons necessitating changes in a patient's behavior, a game may be made available (Hawn, 2009). Serious games are a useful tool in such circumstances as they "address the psychological and behavioral barriers to optimal health care" (Kato, 2010, p. 113). Kato explains that there have been reports in the literature about the use of games for therapeutic purposes since the early 1980s and that, over time, the market has broadened and the games have become more complex. Initially, only commercially available, non-health oriented videogames were used but eventually serious games were constructed with specific goals healthcare goals.

Commercially available games have been used to assist in the management of nausea in pediatric cancer, anxiety management, physical fitness, and physical therapy. Serious games designed to improve health outcomes in specific medical scenarios have been used to help manage burn pain, diabetes, asthma, and bladder and bowel dysfunction (Kato, 2010). A meta-analysis of 38 studies of the use of both commercial and serious videogames as interventions to improve health outcomes found that games "improved 69% of psychological therapy outcomes, 59% of physical therapy outcomes, 50% of physical activity outcomes, 46% of clinician skills outcomes, 42% of health education outcomes, 42% of pain distraction outcomes, and 37% of disease self-management outcomes" (Primack, et al., 2012, p. 630). Studies were considered to be positive where the "video game intervention was superior to the control based on the significance criteria for that study" (Primack, et al., 2012, p. 633). The types of games used in the studies this meta-analysis reviewed included both serious and commercial games. The significance criteria included any positive health outcome that was either defined as the alleviation of an illness or the development of conditions that are associated with improvements in health outcomes. Such conditions include an individual's development of disease management

skills, the development of knowledge about health outcomes, and improvements in doctor-patient communication and treatment adherence. Unfortunately, the authors do not provide a detailed analysis of the exact types of positive outcomes of the studies, or the reporting measures used by the studies, in each health scenario. Only an indication of the positivity of the effect of the videogame intervention is visible. These authors indicate that a study's inclusion in this meta-analysis required that participants were randomly assigned to intervention and control groups but had no requirements regarding "dose, intensity, or length" (Primack, et al., 2012, p. 631-632). Only four of the studies included in Primack et al.'s meta-analysis examined the use of games to assist with chronic disease self-management. (Primack, et al., 2012, p. 633).

While few in number, the studies that do exist specifically regarding serious games and the management of chronic illnesses are encouraging. In the era of ubiquitous computing, games are considered to be a mass medium that can be exploited to improve health outcomes (Faiola & Kharrazi, 2010). For example, Games may potentially serve healthcare providers by allowing clinicians to "keep track of patients through online monitoring of gameplay, scores, etc" (Kahol, 2011, p. 293). Such a measure helps to ensure that healthcare providers are informed of their patient's status and may help to reduce the cognitive burden that tracking personal health data places on the patient.

Videogames have been beneficial to cancer patients. Kato et al. studied the effect of an intervention in the form of a videogame on 375 male and female cancer patients between 13 and 29 years of age. The game in question, *Re-Mission*, is a 3D game in which players control a nanobot within the bodies of young patients who have been diagnosed with several different forms of cancer. In the game, the player destroys cancer cells and manages treatment-related maladies such as infections and nausea by using tools such as chemotherapy, antibiotics, and antiemetics as ammunition. *Re-Mission's* content was



designed to address behavioral issues identified in literature reviews and preproduction targeting studies as being critical for good patient participation for adolescents and young adults. The results of the study indicated that the intervention significantly improved patient adherence to the uses of trimethoprim-sulfamethoxazole (an antibiotic) and 6-mercaptopurine (an immunosuppressant), patient self-efficacy, and overall cancer knowledge. *Re-Mission* did not, however, result in a significant improvement the self-reported measures of adherence, stress, control, or quality of life. It bears noting, however, that patients in both the control and experimental groups in this study demonstrated “uniformly high” treatment adherence (Kato, et al. 2008, p. 309).

Similarly, games have also been demonstrated to be helpful in the management of asthma. *Asthma Command*, a game for the Apple IIE microcomputer was tested with both asthmatic and non-asthmatic children in 1983. This game focused on four points: recognizing symptoms and allergens, using medication appropriately, the appropriate use of the emergency room and the doctor’s office, and the importance of school attendance. Players use their knowledge of good asthma management to navigate obstacles and score points. A controlled trial demonstrated that the intervention provided by *Asthma Command* led to increased knowledge about asthma, improved asthma management behaviors, a reduction in the number of acute medical visits due to asthma in the experimental group (Rubin, et al., 1986).

Likewise, in a 2000 study, Bartholomew et al. found that a videogame designed to enhance disease self-management skills among inner city youth with asthma was helpful. Children ages 6-17 played *Watch, Discover, Think, and Act*, a CD-ROM game used in doctors’ offices and clinics as an educational tool for managing asthma. The study concluded that the intervention was associated with “fewer hospitalizations, better symptom scores, increased functional status, greater knowledge of asthma management,

and better self-management behavior” (Bartholomew, et al., 2000, p. 269). The videogame itself is an adventure game, in which the player makes decisions about managing the game character’s asthma. *Watch, Discover, Think, and Act’s* conceptual framework included the “self-regulatory processes of goal setting, self-monitoring, problem identification, solution generation, action, and evaluation.” The game’s designers drew upon social cognitive theory methods of “self-monitoring, problem solving, modeling, and skill building” (Bartholomew, et al., 2000, p. 270).

In another study, this time of hospitalized pediatric asthma patients, the Super Nintendo videogame *Bronkie’s Asthma Adventure* was found to enhance social interactions amongst the study’s participants, it also improved patient communication with clinical staff, and it increased the children’s knowledge of proper self-management behaviors (Lieberman, 2001). Finally, in a study of at-risk children and asthma self-management, Shames et al., found that a multicomponent self-management intervention that included an asthma education videogame improved both asthma knowledge and quality of life. This study also utilized the 1995 product *Bronkie’s Asthma Adventure* (Shames, et al., 2004).

From this literature, we understand that games are generally understood to possess properties that are considered beneficial for the management of a variety of chronic illnesses. Specifically, this literature argues that games are useful for health education, may be present when traditional health care providers are not, and can improve a patient’s adherence to prescribed behavioral regimens. However, while this literature discusses the beneficial properties of health games, it does not speak to the how to actually craft those games. To understand this, we turn to a subset of the literature on health games that discusses the theoretical frameworks that inform the design of games.

## **Frameworks for Designing Health Games**

Social cognitive theory is a useful framework for understanding health behaviors. Bandura explains that social cognitive theory, “specifies a core set of determinants, the mechanism through which they work, and the optimal ways of translating this knowledge into effective health practices” (Bandura, 2004 p. 144). Core determinants include the knowledge of the benefits and hazards associated with health behaviors, individual beliefs regarding the efficacy of behaviors (self-efficacy), the outcome of expectations about the anticipated costs versus benefits of health behaviors, health goals and strategies, and the perceived facilitators and social or structural impediments to changing behaviors. A knowledge of the consequences of health behaviors is necessary to effect behavioral change. If an individual does not understand how his or her decisions effect health, he or she will have great difficulty adopting new behaviors. Self-efficacy is important because individuals must believe that their actions can produce a desired result. Self-efficacy is a “focal determinant because it affects health behavior both directly and by its influence on other determinants.” Bandura further observes that self-efficacy shapes outcomes as, “The stronger the perceived self-efficacy, the higher the goals people set for themselves and the firmer their commitment to them (Bandura, 2004, p. 145). Those with high self-efficacy expect to succeed whereas those with low self-efficacy tend to believe that goals are futile. In addition to influencing beliefs about goals, self-efficacy shapes the way individuals perceive obstacles. Individuals with low self-efficacy are likely to give up when faced with difficulties while individuals with high self-efficacy may persevere. Individual factors are not the only things that determine health behaviors: external forces such as the social and economic structures of systems such as healthcare providers are also a major factor.

Health behavior is affected by the outcomes individuals expect. These expectations take different forms: physical, social, and self-evaluative. The physical outcomes include

“the pleasurable and aversive effects of the behavior and the accompanying material losses and benefits” (Bandura, 2004, p. 144). Social approval and disapproval influences behavior through the effects of behaviors on interpersonal relationships. The third type of outcome, “concerns the positive and negative self-evaluative reactions to one’s health behavior and health status” (Bandura, 2004, p. 144). People have personal standards that shape their behaviors. They tend to do things that give them satisfaction and avoid things that do not. An individual may be motivated to change his or her behavior where he or she is shown how changes to behavior serve both self-interest and valued goals.

Goals are rooted in value systems and provide incentives and guides for health behaviors. Although long-term goals may set the course of personal change, there are too many “competing influences at hand for distal goals to control current behavior.” Consequently, short-term attainable goals “help people to succeed by enlisting effort and guiding action in the here and now” (Bandura, 2004, p. 145). Bandura further argues that, “Interactive computer-assisted feedback provides a convenient means for informing, enabling, motivating, and guiding people in their efforts to make lifestyle changes” (Bandura, 2004, p. 150). Feedback may be tailored to the participant’s efficacy level, individual impediments, and track progress. Individualized interactivity enhances the persuasive aspect of health promotion. Even where they are not tailored to the individual, digital games have the potential to serve health promotion purposes by improving the knowledge of a diabetic youth and his or her perceived self-efficacy. Bandura cites the cases of *Packy and Marlon* and *Bronkie’s Asthma Adventure* as successful examples of health-promoting games (Bandura, 2004, pp. 157-158).

Other scholars point to behavioral science as a source of guidance for game designers seeking to achieve the challenging goal of altering the player’s health behavior. Thompson identifies five concepts from behavior science that help to guide the design of

serious games such that a balance between the competing goals of entertainment and education may be struck.

The *first* of these concepts is that “knowledge and skill provide the foundation for behavior change” (Thompson, 2012, p. 808). This concept suggests that basic knowledge of proper health behavior provides a necessary foundation for behavioral change but it alone is insufficient to effect behavioral change. Individuals need to develop skills that allow them to effectively operationalize their understandings of healthy behaviors. Thompson notes that well-designed health games may allow individuals to develop such skills as setting realistic goals, self-monitoring, and problem-solving. She notes that, “Obtaining knowledge and enhancing skill can easily be integrated into a video game” through such mechanisms as character dialogue, character modeling, and the inclusion of mini-games embedded in gameplay (Thompson, 2012, p. 808). These game mechanisms allow players to apply their knowledge to scenarios and, through their interaction with game’s systems, gain or increase skills.

Drawing from social cognitive theory, Thompson advances her *second* concept, that “personal mastery is key,” and that, “an important way to learn a new skill or behavior is to perform it successfully yourself” (Thompson, 2012, p. 808). She explains that, “Personal mastery experiences can be promoted by setting specific, precise, proximal goals in the video game that have to be achieved in the real world and reported in the game world, subsequently influencing game play.” Feelings of mastery are enhanced as real world behaviors such as self-monitoring are detected and reflected in the game. For example, regularly performing certain tasks could lead to in-game rewards such as access to new levels. This design approach leverages the game artifact’s situation in the real world to persuade the player to adopt certain types of behaviors and avoid others (Thompson, 2004, p. 808).

Watching others successfully perform behaviors or skills and receive rewards is an example of Thompson's *third* concept: observational learning. Observational learning, also known as modeling, is regarded by some as the most common way that new skills and behaviors are developed. There are many ways that observational learning can inform the design of a persuasive game. Thompson suggests facilitating observational learning through such techniques as having game avatars model skills such as problem solving, goal setting, decision making, and self-monitoring. In such a design, players would interact with and observe characters behaving in certain ways and vicariously experiencing the positive or negative consequences of actions. She further suggests that a game's characters can emphasize the importance of developing skills and persevering by emphasizing coping styles, such as an imperfect performance that gradually improves as opposed to mastery styles, wherein an individual strives for a "perfect initial performance" (Thompson, 2012, p. 809). If game scenes are well-written and engaging, those scenes may convey information related to behavioral change in a non-didactic manner.

People are more receptive to persuasion when the message has been tailored to address the specifics of their situation. In her *fourth* concept, Thompson stresses the value of personalized messaging in establishing and maintaining the interest of the player, writing that, "Previous research has documented that tailoring enhanced personal relevance and facilitated desirable changes in diet and physical activity behaviors. Thus, to attract and maintain attention, messages and options in the video game, particularly in a serious video game for health, need to be tailored to players' perceptions, expectations, problems, solutions, and situations" (Thompson, 2012, p. 809). It is important that research be conducted throughout the development process to ensure the effectiveness of the game's messaging. Additionally, the characters in the game should be designed to underscore the persuasive themes. Positive character traits enhance the persuasiveness of game actors.

Protagonists and other positive characters should possess traits such as “trustworthiness, attractiveness, and likability,” while negative characters should not (Thompson, 2012, p. 809).

While the lessons of behavioral science are helpful tools for honing the persuasive capabilities of a serious game, more is needed to create an effective artifact. Thompson’s *fifth*, and final, concept, “fun trumps all,” argues that players expect games to be fun and entertaining. Elements such as drama, humor, and challenge are useful for enhancing entertainment and are the “purview of entertainment specialists.” That being the case, Thompson argues that, “the serious video game design team should be multidisciplinary and include behavioral scientists, content experts, and entertainment specialists” (Thompson, 2012, p. 809). Lewis echoes this analysis, writing that, “Designing effective game-based health interventions will continue to be a blend of science and art: a successful development team needs an integrated set of professional skills” (Lewis, 2007 p. 919). He notes that the expert domain of game design knowledge is “an art in itself” and that “Academics and clinicians should not believe that they, as sophisticated consumers of games themselves, or parents of children who play games, know how to blend the elements of game mechanics, reward systems, levels of play, graphics, animation, sound, and graphical design” (Lewis, 2007, pp. 919-920).

The balance of skills across the design team is important as, “it is essential that the behavior change components and the entertainment features be seamlessly integrated to achieve a balance between fun-ness and seriousness” (Thompson, 2012, p. 809). Achieving this balance is crucial, as the more entertaining a game is, the more likely it is to motivate players to keep playing. The longer that a player keep playing, the greater his or her exposure to the game’s message is. Therefore, the effectiveness of the game’s persuasive aims is directly tied to how entertaining it is. This is related to the desirable game

characteristic of depth, which increases the amount of time the player is likely to remain interested in the game and thereby extends its value. Lewis echoes this sentiment, writing that, “Regardless of the merits of the underlying intervention, if the target audience is not engaged by the game, it will not be played and learning will not take place” (Lewis, 2007, p. 920).

Makhlysheva et al. conducted a review of serious games for diabetics and distilled from them eight features that they considered important to the success of serious games. These authors found the following: that characters should be empathetically related to the players and their health challenges, a “motivational and adjustable reward system should exist” such that experimental learning is enabled, the player’s skill should be tested by setting clear but challenging goals that are consistent with “targeted health-related behavioral changes in real life,” that the game should gradually increase in difficulty while giving the player “opportunities for further improvement of health skills by learning the subtleties of the game,” that interactive visual feedback to the player’s actions should be implemented, that social aspects such as multiplayer or communication between play settings are important, realistic health-based background stories and attractive design including, “high-quality graphics, sounds, and animations,” and that the game should have some element of uncertainty (Makhlysheva, et al., 2016, pp. 421-422). While there are useful points to be taken from this list, it was constructed in a somewhat naïve fashion. The authors extracted elements from games they considered successful and put them all together without regard for the fine points of craft and design that scaffold successful games. These features should be considered as valuable suggestions rather than absolute prescriptions because a solution that works in one design dilemma cannot be necessarily be considered to work the same way in another.



## **DIGITAL GAMES AND DIABETES**

There are many serious games that focus on topics such as nutrition, exercise, and the prevention of health problems related to obesity. Such games are outside of the scope of this review, as it is limited only to games that are intended to assist people with the self-management of diabetes.

Digital games are promising tools for the delivery of diabetes self-management interventions because they “provide new and unique ways to motivate and support health behavior change” (Lieberman, 2012, p. 803). There has been scholarly interest in the use of digital games to address diabetes management since at least the 1990s. In a 1997 article, Lehmann reports that many researchers have suggested that information technology could be used to teach patients about the proper management techniques associated with type 1 diabetes. While glycemic control has been demonstrated to improve in patients who received education in addition to treatment at clinical visits, there is scholarship that suggests the benefit of one-time educational sessions may be fleeting. Lehmann argues that computer simulations could more effectively assist patients in learning to manage their disease by virtue of their availability; an educational course at the clinic fades from memory but an interactive software program could be accessed at any moment. He notes that digital games hold special promise, writing that, “While traditional classroom lessons may provide more didactic content, a compelling video game can expose children to essential material repeatedly, as many children will typically play a game they like for a considerable period of time” (Lehmann, 1997, p. 64). He also notes that playing games socially encourages children to discuss health topics and makes it easier for parents and health-care professionals to find ways to talk to children about health issues.

Faiola and Kharrazi argue that there is a “critical need to take innovative approaches to effectively delivering diabetes education that can address the complexity of

developmental issues that face children and adolescents specifically” (Faiola & Kharrazi, 2010, p. 162). These authors argue that interactive media, is an “inescapable part of our everyday life” and that “With the emerging digital gaming culture, serious gaming will become an increasingly vital part of health care education for upcoming generations” (Faiola & Kharrazi, 2010, p. 171). Brox et al. explain that digital games have advantages over traditional forms of media such as brochures or books as they allow children to experiment with interactive systems. Digital games provide children with hands-on experiences that engage them with concepts behind the management of diabetes, which leads to more effective learning. Furthermore, digital games provide children with a social activity in which they can interact with other children and gain the peer support that has been shown to be an important factor in coping with diabetes (Brox, et al., 2012, p. 291).

Makhlysheva et al. observe that there are two ways that self-management games for diabetics reach the software market. The first way is “represented by research projects in the health field” where “games are developed by relatively small research-driven teams with limited funding and, in most cases, without (or limited) game development experience.” While these types of research projects sometimes result in good ideas, and sometimes even playable prototypes, they often have “poor game quality and a limited number of testers.” Such limitations prevent these games from being viable in the market and most never see light of day. The second way that games for diabetics reach the market is through the game industry’s companies. These projects are driven by profit and necessitate the involvement of experts such as child psychologists, endocrinologists, and pediatricians. Such expertise is expensive and, given the uncertainty of a game’s commercial success, forms a major barrier to the development of complex games for diabetics. Another barrier comes from the fact that a “limited number of people with a particular disease makes the market for this game either non-scalable or even unprofitable.”

As a result, it usually makes more sense for companies to focus on games with a wider appeal, such as games that promote physical activities (Makhlysheva, et al., 2016, p. 430). The authors conclude that the “intensive” development of serious games for health, particularly serious games for diabetic children, is “possible only in the case of close cooperation between the game development industry and research institutions” (Makhlysheva, et al., 2016, 430).

### **Digital Diabetes Games Discussed by Scholarly Literature**

This section surveys the scholarly literature surrounding the digital games that were created to address diabetes issues. The studies are discussed in the chronological order of the games they scrutinize. There is substantial discussion of serious games focused on diabetes in the scholarly literature. Generally, digital games have addressed the needs of type 1 diabetics and studies have shown that diabetes interventions that utilize games are more successful than those that do not (DeShazo, et al., 2010, 815). However, recent years have witnessed a lack of self-management games for diabetics. (Makhlysheva, et al., 2016, p. 422).

One of the earliest digital games for diabetic children was Raya Systems Inc.’s 1989 PC game *BG Pilot*. In this game, the player attempts to guide an airplane along a safe path over the course of a three-day trip. The plane’s altitude is represented as blood glucose levels and it is controlled by using insulin, food, and exercise. The plane needs to keep its altitude within a safe range—if it flies too high it can run into birds but if it dips too low it risks hitting ground objects. The player does not directly control the plane’s altitude but influences the simulated blood glucose level by electing to use insulin, eat, or exercise. The plane’s actual performance is controlled by the computer and is based on simulated blood glucose levels (Lehmann, 1997, pp. 64-65).

After releasing *BG Pilot*, the same developers released *Captain Novocare*, an adventure starring a diabetic superhero. In this game, players attempt to rescue the mayor, who is also diabetic, while fending off sugary aliens. In a preliminary study of 23 children who played *Captain Novocare*, 22 out of the 23 youth chose videogames over videotapes as their preferred form of patient education. After playing the game for half of an hour, upwards of two-thirds of the children did not want to stop playing (Lieberman & Brown, 1995). Like *BG Pilot*, the game occurs over a number of days and a simulated blood glucose system informs the well-being of the game's principal character. *Captain Novocare* was re-imagined as *Captain Novolin* and released on the Super Nintendo platform in 1992. In the re-design, the complex modeling of blood sugar levels was abandoned in favor a more simplified, rules-driven approach to player success. Raye Systems went on to release what is perhaps the most-studied diabetes digital game, the 1995 Super Nintendo game *Packy and Marlon* (Lehmann, 2007, p. 65).

In a 1997 study, Brown et al. determined that type 1 diabetic children who played a digital game designed to improve self-care were far less likely to need unscheduled urgent doctor visits. In this widely-cited study of young diabetics, the authors investigated the effects of *Packy and Marlon*, a Super Nintendo game about diabetic elephants plagued by rodents at a summer camp. The children involved in this study were already receiving optimal care and were not newly diagnosed with diabetes. The children were given Super Nintendo videogame consoles to take home. The treatment group received a copy of *Packy and Marlon* while the control group received a copy of a pinball game. The participants were told that they could play their games as much or as little as they liked.

The authors praise *Packy and Marlon's* production values and engaging character design. They stress the importance of repetition of behaviors in the development of self-management skills and note that, "A well-designed video game is never the same

experience twice, and children are likely to return to it over and over again. This repetitive play exposes players to the same content and enables the same rehearsal of skills dozens and sometimes hundreds or thousands of times over the course of several months” (Brown, et al., 1997, p. 78).

In addition to combatting enemies, players must also help the elephants monitor their blood glucose, take insulin in appropriate amounts, review diabetes logbooks, and select appropriate foods for a meal plan. The development of *Packy and Marlon* was guided by theories and evidence from cognitive psychology, education, communication, health promotion, and HCI. It was designed to “enhance mediating factors, including self-concepts, social support, and knowledge” as these factors are related to improvement in self-care. Over the six-month period of the study, the group of children that were playing the game experienced a decrease in urgent care visits for diabetes of over 70% while the frequency of doctor visits for the control group of children increased (Brown, et al., 1997).

The 2001 platforming game *Balance* was developed at the University of Duisburg-Essen with the intention of persuading teenage type 1 diabetics to adopt proper self-management behaviors. The game was developed with the aid of medical professionals and psychologists. *Balance*’s developers targeted adolescent diabetics due to the consensus among medical practitioners that effective diabetes self-management among juvenile patients cannot be achieved by “conventional schooling or motivational techniques” (Fuchslocher, et al., 2001, p. 98). The authors acknowledge the value of *Packy and Marlon*’s depiction of self-management but argue that teenagers do not easily identify with anthropomorphic elephants. Specifically, the authors state that, “children tend to be highly attentive to role characters that are similar to them or that appear in media genres like cartoons and videogames” (Fuchslocher, et al., 2001 p. 98). *Balance* is a platforming, or run and jump a la *Super Mario Bros.*, game in which the player moves through a world of

suspended platforms, avoiding obstacles along the way. The player's friends have been captured and increasingly complex environments are encountered in search of them. In addition to the environmental hazards, players must control their character's blood sugar level by eating food and taking insulin. Having a very high or very low blood glucose level makes the player's character less responsive to controller input. The reduction in the character's responsiveness to input makes the game's challenges much more difficult. Players are awarded points for successfully managing blood sugar levels and are provided with negative reinforcement where they fail to manage blood sugar levels. The negative reinforcement appears in the form of the player's inability to optimally control their avatar.

*Balance* was designed chiefly around the concept of self-efficacy. The authors explain that, "Perceived self-efficacy consists of beliefs that one is capable of carrying out a desirable behavior, bringing about desirable events, and avoiding undesirable ones," and that, "people who have high self-efficacy related to carrying out specific positive health behaviors are more likely to have a healthy life style and to seek and follow medical advice" (Fuchslocher, et al., 2001, p. 98). Social learning theory guided the design of the game's mechanics. According to social learning theory, behavior of a role model in the form of an in-game character, in this case the player's avatar, will positively influence the player's own self efficacy where the player's interactions with the game produce desirable outcomes for the role model.

Fuschlocher et al. conducted a study using *Balance* to determine whether or not children preferred a version of the game that explicitly dealt with diabetes or an alternate version that dealt implicitly with diabetes through the metaphor of regulating temperature. They found that children preferred the explicit version, writing that, "Apparently, the possibility to identify with a game character also suffering from diabetes can be more beneficial than an implicit game version that tries to prevent reactance by not addressing

the relevant health content” (Fuschlocher, et al., 2001, p. 100). The authors note, however, that they are not able to explain the causal relationships between this preference. Therefore, while children found diabetes more interesting than temperature regulation in this case, it may be that there are more effective solutions to implicitly addressing diabetes issues. It also bears noting that the sample size in this study was small, with only 20 participants. The authors conclude that a larger, longitudinal study is warranted by their results.

In 2004 Aoki et al. at the HAL College of Computer Technology in Osaka published a study of three games that they developed for type 1 diabetic children. Echoing Lehmann’s sentiments regarding the capability of serious games to “be there” when continuous care specialists cannot, these researchers worked with doctors and nurses to create games that diabetics found engaging. In their preliminary evaluation, Aoki et al. found that patients “did not think that they had acquired sufficient basic knowledge” regarding their diabetes and that traditional methods of delivering information were unappealing or boring (Aoki, et al., 2004, p. 855). In an attempt to remedy this problem, the researchers developed three games, one PC game and two games for the Nintendo GameBoy Advance, intended to be used for the initial education of type 1 diabetics.

The PC game, *Tamagoya* (Egg Breeder) is for players who are newly diagnosed with diabetes. This game tasks players with nurturing a diabetic egg by supplying appropriate food, exercise and insulin. After a week’s time, the egg will hatch into different types of chicks based upon the player’s ability to successfully control blood glucose levels. The second game, *Tantei* (Detective) is for patients who have a basic level of diabetes knowledge. In this game, the player is a diabetic detective who, while in pursuit of a criminal, must also manage to maintain a healthy blood glucose level. Failing to adequately manage blood glucose causes the screen to fog up, crippling the player’s ability to perceive what is happening in the game. The third game, *Magic Toom* (Buildup Blocks) helps

players learn which foods are appropriate in different situations. Players stack colored blocks as directed by the game to control blood glucose levels.

In evaluating their games, Aoki et al. found that their testers thought the games were fun and that many of them would recommend the games to their nondiabetic friends. While the main conclusion from Aoki et al.'s article is that serious games are an appealing method of delivering medical instruction, an important consideration is present in their discussion. The authors mention that some of the medical professionals that they worked with had difficulties "understanding the logic behind game development." This led the authors to posit that "It is important to foster the development of professionals who can produce interdisciplinary research and development...especially in the health informatics area." They further note that health games must strike a careful balance between being persuasive and being entertaining—as both aspects are necessary for a game's success (Aoki, et al., 2004, p. 859). Here, Aoki et al. make the same point that Thompson does in her fifth concept from behavioral sciences: that effective serious game must strike a balance between fun and education.

In a 2004 pilot study, Kumar et al. found that the use of a motivational digital game increased the frequency of blood glucose monitoring, reduced the frequency of hyperglycemia, improved diabetes knowledge, and might help with glycemic regulation (Kumar, et al., 2004, p. 445). In this case the researchers used hand-held wireless technology to interface with a "predictive game" named *DiaBetNet*. *DiaBetNet* integrates blood glucose readings, insulin dosing, and carbohydrate intake data and challenges the player to correctly guess their next blood glucose level (Kumar, et al., 2004, p. 446). Players receive a fixed amount of points for playing and are rewarded with more points based on the accuracy of their predictions. Both groups in the study received blood glucose monitoring equipment and a personal digital assistant (PDA) with data management



software but the experimental group also received *DiaBetNet* game software. After a four week period, the experimental group demonstrated steady health behavior while the control group exhibited a “trend toward worsening” (Kumar, et al., 451). It bears noting that the “game” in this case is far less sophisticated than most of the other games mentioned in the literature.

Aoki et al. also created a cellular phone-based diabetes management game in 2005. The game, *Insulot*, was designed to encourage and motivate the confidence of type 1 diabetics. The game’s name is combination of the words insulin and slot machine. The game itself is a three-window slot machine “designed to teach the relationships among plasma glucose level, food (carbohydrate grams), and insulin dosage” (Aoki, et al., 2005, p. 760). *Insulot* uses computational methods to simulate postprandial glucose levels. It works by calculating the grams of the carbohydrates in each food item using the available glucose and then the insulin-to-carbohydrate ratio is used to simulate the amount of carbohydrates absorbed by a one-unit dose of insulin. Next, the carbohydrate level is determined by subtracting the carbohydrates absorbed by insulin from the intake of the carbohydrate grams. The player is scored based on the appropriateness of the postprandial plasma glucose level. The game is capable of using personal settings with its algorithms, tailoring the results of the slot machine to factors such as the player’s age and body weight. A study of 30 diabetics demonstrated that *Insulot* was perceived by more than 80% of the participants as a useful learning tool and around 80% indicated that they would recommend it to other type 1 diabetics. The authors conclude that they had developed an effective edutainment tool.

Not all diabetes-related material in digital games occurs on the software side; there have been a small number of devices that interact directly with game consoles. The 2007 Glucoboy is a glucometer that connects to a Nintendo Gameboy. It encourages users to test

regularly by “converting test results into reward points” that can be used to unlock minigames (Harris, et al., 2010, p. 135). Similarly, the Didget, manufactured by Bayer Healthcare in 2010, is a blood glucose monitoring system designed to promote good self-monitoring in children. The Didget itself connects to the Nintendo DS and Nintendo DS Lite handheld gaming systems. If the user has practiced consistent self-monitoring, reward points are accrued in the Didget which the user may spend to unlock games on Nintendo devices. Klingensmith et al. evaluated the Didget’s performance with users and found that people were satisfied with the device and thought that it would be helpful in building good blood glucose monitoring habits. A decrease in “at home” interest in the Didget is attributed to the users’ desire for more advanced games (Klingensmith, et al., 2011).

*Power Defense* is an unreleased 2011 real-time tower defense strategy game intended to improve numeracy in adolescents with type 1 diabetes. Poor numeracy skills have been linked to poor self-management of diabetes. In a tower defense game, the player’s goal is to prevent enemies from reaching a certain point on the map. To this end, the players construct towers which automatically fire upon enemies. Defeating enemies rewards players with points which can be used to either purchase new towers or upgrade existing ones. In *Power Defense*, the area that enemies attempt to reach is the player’s power base station, a representation of the individual with diabetes. The enemies, which are stand-ins for food, attempt to reach the base and are opposed by the player’s towers, which fire on approaching foes. The overall power level of the base station is in constant flux and players must take care that it doesn’t get too high or too low (Bassilious, et al., 2011). This author could find no study of the effect of *Power Defense* on the numeracy skills of type 1 diabetic adolescents. Over 90% of the testers showed an interest in games for healthcare education.

Recently, Joubert et al. conducted a 2015 study on the impact of *Mr. Birman's File*, a French game designed to educate children about flexible insulin therapy. In *Mr. Birman's File*, the player is tasked with managing the type 1 diabetes of a youth named Alex. The management of Alex's diabetes is conducted through "playful investigation" on the part of the player—interaction with a simulated glycemic monitor. The game's development was funded by the French Health Ministry and its production was carried out by a multimedia development team. The game's medical content was designed by a team of doctors and nurses. The theoretical background guiding the design of the game was Thompson's 2007 article on game design from the perspective of behavioral sciences. The study of the resulting game's effectiveness was conducted in the pediatric departments of four French university hospitals (Joubert, et al., 2016).

Joubert et al. take care to note that the game is not customizable based on the player's personal health information. The children who participated in the study were 11-18 years old, had been diagnosed with diabetes for more than one year, had received therapeutic education regarding self-management as per the standard procedures at each medical facility, and received intensive insulin therapy for at least six months (Joubert, et al., 2016, p. 3). The study included 38 patients and found that playing the game improved insulin titration (proper application of insulin doses) and carbohydrate quantification. The authors note that their results are consistent with the results of other studies of the effect of serious games on diabetes self-management. Other results of the study suggest that *Mr. Birman's File* is not a well-designed game. Only 40% of the participants found the game interesting and 30% complained about the "lack of action." The authors point out that the production of new serious games about type 1 diabetes has decreased in recent years. They postulate that the lack of new games could be due to several reasons such as the difficulty of achieving a balance between education and fun, the costly lability of the technology

underlying digital games, and the reluctance of medical professionals to, “use such recreational educative tools without previous control or regulation” (Joubert, et al., 2016, p. 6).

Some diabetes-focused games are “graphically intensive action games that add a diabetes narrative and layers of abstraction” (Patterson, et al., 2010, p. 7). These authors explain that *The Magi and the Sleeping Star* is one such game and notes that such designs have had low commercial success rates. It bears noting, however, that *The Magi and the Sleeping Star* was never completed. The authors do, however argue that advances in game development tools, game design knowledge, and instructional design may help diabetes games achieve widespread success (Patterson, et al., 2010 p. 7). In the case of *The Magi and the Sleeping Star*, the developers attempted to crowdfund the development of a videogame but succeeded in raising less than \$6,000 of the \$200,000 they sought. Included in the promotional materials for the Kickstarter campaign were screenshot mock-ups and a brief video of a prototype gameplay. When the crowdfunding effort failed, the game was never completed and production halted (Grantham, 2013). There could be a number reasons for the game’s failure to raise sufficient funds: the design may have been viewed as derivative, the Kickstarter campaign’s marketing efforts may have been insufficient, perhaps people found the particular game unappealing, or perhaps people have little interest in crowdfunding a game about managing diabetes. It is unclear as to why this article discusses a game that does not exist as if it did.

## CONCLUSION

The relevant literature related to diabetes management and digital games is generally strong where authors are discussing their own areas of expertise and relatively weak where they attempt to synthesize health and games literature. For example, the

diabetes literature is strong where it identifies relationships between potential design decisions and social or behavioral factors that may aid an individual in the self-management of the disease. The scholarship is weaker, however, when it comes to discussion of how games might actually accomplish such goals.

Rather than discuss the rich possibility spaces that are offered by the medium of games, much of the diabetes games literature takes what are effectively case studies and draws from them prescriptive design guidelines that are argued to be necessary for the creation of successful serious diabetes games.

Prescriptions can be detrimental to the design of effective solutions. This is to say that there is substantial underdetermination in the literature regarding the way in which features should embody the elements believed to be effective for diabetic self-management. For example, the discussions in the literature about the importance of peer and family support are useful in identifying an important purpose a game could serve, but there are no discussions about how to think about designing features that would engender that. As such, there is a need to test this literature against the knowledge of a practicing design community.

The existing game design literature is useful in that it helps us to understand the elements that comprise digital games but it offers little in the way of expressly explaining how games might be designed to achieve the goals expressed by the health literature. The strength of the game design literature is that it is instructive about the techniques of design that might be creatively applied to novel design dilemmas, but the effective application of those techniques to the issue of diabetes self-management requires a suite of skills and understandings. The diabetes games literature exists somewhere on a continuum between diabetes management and behavior literature and game design literature. More work must be done before we are able to move towards an articulation of best practices in chronic

disease management games. Because competent design is a crucial element in the development of a videogame, part of this work must involve the strengthening of the diabetes game literature by integrating the kinds of knowledges and techniques used by designers. Because many of the arguments made by the diabetes game literature about the elements that a self-management game should possess involve concepts whose meanings might be interpreted in different ways, exploring these elements requires the participation of multiple experts.

### **Chapter 3: The Design Template and Focus Group Methodology**

In order to both map the contours of the relevant scholarly literature and develop a tool with which to evaluate existing diabetes self-management games, I created a design template. The design template is composed of twenty-four interrelated elements drawn from existing scholarship related to diabetes self-management games and synthesized into an analytical instrument. Each of these elements may be understood as a vector that is considered important to the effectiveness of the artifact. It bears noting that the elements are not discrete. Rather, they flow into and inform one another—each mapping part of a continuum.

The form that the template takes allows us to do two useful things. Firstly, these elements articulate the arguments expressed by the literature regarding what makes for a good serious diabetes self-management game. By examining these questions, we gain a high-level view of the issues that the literature identifies as being central to the success of a serious diabetes self-management game. This allows us to understand what is considered valuable and ask questions about how far these valuations take us. Likewise, a high-level mapping enables us to identify gaps in the literature. As such, the template's form allows us to perform the second useful activity: asking experts to evaluate the adequacy of the literature's grasp of the important issues.

I have operationalized the elements in the form of questions to facilitate the evaluation of a serious diabetes self-management game. In addition to making clearly visible the arguments of the relevant bodies of literature about such games, the method of arraying the elements as a series of questions allows us to conduct a focus group study with game design experts—an important voice that has been absent from the health games scholarship. The elements were purposefully not organized into a hierarchy. The flat

presentation of the elements was intended to elicit from the focus groups arguments about the comparative importance of different elements.

The focus group is an appropriate methodology for this study for a number of reasons. *Firstly*, this research is exploratory. Focus groups are useful where little is known about a topic (Stewart & Shamdasini, 1990). In this case, almost nothing is known about how closely the beliefs of practicing game designers align with the scholarship on serious games for health. While I have some certainty about some of what the important issues in this area are, I am also aware that there may exist important issues that are not readily evident. By having game design experts evaluate serious diabetes self-management games through a series of focus groups using this template, and then reflecting upon the adequacy of that analysis, we are afforded an opportunity to test the arguments of the literature against the embedded knowledge and beliefs of individuals who actually design games. Here, a focus group allows issues that might otherwise go unnoticed to arise over the course of the groups' discussions. *Secondly*, the vague nature of many of the concepts embodied in the desirable game elements requires the application of expert knowledge. For example, the precise meanings and dimensions of the concepts of depth, challenge, and empathy in the context of videogames are not clearly evident. The exploration and triangulation of the meaning of these concepts in this context necessitates the involvement of experts. We have no way of knowing in advance if the experts will agree with one another about the meanings of vague concepts. Here, by facilitating a discussion amongst the experts, the use of a focus group methodology aims to expose tensions and explore the complexities of issues raised by the diabetes games literature. *Thirdly*, the circumstances surrounding the creation of the diabetes games are not clear. We do not know exactly who worked on these games, what their levels of expertise were, what their precise goals were, or what the processes and rationales were relied upon. While a group of experts cannot answer these questions, they



do possess specialized knowledge that helps us to peer into the inner workings of the diabetes games and address the issues raised by the template in a way that would not otherwise be possible. While focus groups are a useful tool for capturing different viewpoints and investigating topics about which little is known, they do have limitations. Krueger and Casey explain that participants in focus groups tend to try to portray themselves as being thoughtful and reflective. They further explain that this is most likely to occur where persons are being asked to explain the reasons for their behaviors. However, people may not be very good at actually expressing what drives their own behaviors. Likewise, participants might respond in ways that they feel will represent them in a positive way. They might be unwilling to admit that they do not know something or hesitant to respond in a way that makes them feel vulnerable. Lastly, dominant individuals may threaten to overtake the group's discussion. However, Krueger and Casey explain that skilled moderators are able to limit the risk of that behavior and might even be able to turn it into a benefit (Krueger & Casey, 2015, pp. 15-16).

The contribution of this study is twofold. *Firstly*, it addresses the gap in the diabetes games literature caused by the absence of the knowledge of the expert game designer. *Secondly*, it presents to members of the game design community a list of elements that the scholarly literature argues must be present in a successful diabetes self-management game. By presenting these elements to the game design community, I expose the arguments of the literature to critical analysis by a body of expert knowledge that has been so far ignored.

This chart lists both the elements that comprise the template as well as the literature from which they are drawn.

Table 1: Diabetes Game Elements from Literature

Element Number	Element	Literature Referenced
1	How well does the game teach basic diabetes knowledge?	DG, S, HG, HB
2	How well do characters, if present, serve as models for positive or negative behaviors?	HB, DG, DM, GD
3	How empathetic is the game towards diabetics?	DG
4	How well does the game allow users to practice skills related to diabetes management?	HG, DG, DM, S
5	How well does the game present the consequences of health behaviors on diabetes?	HB, GD, P, HCI, DG
6	How well does the game reward players for practicing self-management skills?	DG
7	How well does the game promote discourse about diabetes?	DG, HB, DM, GD,
8	How well does the game suggest that people can effectively manage diabetes?	DG, HB, DM
9	How well does the game engender peer support?	DG
10	How well does the game balance fun and education?	DG, S, HCI, GD
11	How aesthetically pleasing is the game?	DG, S, HCI, D
12	How strong, if present, is the game's narrative?	DG, P, GD
13	How clearly does the game communicate what is happening in the game world?	DG, HCI, GD
14	How easy is the game to pick up and play?	HCI, GD
15	How well does the game provide the players with clear goals?	DG, GD
16	How well does the game provide users with appropriate feedback?	HCI, GD
17	How clear is the relationship between the game's themes and the game's mechanics?	GD
18	How strong is the sense of progression provided by the game?	GD
19	How sufficient are the game's challenges?	GD
20	How well-designed, if they are present, are the characters?	DG, S, GD, P
21	How much choice are the players given?	DG, HCI, GD
22	How much do player decisions affect future gameplay?	DG, GD
23	How much does the game reach into the real world? For example, does it have social networking features that link users?	DG, HCI, GD



Hawn, 2009; Kato, 2010). Games are not entirely unique in this respect, as one could argue that the information contained in a pamphlet or video can be accessed again and again by an individual, but games possess two important advantages over traditional forms of health education. Firstly, where written or pre-recorded material is fixed, the medium of the game is potentially fluid. Secondly, the literature argues that individuals, particularly young individuals, engage with compelling games more than they engage with the didactic content of classroom lessons (Lehmann, 1997; Aoki, et al., 2004, De Shazo, 2010). This contribution is one of the most clearly visible ways that a serious health game is able to provide value.

**2) How well do characters, if present, serve as models for positive or negative behaviors?**

This element is informed by health behavior literature, diabetes game literature, diabetes management literature, and game design literature. The health behavior literature argues that an individual's belief about his or her ability to affect health outcomes through behavior is a necessary component of behavioral change. Without a belief in self-efficacy, an individual is not likely to behave in ways that engender desirable health outcomes (Bandura, 2004). If properly designed, the game's characters help to scaffold the development of positive self-efficacy. Multidisciplinary treatment programs focused on improving attitudes and motivation have been shown to result in improved self-management (Keers, et al., 2006).

The design of the characters should reflect the health challenges faced by users. This point important because that type of character design demonstrates empathy with the user's circumstance. It is also important because it facilitates observational learning (modeling). Through observational learning, the user observes how the behaviors of the game's characters affect their health outcomes. Where good behaviors result in good

outcomes, the user vicariously experiences positive results, whereas the inverse is true of negative behaviors. To underscore this point, and to increase the persuasive capabilities of the game, the design of the characters should reflect the desirability of their behaviors. Characters who perform positive behaviors should have positive traits, such as attractiveness and likability, whereas negative characters should not (Thompson, 2012; Makhlysheva, et al., 2016). This element is also informed by literature on game environments, as the design of the characters helps to convey the rules and themes of the game (Gee, 2006). In this respect, this element is linked to element 20, which asks how well-designed the game's characters are.

### **3) How empathetic is the game towards diabetics?**

This point is informed by diabetes games literature. People are more receptive to persuasive content where that content has been tailored to address the specifics of their circumstances. A serious health game that aims to convince people to change behaviors should be tailored to reflect the realities of their lives (Makhlysheva, et al., 2016). There is some scholarship that suggests a direct representation of diabetes is preferable to a metaphorical representation (Fuschlocher, et al., 2001). Such an approach also allows for the game to deal with coping styles, as opposed to an all-or-nothing mastery style that prizes initial perfect performances (Thompson, 2012).

### **4) How well does the game allow users to practice skills related to diabetes management?**

This element is informed by health games literature, diabetes games literature and serious games literature. The optimal management of diabetes depends upon multiple factors. In addition to possessing an understanding of diabetes and a belief in his or her ability to affect health outcomes through behavior, a diabetic must also develop a set of

skills related to the management of his or her condition. Serious games allow players to practice and develop skills through engagement with a virtual world (Griffiths, 2002; Lieberman, 2001; Van Eck, 2006). In the case of diabetes management, games might allow the player to refine such skills as goal setting, decision making, and self-monitoring (Thompson, 2012; Brown, et al., 1997). By repeatedly playing a serious diabetes game, players may hone critical self-management skills in a simulated environment. These skills may then be used in the real world to improve health outcomes.

**5) How well does the game present the consequences of health behaviors on diabetes?**

This element is informed by health behavior literature, persuasion, HCI, game design literature, and diabetes games literature. Furthermore, this element is related to the second element, “How well do characters, if present, serve as models for positive or negative behaviors?” but is distinct in that it is concerned not merely about characters but about the entire scope of what is present in the game. This element is concerned with whether the broader components of the game, such as its themes and mechanics, demonstrate the consequences of health behaviors on diabetes (Crowley, et al., 2008; Law, et al., 2008; Bandura, 2004; Gee, 2006). The depiction of health outcomes, as determined by the player’s interaction with the game’s systems, may be understood to be persuasive (Tøring, 2008).

**6) How well does the game reward players for practicing self-management skills?**

This element is informed by diabetes game literature. It is tied to the formal goal structure of a game, as well as being related to the depiction of the consequences of behaviors on health outcomes. It is also related to the fourth element, that of allowing players to practice diabetes self-management skills but is distinct in that this element is

about how the practice of skills is tied into the systems and overall structure of the game. It is also tied to element 15, which is about the clarity of a game's objective. In order to encourage players to practice diabetes management skills, a game must provide appropriate rewards where players successfully demonstrate a mastery of those skills (Brown, et al., 1997; Fuchslocher, et al., 2001).

**7) How well does the game promote discourse about diabetes?**

This element is informed by diabetes management literature, diabetes games literature and game design. There is a belief in the diabetes games literature that one of the ways that serious games about diabetes provide value is in their facilitation of discussions about the disease (Lehmann, 1997). As family and peer support are important determinants of adherence to a prescribed behavioral regimen, the extent to which a game encourages discussion and raises awareness about diabetes is understood to be a contributing factor to positive health outcomes (Haynes, et al., 2002; Schwartz, et al., 1991). Social elements play an important role in determining whether or not people will play games, as many people play games they aren't particularly interested in as a way of spending time with friends or family (Lazarro, 2004). Where the subject of the game is diabetes, the social elements associated with play encourage acknowledgement and discussion of the disease.

**8) How well does the game suggest that people can effectively manage diabetes?**

This element is informed by diabetes management literature, health behavior literature, and diabetes game literature. It is about both the explicit and implicit messages of the game about a diabetic's ability to manage his or her condition. Positive messaging is important for the cultivation of self-efficacy. The game should demonstrate that good behavior can lead to good health outcomes and that such a goal is achievable (Brown, 1997). In this sense, this element is associated with element 15, which asks how well the

game provides the player with clear goals. By depicting positive results, the game suggests that a player has real agency over his or her own health. Such a suggestion promotes the development of self-efficacy in the player (Bandura, 2004). Empowering an individual by improving attitudes towards the feasibility of management leads to improvements in self-management outcomes (Keers, et al., 2006).

**9) How well does the game engender peer support?**

This element is informed by diabetes management literature and diabetes game literature. It is related to both element 7, in which the discussions facilitated by diabetes games enable family and peer support, and element 23, in which digital games may possess features (such as connections to social media) that reach out into the broader world. The diabetes games literature specifically notes that the social nature of gameplay provides children with an activity through which they can interact with another and thereby gain the peer support they require (Brox, 2012). In a way, this element is also related to the concept of empathy towards diabetics, as non-diabetic users who are exposed to the game may understand the hardships faced by their peers.

**10) How well does the game balance fun and education?**

This element is informed by serious games literature, game design, and diabetes games literature. There is a consensus in the literature that if a game is not fun people will not play it (Aoki, et al., 2004; Crowley, et al., 2008; Sweetser & Wyeth, 2005; Thompson, 2012; Joubert, et al., 2016). Games are unlike other forms of software in that people play them not to accomplish tasks but for entertainment and pleasure (Sotamaa, 2007; Pagulayan, et al., 2008). If the player is not engaged by a serious game, the intended instruction or persuasion will not happen (Lewis, 2007). In such cases, the efforts of the game's creators are understood to have resulted in failure. However, where the player



derives pleasure from interacting with the game artifact, repeated use and the successful delivery of the educational content may occur (Lieberman & Brown, 1995; Lehmann, 1997; Brown, et al., 1997). Thus, to be effective, serious games must strike a careful balance between their educational or persuasive aspirations and the creation of interest and pleasure (Aoki, et al., 2004; Thompson, 2012).

**11) How aesthetically pleasing is the game?**

This element is informed by serious games, design, human computer interaction, and diabetes games literature. People interact with games voluntarily and are motivated to do so for entertainment and pleasure. The virtual environment, or world, of the game is a synthesis of different types of craft around a unified theme. Most users expect that the game environment meet a certain standard of quality before they are interested in spending time with the game (Law, et al., 2008; Makhlysheva, et al., 2016). Another way of understanding this is through the concept of visceral design, which articulates the importance of the affective dimensions of the experience of an artifact. The way a game makes a person feel, and the responses that it immediately invokes, are important (Norman, 2004). As such, mere functionality is insufficient. Serious game designers must ensure that their work produces a positive emotional response from users (Shniederman, 2004). It bears noting that commercial games are generally regarded as being superior to serious in this respect, as the latter often lack the quality of production that are associated with the former (Van Eck, 2006).

**12) How strong, if present, is the game's narrative?**

This element is informed by game design, persuasion, and diabetes game literature. Narrative elements contribute to the strength of the game's environment and enrich the

game's characters. Although game designers often stumble with narrative delivery, as many are only schooled in the technical disciplines, effective narratives contribute to immersion. The game's narrative may be delivered in a number of ways—not all storytelling in games is delivered in an explicit fashion. Rather, games can embed narrative in the design of the game world (Jenkins, 2004). As effective narratives facilitate immersion, they may be understood to enhance the effectiveness of a game's persuasive aims. In particular, where the narrative elements mirror the experience and cultural context of the player, the persuasive aims are powerfully bolstered (Khaled, et al., 2009; Fuschlocher, et al., 2001; Thompson, 2012; Makhlysheva et al., 2016).

**13) How clearly does the game communicate what is happening in the game world?**

This element is informed by game design and HCI. As the state of the game changes, players must receive appropriate feedback. Otherwise, players will not be able to understand what effect their decisions have. Feedback should be continual, precise, and guide the player towards the accomplishment of goals (Norman, 2004; Sweetser & Wyeth, 2005; Makhlysheva, et al., 2016). If the feedback provided to the player does not allow him or her to understand what is happening in the game, the game may be understood to be unplayable.

**14) How easy is the game to pick up and play?**

This element is informed by game design and HCI. Games must be approachable. Because games are used voluntarily for entertainment, it is important that the player is able to quickly engage with the game. Where players cannot quickly and easily learn to play the game, they are likely to abandon it in favor of something less frustrating (Pagulayan, et al., 2008). Games should guide the player to develop the skills necessary to succeed at them

game. In this sense, the game is a teacher and the game designer is a sort of theoretician of learning (Gee, 2006). As the player progresses through the game, the game's design should support a smooth evolution from novice to expert play (Shneiderman & Plaisant, 2010).

**15) How well does the game provide the players with clear goals?**

This element is informed by game design and diabetes games literature. In addition to being approachable (element 14), a game should provide players with clear direction. Goals are an important part of almost any game, as they provide players with the direction and enjoyable challenges necessary to sustain interest (Sweetser & Wyeth, 2005; Lewis, 2007). This element is related to the broader elements of progression and challenge (elements 18 and 19) but has a distinct, more nuanced layer due to the fact that it deals specifically with serious health games about diabetes. Because one of the aims of diabetes management games is facilitating the player's development of self-management skills, clear goals are important. For example, an in-game goal could be linked to the type of real-world data integration discussed in element 23, or it could be present in the form of a series of exercises designed to hone some specific aspect of self-management. Where a player achieves the goals related to self-management and understands that he or she possesses the skills necessary to handle the challenges posed by diabetes, the persuasive element of the game is strengthened (Thompson, 2012; Makhlysheva, et al., 2016). In this sense, the provision of clear goals is also closely related to element 8, which is about how well the game suggests that people can successfully manage diabetes.

**16) How well does the game provide users with appropriate feedback?**

This element is informed by game design and HCI. It may be understood to be an extension of element 13, which asks about how clearly the game communicates what is happening. While clear representation is important, it alone is not sufficient. Feedback

needs to be both engaging (Shneiderman, 2004) as well as appropriate to the themes of the game. The rules of the game are communicated through feedback and such information should be delivered in a way that complements the symbol language that comprises the game's environment (Jewitt & Oyama, 2001; Gee, 2006; Gee, 2007). When properly implemented, feedback systems may elicit emotional responses in the player such that the persuasive elements of the game are enhanced. For example, feedback can be tailored to an individual's self-efficacy level, impediments, and goals (Bandura, 2004).

**17) How clear is the relationship between the game's themes and the game's mechanics?**

This element is informed by game design. The effectiveness of the game is enhanced where the game's themes and mechanics (rules) are closely linked. Where the interactive elements of the game fit smoothly into the game's overall concept, players understand what works and doesn't work in the game's world (Gee, 2006). In this sense, the game's rules help to communicate the game's themes, and, in the case of serious games, the game's message.

**18) How strong is the sense of progression provided by the game?**

This element is informed by game design and HCI. As a player interacts with a game and achieves goals, the state of the game should change in such a way that the player experiences a sense of progress. Progression might take a number of forms, including a gradual increase in difficulty, an expansion of available features or tools, and perhaps access to new layers or levels (Shneiderman & Plaisant, 2010). Effective implementation of progression extends the novelty provided by the game, and helps to keep a player interested.

**19) How sufficient are the game's challenges?**

This element is informed by game design and HCI. Unlike productivity software, which is designed to help people accomplish specific tasks, a game is designed to resist the player (Pagulayan, et al., 2008). In the case of most games, there is a complex relationship between the player's intentions and the in-game outcomes. In other words, the player tries to do something, but the results depend upon factors such as the player's skill and the configuration of the game's systems. The difficulty the player experiences in realizing his or her intentions may be understood to comprise the game's challenge. A player will not remain interested in a game where challenge is improperly balanced. If the game is too easy, or too difficult, players will not find the game enjoyable and will quickly lose interest (Sweetser & Wyeth, 2005). However, where the game's challenges are well-crafted, the player is encouraged to stick with the game through a gradual increase in the complexity and difficulty of challenges (Sotamama, 2007; Shneiderman & Plaisant, 2010).

**20) How well-designed, if they are present, are the characters?**

This element is informed by game design, serious games, diabetes games, and persuasion. The characters present in the games occupy and reflect the game's environment. Characters have aesthetic dimensions and players expect that those dimensions meet certain standards of quality. Poorly realized characters make it more difficult for players to invest in the game (Law, et al., 2008). The importance of the design of characters is linked to the third element, that of empathy towards diabetics. Characters contribute to the empathetic qualities of the game artifact where their struggles mirror the health circumstances and goals of the player (Fuchslocher, et al., 2001). In this sense, this element is related to element 2, which asks how well characters serve as models for positive or negative health behavior. Characters also contribute to the persuasive aspects of the game, as positive characters should possess positive traits, such as attractiveness or

trustworthiness, while characters who promote negative health outcomes should have undesirable characteristics (Thompson, 2012). Finally, the design of the characters is linked to the overall strength of the game's environment, as they not only join the abstract concept of game mechanics to symbols but also suggest to the player how her or she should feel about the world of the game (Jewitt & Oyama, 2001; Gee, 2006). Here, this element is associated with element 11, which is the strength of the aesthetic components of the game.

### **21) How much choice are the players given?**

This element is informed by game design, HCI, and diabetes games. As interactive objects composed, in part, of layered systems, games as a medium are defined by the player's ability to make choices that shape the state of the game (Crawford, 2003; Crowley, et al., 2008; Schell 2008). Where the player is not given agency to make decisions, the game is understood to be shallow. In the case of diabetes management games, players are not able to practice and develop useful skills where the game does not afford branching choice. Another way of saying this is to argue for the importance of uncertainty in the progression of the game (Makhlysheva, et al., 2016). It bears noting that the abundance of choice does not necessarily result in meaningful choice. For example, if one choice is mechanically superior to all other choices, then it is as if the player has no real choice to make (Schell, 2008). Thus, the choices offered to players must allow them to architect their experience of the game. The degree of choice provided to players is understood to correspond to the complexity of the challenge faced by the game designer (Law, et al., 2008).

**22) How much do player decisions affect future gameplay?**

This element is informed by game design and diabetes games. It may be understood to be a corollary to the previous element, that of the degree of choice given to players. Where the quality of that element asked how much choice players are given, this element is concerned with the way in which the game reflects the consequences of those choices. Meaningful play emerges from meaningful choices. It appears where the game's systems interact with the decisions made by players to produce outcomes that are represented by alterations in the game's state (Salen & Zimmerman, 2005). Where the player has agency to shape the game artifact, each play session becomes different as different choices lead to different experiences (Gee, 2006). It is through this mechanism of meaningful choice that games attain their fluid characteristics and encourage repeated interaction. The presence of meaningful choice speaks to the fourth element, that of enabling players to practice diabetes self-management skills, as repeated engagement fosters the development of those skills (Brown, et al., 1997). Finally, players that are able to shape the game through their decisions find it easier to invest themselves in the game (Sotamaa, 2007).

**23) How much does the game reach into the real world? For example, does it have social networking features that link users?**

This element is informed by game design, HCI, and diabetes games. As designed digital artifacts, digital games are situated in the broader social and cultural world of daily life (Lowgren & Stolterman, 2007). Games should facilitate opportunities for social interaction, as social interaction is a strong element of enjoyment in games (Sweetser & Wyeth, 2005). It is the mission of every serious game, including diabetes management games, to encourage some sort of change in the world (Khaled, et al., 2009). In the case of health games, the hope is that exposure to the game will cause a player to adopt healthy behaviors. Digital games have the ability to include real-world elements in the game's

“space” by implementing certain types of features. Features that track real-life health data can reward the regular performance of tasks, such as monitoring blood sugar levels, with in-game rewards (Thompson, et al., 2012). Games can also encourage social interaction by including support for multiple players or social media integration (Makhlysheva, et al., 2016). For example, the gameplay results of a diabetes management game, such as the score that a player achieved or time spent an individual playing, could be monitored by healthcare providers (Kahol, 2011). Integrating the social elements of the exterior world into the world of the game is a very difficult design challenge, as artifacts comprised of both technological and social elements are highly complex (Lowgren & Stolterman, 2007).

#### **24) How replayable is the game?**

This element is informed by game design, serious games, and diabetes games literature. The lifespan of a game is closely linked to how replayable its content is. The primary indicator of replayability is the game’s depth. Games are understood to be deep where the interactions between player choice and game mechanics can produce a substantial variety of outcomes (Salen & Zimmerman, 2005; Gee, 2006). Thus, this element is related to both elements 21 and 22, which ask about how much choice players have and how those choices shape gameplay. It is also related to element 4, which is about allowing players to practice diabetes management skills. The concept of replayability is associated with the game’s ability to achieve its designer’s goals, as repetitive play increases an audience’s exposure to persuasive or educational content (Lehmann, 1997; Brown, et al., 1997; Lewis, 2007; Thompson, 2012).

#### **DESCRIPTION OF THE FOCUS GROUP METHODOLOGY**

Each of the three focus groups consisted of four expert game designers who were asked to both play two games about diabetes self-management and then evaluate the games



using the design template discussed in this chapter. The participants were recruited via flyers distributed at a game design meet up in a large city in the southern United States. While each of the participants had a minimum of three years of game design experience, a few had decades of experience. The identities of the focus groups participants have been concealed in order to protect them from potential professional conflicts.

The selection criteria for the diabetes management games was as follows. *Firstly*, the game had to be chiefly about the management of diabetes. Games which focused on general health concerns, such as nutrition or the importance of exercise were excluded. *Secondly*, the game had to be available in the English language. *Thirdly*, the game had to be available in the United States. *Lastly*, the game had to be available on hardware that could not reasonably be considered to be obsolete. All of the games that met these criteria were included in the focus group study.

Each session was held at the author's home. Sessions with each game lasted around forty-five minutes and consisted of two phases: collaborative play and then critical evaluation of both the games and the template. As the moderator of the focus groups, I provided the participants with instructions and explained that the value of the sessions comes from their interactions with one another and the games, not with me. My participation was almost entirely limited to observation except when asked to clarify a question or when I thought a point merited further explanation or discussion.

During the collaborative play session for the first two focus groups the games were played on a single laptop. The seat at the head of the table was occupied by the participant that was playing the game on the laptop. The participants frequently swapped in and out of this seat as they took turns playing the games. The display was mirrored on a large television so that all the participants could clearly observe the gameplay activity. When it

was time to discuss the template questions, the participants sat across from one another and the seat at the head of the table was empty.

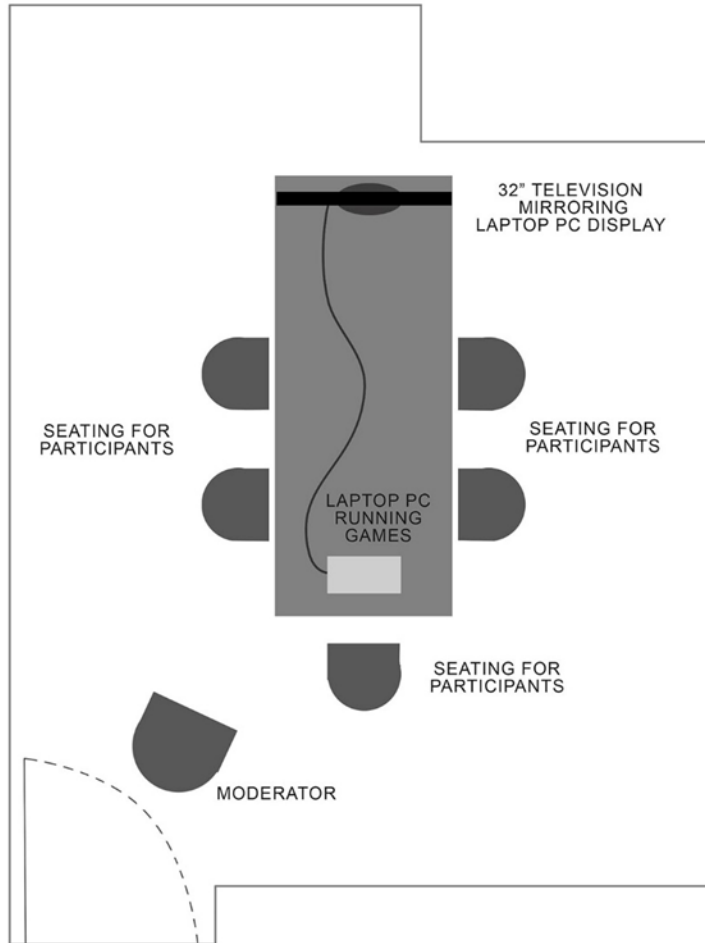


Illustration 1: Setup of the First and Second Focus Groups

The third focus group examined games on a smartphone. This was necessary because the games that they played were only available on that specific platform. That focus group used a combination of seating arrangements and passing around an android device to facilitate group play.

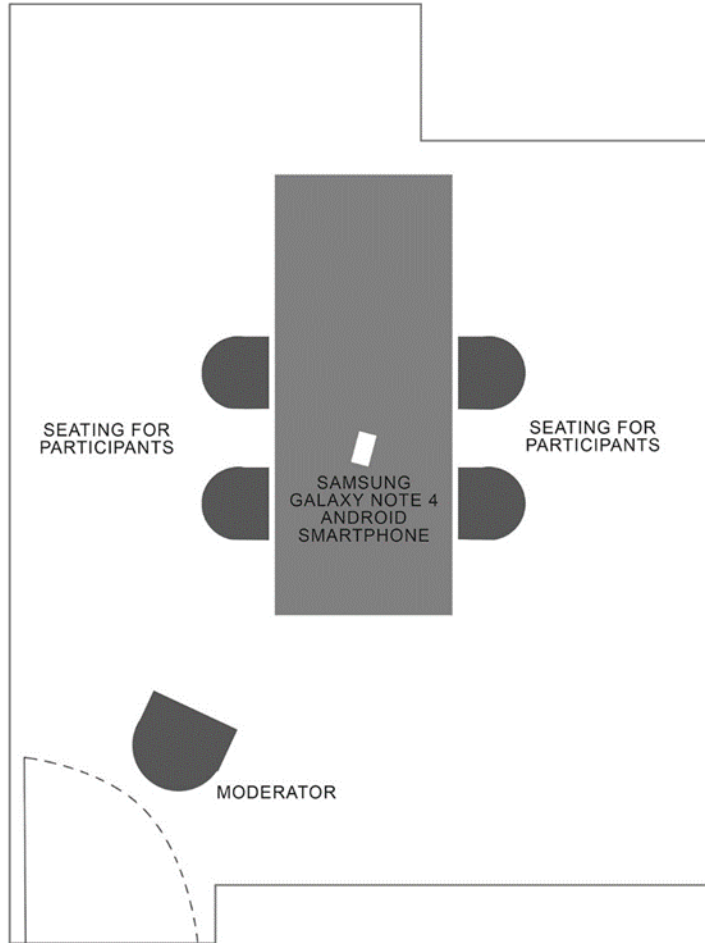


Illustration 2: Setup of the Third Focus Group

In each of the focus group sessions, the participants were asked to talk aloud, sharing their thoughts, reactions, and opinions, as they both played and watched gameplay. In every session, the participants collectively negotiated gameplay decisions, pointed out things they liked or did not like, and worked together to try to understand how to play each game. The decision to have the participants play collectively, as opposed to individually, was made due to both time constraints, as the designers' time was valuable and not easy to

secure, and in the interest of capturing their discussions with one another during a play session.

After spending around fifteen minutes with each game, the participants were provided with a copy of the template and asked, as a group, to assign a rating of one through four to each of the questions posed by the design template. A score of one represents the worst assessment while a four represents the best. The scored templates are included at the end of this document as Appendix B. The participants were only provided with the questions raised by the template, not an explanation of where the questions came from or what they mean. The reason for this is that part of the value of the focus group discussions comes from the group's negotiation of ambiguous concepts that are treated lightly by much of the literature they are derived from. They were also asked to think critically about the adequacy of the questions and whether or not there were any problematic assumptions embedded within them. Reaching a decision as a group required the participants to vocalize their opinions and the reasoning behind their responses. Part of this process often included discussions about what the questions actually mean.

The discussions of the focus groups were captured by this researcher using a digital audio recorder. The audio recordings were sent to a professional transcription service that was previously approved by the Institutional Review Board of the University of Texas at Austin. In total, 324 minutes of focus group data was recorded. Unfortunately, the professional transcript was highly inaccurate. This was likely caused by the frequent use of terms of art that are familiar to the expert game designer but unfamiliar to the layperson. As a result, this author manually transcribed the entirety of the audio data. After transcription was completed there were 179 pages of text.

## **DATA ANALYSIS**

My approach towards the coding process was guided by the work of Corbin and Strauss (2015). This approach provided me a way to gain intellectual control over the data. After the transcription of the focus group audio was complete, I coded all of the raw data. Initially, I utilized an open coding method.

The open coding method initially utilized in vivo codes—deriving the labeling from the actual language used by the focus group participants. Next, the codes with common properties were grouped into concepts. For example, 45 statements detailing confusion about how the things presented by the diabetes management games were grouped into the concept of “Abstraction of the game world doesn’t map back to reality and is confusing.” Likewise, 64 instances of confusion about what the games were trying to communicate to the player about the effects of their actions and the state of the game world were grouped into the concept of “Feedback is inadequate.”

The categories were created and defined through multiple readings of the raw data. Once the coding was complete, and saturation was clear, I was able to engage in axial coding. This allowed me to identify relationships between the open codes and establish a frame of relationships. After the axial coding was complete, I was able integrate the codes into higher level categories. The higher-level categories are discussed in detail in chapter 4. For example, the concept of “Game did not teach basic diabetes knowledge” and the concept of “Text instructions don’t teach effectively” are related. The relationship between these concepts is expressed in the category of “Teaching diabetes knowledge.” This category is unpacked and explained, along with all of the other categories in the findings section of chapter 4. This explanation involves presenting the concepts that formed those categories, as well as interpreting for the reader what the participants are trying to express. Together the categories discussed in the findings section of chapter 4 inform the lessons

that are derived from the focus groups and help to inform the construction of the revised design template in chapter 5.

## **Chapter 4: Empirical Findings from Three Diabetes Games Focus Groups**

### **CHAPTER OVERVIEW**

This chapter is focused on the empirical data gathered from the three diabetes games focus groups with expert game designers. The first part of this chapter discusses the actual games themselves—providing an overview of what the games are, how they are played, and provides illustrative screenshots from each game. The second part of the chapter discusses the findings from the focus groups. All of the high-level categories, or issues, that emerged from the analysis of the focus group transcripts are detailed in this chapter. In many cases, the same issue manifested across different games and focus groups. In the interest of demonstrating to the reader how the issues manifested, and which groups they manifested in, the findings are organized around the issues. The third and final section of the chapter is devoted to the lessons that are derived from the findings. These lessons connect the findings of the focus groups to the issues raised by the literature. Furthermore, they offer guidance for future diabetes games work.

## DIABETES GAMES EXAMINED BY THE FOCUS GROUPS

Table 2: Games Examined by the Focus Groups

Game	Platform	Focus Group	Genre
Diabetes Dash	Laptop PC	1	Action
Ketones Attack	Laptop PC	1	Action
The Diabetic Dog Game	Laptop PC	2	Virtual Pet
Equalize: Dependency	Laptop PC	2	Platformer
Tina the Cat	Android Device	3	Virtual Pet
Coco's Cove	Android Device	3	Puzzle

Table 2: Games Examined by the Focus Groups, cont.

### Focus Group 1

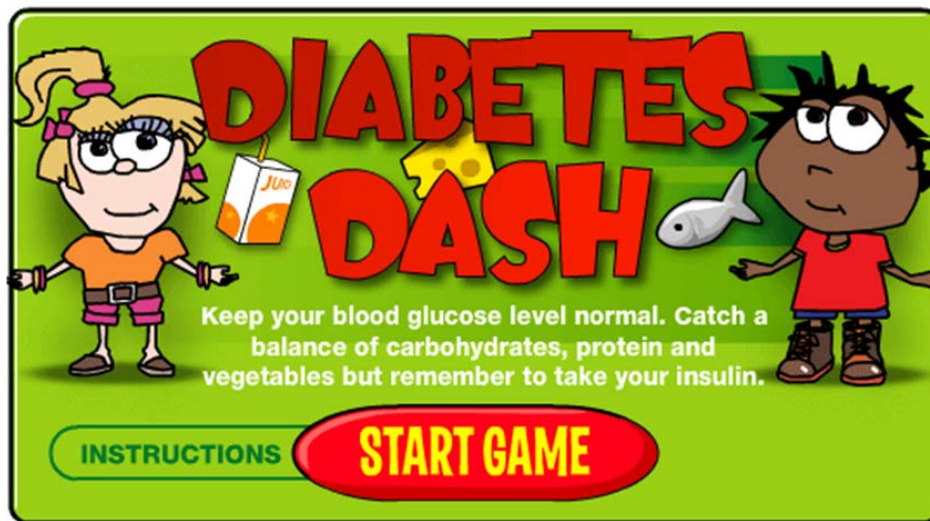


Illustration 3: *Diabetes Dash* Start Screen



The first focus group looked at two diabetes games that were playable in a web browser. The first of these games, Diabetes Dash, tasks the player with moving a child back and forth on a two-dimensional plane as food and insulin fall from the sky. The player tries to make contact with healthy foods while simultaneously monitoring a meter that approximates the child's blood glucose level. The player attempts to keep the blood sugar level within an acceptable range for a given amount of time. The speed at which the player is able to move is related to the blood glucose level: should it reach dangerously high or low levels the player's ability to avoid undesirable foods or obtain necessary insulin is compromised.

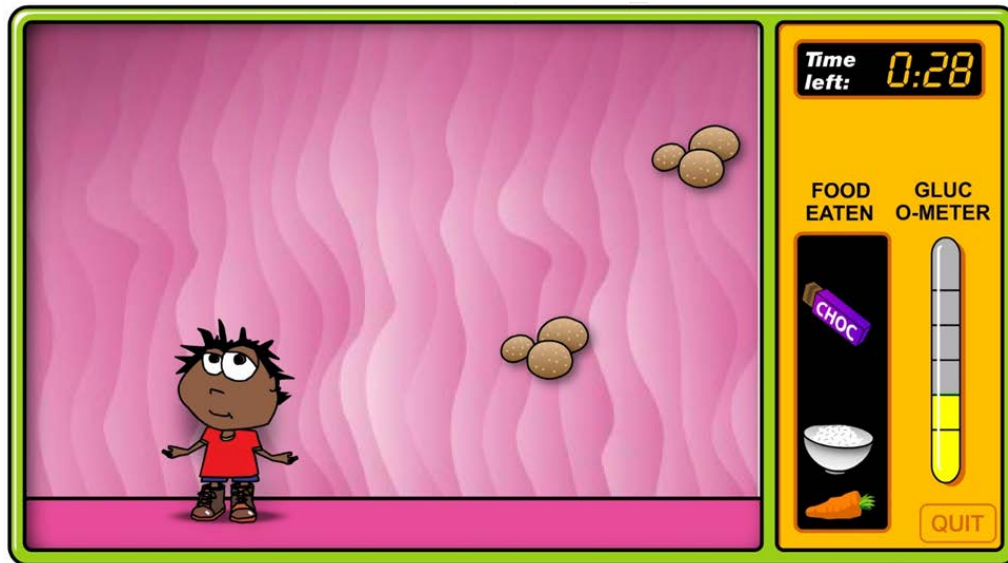


Illustration 4: *Diabetes Dash* Gameplay

Successful performance grants access to increasingly difficult stages (levels) where the food begins to fall more quickly. A stage, or level, in the context of a game is a discreet configuration of the game's components. In games, levels are typically presented in a sequence. As a player progresses through a game's levels, the actors that make up the

game's components are presented in differing quantities and structures. As a general rule, levels are progressively increase in difficulty.

The second game was *Ketones Attack*. In this game, the player controls a child who has shrunk down and entered the blood stream of a diabetic.



Illustration 5: *Ketones Attack* Start Screen

This game uses a top down perspective and tank-style controls. In a tank-style control scheme one set of keys rotates the direction the player is facing and another set causes them to move either forwards or backwards. Another button allows the player to shoot streams of insulin at the sugar cubes that are drifting through the environment.



Illustration 6: *Ketones Attack* Gameplay

Players move around, collecting insulin for ammunition, and clearing the blood of excess sugar. If players fail to remove sufficient amounts of sugar, ketones appear in the form of monsters that must be driven off.

## Focus Group 2

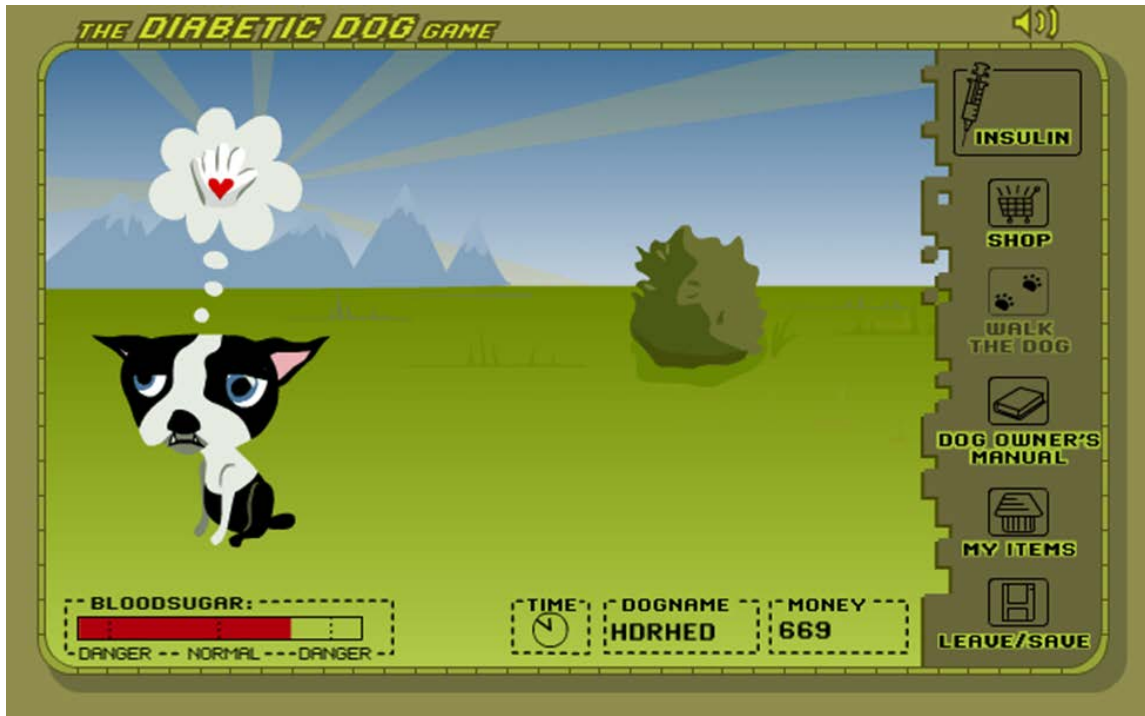


Illustration 7: *The Diabetic Dog Game* Gameplay

The first game examined by the second focus group, *The Diabetic Dog Game*, is a browser-based pet management available on the Nobel prize's website. In this game, the player assumes the role of caretaker for a dog with type 1 diabetes. After agreeing to take care of the dog, the player is presented with the dog owner's manual.

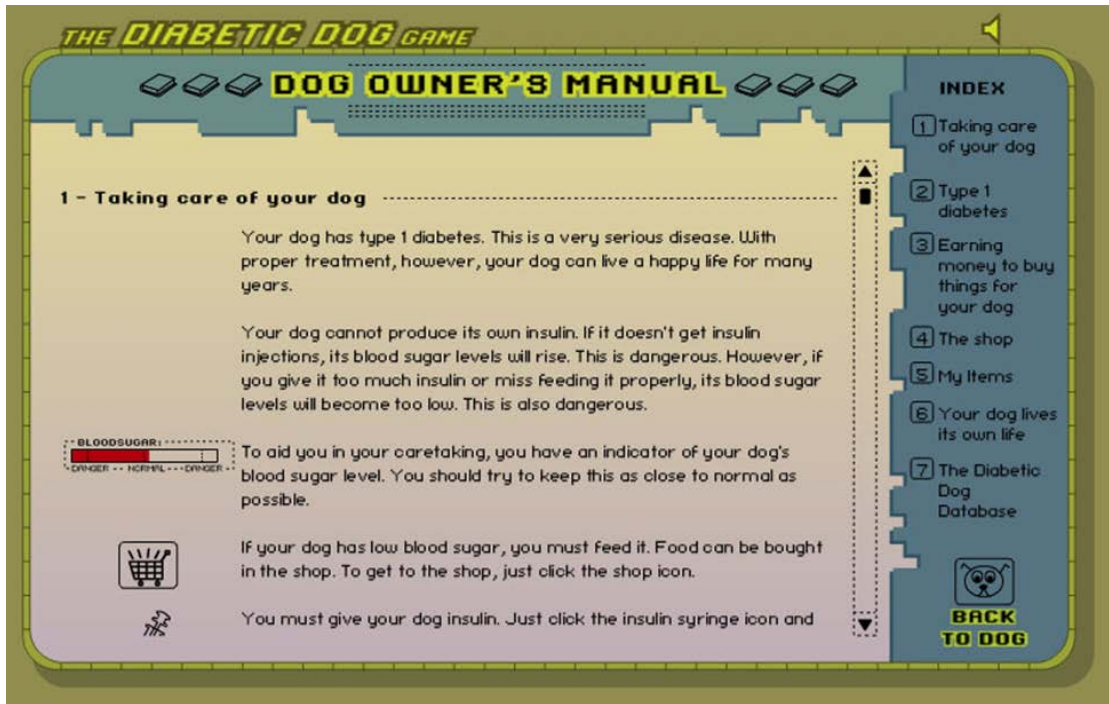


Illustration 8: *The Diabetic Dog Game* Manual

The dog sits on a green plane populated by a single bush. Aside from wandering the plane, the dog occasionally disappears behind the bush to relieve itself. The dog's blood sugar level gradually depletes, requiring the player to purchase food from the in-game shop. After the dog is given food, its blood sugar rises. This requires the player to administer insulin. The player is also able to pet the dog by clicking on it as well as take it for walks. New players are provided with a small amount of money to purchase food for the dog. At the end of a game's "day," which serves as a round of play, the player is awarded additional money for taking care of the animal.

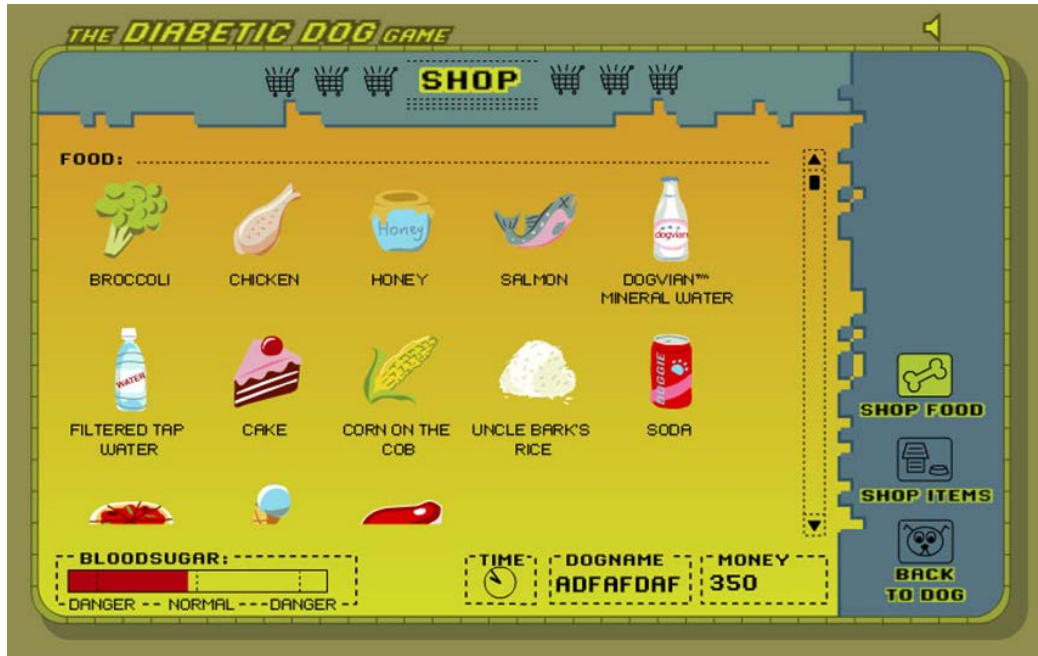


Illustration 9: *The Diabetic Dog Game* Shop

They can then use this money to purchase food or cosmetic items for the dog. The game maintains a registry of players and dogs. The game’s manual cautions that if a dog is treated poorly, it will be taken away from the player and erased from the game’s database.



Illustration 11: *Equalize: Dependency* Splash Page



The second game examined by the second focus group, *Equalize: Dependency*, is a browser-based, film noir-themed game. In this game, the player assumes the role of either Harvey or Vicky—both of whom are diabetic. Harvey and Vicky are working to take down a corrupt sugar magnate, named Zacharias Slim, who has developed a form of addictive sugar. Between gameplay segments, the game’s story is presented in a series of moving comic book panels.



Illustration 12: *Equalize: Dependency* Gameplay

The gameplay in *Equalize: Dependency* is a mixture of platforming and top-down driving. *Super Mario Bros.* is perhaps the most famous example of a platforming game. In a platforming game, the player controls a character who progresses through the game world by jumping through a series of suspended platforms. In addition to puzzling out how to jump between platforms and open barriers, players may also have to contend with obstacles. In this case, the player’s efforts are frustrated by thugs employed by the sugar

magnate. These thugs are armed with sugar weapons that cause the main character's blood sugar level to increase. Players are able to stun the goons by using a camera's flash. In the platforming segments, the main character's blood sugar level is displayed by a constantly changing meter in the bottom left part of the screen. Players must monitor the main character's blood sugar level—if it gets too high then the protagonist passes out. When the main character passes out they collapse to the ground before disappearing and reappearing a short distance away. A score is calculated at the end of each section. Collectable items, such as glowing rings, acquired by the player increase the score while points are deducted for every time the main character passed out.

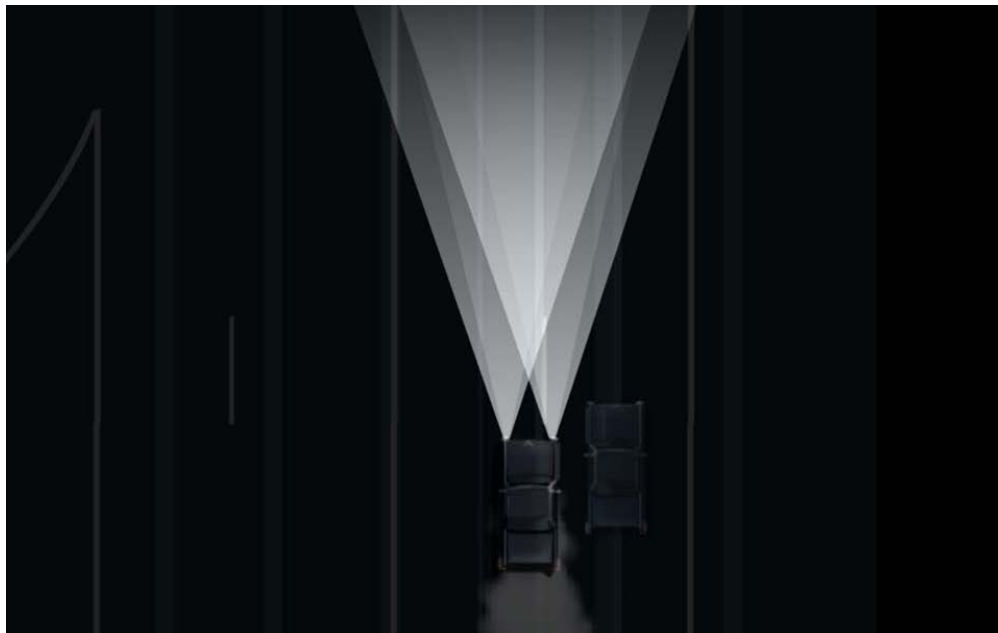


Illustration 13: *Equalize: Dependency* Driving Gameplay

In the top-down driving segments, the player views a car from a bird's eye perspective and attempts to guide the vehicle, which is automatically propelled, along the road while avoiding obstacles. *Equalize: Dependency* does not have a manual. Rather,



educational information about diabetes is presented in the form of text that floats in the game world.

### Focus Group 3

Tina the Cat is a mobile game playable on android devices. In this case, the third focus group played it on a Samsung Galaxy Note 4 android device. The game begins with a brief instruction screen that invites players to assist Tina by regulating her blood glucose level through a combination of exercise, diet, and insulin injections.

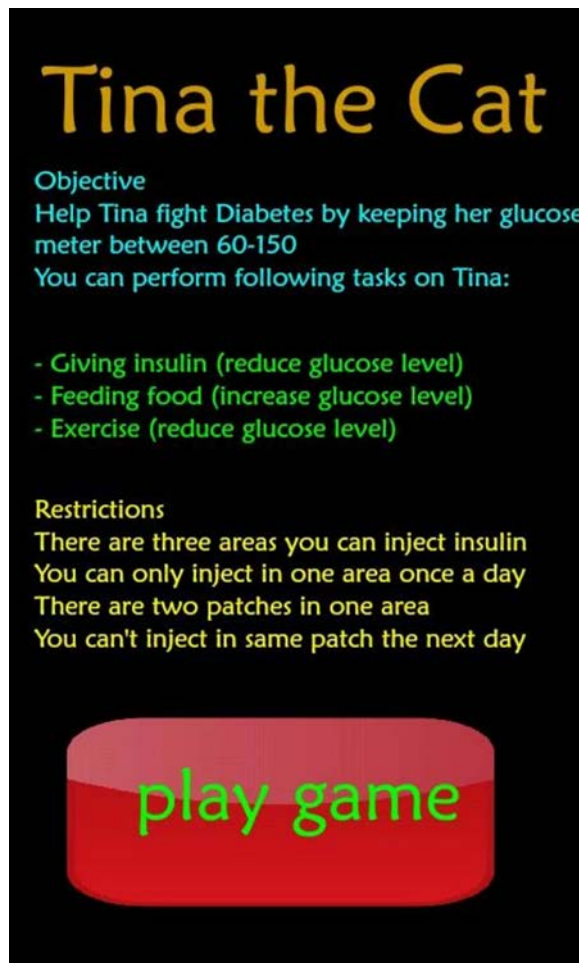


Illustration 14: *Tina the Cat* Start Screen and Instructions

Players are able to select different foods to give Tina, including fries, chocolate doughnuts, eggs, watermelon, and broccoli. The game does not have sound and the image of the cat is static. Tapping the green circular button in the upper right hand portion of the screen causes the day count to increase by one, although it is unclear what effect this has. Both the author and the third focus group were unable to discover an end-game failure state in this game. Negative performance is met with a large frowning face emoticon, but no additional information is provided. After the frowning face vanishes, the game resumes.

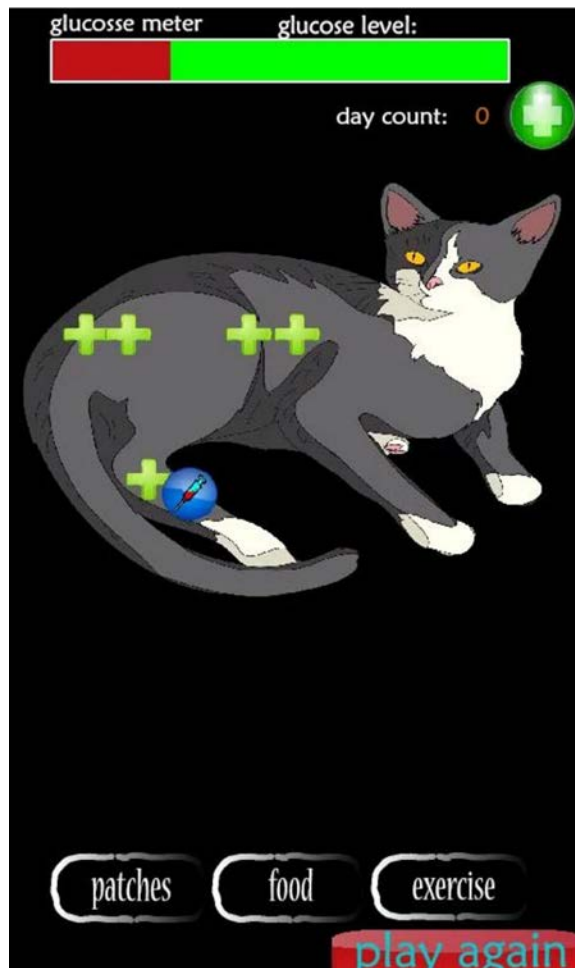


Illustration 15: *Tina the Cat* Gameplay

At the start of a new “day” Tina’s glucose levels are the same as at the end of the last day.



Illustration 16: *Tina the Cat* Food Selection

The author was able to tap the green “day advance button” fifty times in a row (resulting in 50 days of no diabetic management) and there were no in-game consequences.



Illustration 17: *Coco's Cove* Start Screen

*Coco's Cove* was the second mobile game examined by the third focus group. *Coco's Cove* is a physics-driven puzzle game similar to *Angry Birds*. The third focus group used the same android device that was used to play *Tina the Cat* to play *Coco's Cove*. The main character, Coco, is a monkey who is represented in the game by her head. The player uses the touchscreen to pull Coco's tail in the direction they wish to fling her. To progress the player must guide Coco to healthy foods while avoiding junk foods such as hot dogs and pizza. Diabetes is never mentioned in the actual gameplay but it is briefly mentioned on the "About" screen accessible from the start screen and in the game's advertising copy on the Google Play store. The about page explains that Coco has type 2 diabetes and warns the player that too few or too many carbs will lead to trouble. The third focus group, however, ignored the about page and proceeded directly into the gameplay.



Illustration 18: *Coco's Cove* About Screen

The advertising copy states that, “*Coco's Cove* is a puzzle-platformer game that subtly incorporates symptoms of type 2 diabetes. You wouldn't know if we didn't tell you, but Coco has type 2 diabetes! But that doesn't take away from all the fun Coco has out in the jungle.” *Coco's Cove* has the highest production values out of all of the games included in the study.



Illustration 19: *Coco's Cove* Gameplay

Coco herself is lively and emotive, and frowns when flung into junk food. Similarly, to golf, the player is scored based upon how many attempts, or flings, it takes to collect all of the desirable foods. Thus, the goal is to collect all of the healthy foods using the fewest possible attempts. If Coco is flung into unhealthy food, such as a sugary doughnut, she begins to glow red.



## OVERVIEW OF THE TEMPLATE RESPONSES FROM THE FOCUS GROUPS

This section presents and briefly discusses the ratings assigned to each of the template elements for each of the focus groups. Although the sample sizes for each group were small, we may still observe certain trends in the data. The chart below indicates the rating that each focus group assigned to that element when evaluating a specific game. It bears noting that each focus group only evaluated two games. Therefore, the ratings assigned to a game were from one focus group, not all three.

Table 3: Focus Group Ratings of Template Elements

Element	<i>Diabetes Dash</i>	<i>Ketones Attack</i>	<i>The Diabetic Dog Game</i>	<i>Equalize: Dependency</i>	<i>Tina the Cat</i>	<i>Coco's Cove</i>
1	2	2	1	2	2	1
2	2	1	2	2	1	2
3	2	1	2	2	2	2
4	2	1	2	2	2	1
5	1	2	1	3	1	1
6	1	1	1	3	1	1
7	1	1	1	2	1	1
8	3	2	2	3	2	1
9	1	1	1	1	1	1
10	2	1	1	3	1	2
11	2	1	2	3	1	3
12	1	1	1	2	1	2

Table 3: Focus Group Ratings of Template Elements, cont.

13	2	1	1	2	1	3
14	3	2	2	3	3	3
15	2	1	2	3	1	3
16	1	1	1	3	1	3
17	3	3	2	2	2	1
18	2	2	1	2	1	3
19	1	1	1	2	1	3
20	2	1	2	2	1	2
21	2	1	1	2	3	3
22	3	2	1	1	1	3
23	1	2	1	1	1	1
24	1	2	1	1	1	3

Notably, none of the focus groups ever assigned a score of four (which would indicate very high quality) to any element of any of the games included in this study. The games mostly received scores of ones and twos, with the occasional three. This indicates that they were all generally considered to be of poor quality. Element 9, which is concerned with how well a game engenders peer support, was scored at the lowest possible level across all of the games. This suggests that none of the focus groups believed that the games were likely to result in social support for diabetics.

The aggregate scores of other elements also suggest other areas in which the games were perceived as being nearly uniformly weak. Element 6, which is about how well the game rewards the practice of self-management skills, scored a one in each case save for that of the three that was assigned to *Equalize: Dependency*. Likewise, element 7, which is



about the promotion of discourse about diabetes, received a score of one in every game except for *Equalize: Dependency* where it received a score of two. Overall, the focus groups found that the games did a poor job of addressing diabetes issues (elements 1-9) as well as generally failing to balance fun and education (element 10).

The games performed better in other areas. For example, the majority of the games were found to be easy to pick up and play (element 15). However, once the focus groups were playing, there were severe problems with gameplay elements. For example, element 19, which is about the game's challenge, was scored mostly with ones and element 16, which is about feedback, received mostly scores of one. Elements 18 (progression), 20 (character design), and 21 (choice given to players), were similarly scored with the majority of the games receiving poor marks. The games were almost uniformly not found to reach at all into the real world (element 23) and were overwhelmingly found to lack replayability (element 24).

## **FINDINGS FROM THE FOCUS GROUPS**

The template serves as an evaluative instrument that embodies the arguments of the existing literature. By this I mean to say that I expect that the scholars whose work informs the template would generally agree that the template represents a complete accounting of the important issues. Through the focus groups, the template elicited discussions and produced responses that tell us something about the quality of existing diabetes games. However, as the empirical findings chapter details, when game designers actually utilized the template in a focus group, they quickly noticed embedded assumptions that oversimplify, or distort, concepts with which they are deeply familiar. Just as there are many types of games, there are many different approaches to design. None of the game

designers that used the template agreed with the entirety of the template. However, here again the template serves a useful purpose: that of making visible the assumptions and tensions between the arguments of the literature and the practices of a design community.

## **I. Foundations**

### ***Feedback***

Both of the games examined by the first focus group had serious problems with feedback. In the cases of both *Diabetes Dash* and *Ketones Attack*, the group struggled to understand both what was happening in the game world and what effect their decisions were having. Although *Ketones Attack* gave the group more trouble than *Diabetes Dash*, both games received the lowest possible rating on the template question, “How well does the game provide players with appropriate feedback.” This is a critical issue, as games must provide players with effective feedback in order to function. Towards the end of the first focus group’s discussion, John argued that feedback was one of the three most important foundations of a game, along with clarity and playability.

The issue of feedback also brings us to another important point regarding the template. As it was constructed at the time the focus groups were conducted, the template assumed that there was no hierarchy between the questions. This is to say that no question was presented as being more important than any other. However, information provided by the designers over the course of the focus group sessions suggests that this approach is incorrect.

It appears that some of the questions asked by the template cannot really be addressed unless certain prerequisites are met. When discussing the sufficiency of *Ketone Attack*’s challenges, William argued that he couldn’t really answer that question, stating that:

It sounds like it's like this is also like the game has to be like here, feedback and clear goals understand all that and be playable for you to be able to get to this part. It's like all this stuff has to be here before you are like, was it challenging properly? It's like it needs to be like playable and understandable first before we can even have a challenge.

In so doing, he argues that there are important pieces missing that must be there before higher level concerns, such as the balance of challenge, can be addressed. In other words, the game's performance must meet some base level of quality that renders it functional enough to permit deeper inquiries.

The second focus group found that *The Diabetic Dog Game* had severe problems with feedback. Clarence described the feedback as "terrible," and the group agreed that the game provided no clear indication of the effect of the player's decisions. The participants were so frustrated that they wondered whether or not the game was deliberately designed to be opaque. When attempting to apply the template's questions to *The Diabetic Dog Game*, Arnold remarked that, "It may be just for this specific game, but I feel like a lot of these questions are based on the assumption, that the game is successfully and clearly providing feedback. If that's not true, about 50% of these questions are not applicable." He further explained that:

It's super important and it's not ... it is taken for granted a lot in design, like this isn't the only game that has feedback problems. They're very bad here, and they're things that take a long time, but I think it's hard to evaluate ... these are very ... in a lot of ways a lot of these feel like very second order, like higher order concerns that are just not ... if you're not satisfying a really basic thing of, is your simulation providing adequate feedback?

Here, Arnold explicitly argues that the questions in the template should properly be conceived of as belonging to a hierarchy. Specifically, fundamental questions about basic functionality must be satisfied before the "second order" concerns, such as challenge or narrative can be assessed. Terry immediately agreed with Arnold's argument, likening the necessity of good feedback to the importance of being fed and sheltered in a "hierarchy of

needs.” Clarence also agreed with Arnold’s assessment, concluding that *The Diabetic Dog Game* “failed at a much lower level” than one that would involve issues such as challenge, progression, and questions about game mechanics. Terry concurred, arguing that “you can’t build that on top of nothing.” Arnold describes the sum result of these failures, stating that, “if there is no clarity, if there is no feedback and no consequences, it’s not a game. It’s a black box thing and it can’t teach.” From these remarks, it is clear that the designers in the second focus group found that *The Diabetic Dog Game*’s persuasive and educational aspirations were stymied by critical, foundational failures.

*Equalize: Dependency* fared better with the second focus group than *The Diabetic Dog Game* but was not without problems. In particular, the group praised the implementation of the blood glucose meter. Clarence described the blood glucose meter as the “best thing about this game,” and the rest of the focus group agreed. However, Ken, Clarence, and Terry all had trouble making sense of some of the game’s other mechanics. While Terry liked the blood sugar meter, he explained that, “it took me two and a half levels to figure out all of the things that were actually making it go up and down.” Arnold remarked that the game should have been clearer about sources of sugar, explaining that to him, an apple is not as blatantly obvious a sugar source as a big piece of candy. Responding to this, Terry remarked that, “I don’t think the game actually clarified the difference between eating apples and Chinese food and pizza.” This confusion indicates that this game did not provide the player with enough feedback to allow them to make decisions about which types of foods to eat and which types of foods to avoid. Where it is unable to do this, its persuasive message is diluted.

*Tina the Cat*’s dearth of feedback frustrated the third focus group. Because the character of Tina was only depicted as a static image, the group had difficulty

understanding what effects, if any, their actions caused. During the evaluation phase, Patrick remarked that:

Except the problem with the game is that there's no feedback for, like you're trying to do things, but you have no sense of like what is a full day, if you're exercising, how does that affect the cat and how many times can you do it. There's no stamina for the cat [meaning there is no feedback demonstrating the cat's ability to continue to exercise], so it's really hard to get a sense of really like managing things. You don't really know what you're managing, except the meter at the top, which was just going up and down.

Later, when evaluating the game's ability to communicate what was happening in the game's world to the player, Clark remarked that that he would rate it "a big one" out of four. The group agreed with his assessment. While Bruce argued that the game was easy to play, Patrick disagreed and argued that, "There's a lot of confusion on how you play the game too, so it's not like if you picked it up to play, you don't have a narrative, you don't know what your real goals are, or the feedback you give them so I don't think anything makes it (easy to play)." Wallace took a position in between those taken by Bruce and Patrick, explaining that, "We didn't have difficulty with the controls or anything. I just didn't know the rules most of the time. There wasn't enough feedback." Wallace also indicated that he was confused by the star-rating on the food items available to give to Tina. Ultimately, Wallace and Clark indicated that they never understood what the stars were intended to mean. Like the other focus groups, the third focus group identified feedback and clarity as being crucial elements. Clark described feedback as being, "Maybe the most important" aspect of a game. He explained that proper feedback is necessary to prevent player frustration.

### ***The Balance of Fun and Education***

The template question, “How well does the game balance fun and education,” proved problematic with the first focus group. They initially interpreted *Diabetes Dash*’s performance as good in this instance, as Sara explains:

I mean I think it actually balances some quite well. It just doesn’t ... If you took what they are at right now and then amped all of them up. Because the education is like, oh the game play and the education actually go together quite well. It’s just that it wasn’t terribly fun or terribly educational. If you crank them both up at the same rate, actually the balance is quite good.

John agrees with Sara, stating that, “It’s the right idea. They are not skewing hard. They are not skewing hard fun and they are not skewing educational, but they didn’t do a great job with that.” In this context, skewing refers to the purposing of the design decisions towards a specific end. He further explains, however that, “I feel the spirit of this question is that the cost of entry is that it’s at least fun or at least educational.” I interjected, explaining that the question was “derived from some material and literature that basically says you will not achieve educational or persuasive goals unless your game is fun.” With this information, the group decided on a rating of two (poor) for this question.

When evaluating *The Diabetic Dog Game*, the second focus group had a similar observation to the first focus group. Specifically, the second group found that fun and education were balanced because both were absent. I clarified that if the game was not educational, it should receive a poor mark. The group assigned the lowest possible score for this question. Ken explained that, “It could have been fun and it could have been educational, but it wasn’t really either.”

The third focus group had little trouble deciding that the balance between fun and education in *Tina the Cat* was broken. Like Sara from the first group, Clark noticed that the way the template asked the question about the balance between fun and education could

be interpreted as meaning that the need for balance was satisfied where both aspects are poor. However, he dismissed this interpretation, stating that, “I’m assuming there’s no trick questions on this.” Bruce argued that *Tina the Cat* did not have a “good balance of fun” and Clark agreed with him.

*Coco’s Cove* was found to have a poor balance of fun and education by the third focus group. Unlike the other games about diabetes, *Coco’s Cove* was problematic because it was fun but was not educational. Wallace explained that, “I feel like it’s fun, but it’s not that educational.” Patrick agreed, describing the game as “somewhat interesting and fun to play” but explained that the only thing he learned was “doughnuts can make a monkey turn red.” Bruce expressed a similar opinion, stating that, “I think it was on the right track in terms of fun. To be educational, I thought the educational message just needed a bit more.”

### ***The Practice of Diabetes Self-Management Skills***

One of the most important things that the diabetes management literature explains that digital games offer is the ability to practice self-management skills in a simulated environment. In other words, the actions and decisions that the player makes in the game should contribute to his or her ability to effectively perform those actions in the real world. This is not to say that everything a game allows a player to do must map directly back to practical skills. Rather, the argument is that some actions the player performs should facilitate an improvement in the player’s ability to perform some aspect of self-management.

When evaluating how well *Diabetes Dash* allowed players to practice skills related to diabetes management, Sara remarked that:

It doesn't have to be all encompassing right, though like I think they are like no, like the things that we are learning were solid skills. It's not like this is how you

handle your diabetes, I don't think he was even trying to do that, like it's like this is all you need to know for diabetes ...

John responded, "I mean the abstraction is so strong though that ... Again it's like so boom you are diabetic, do you know what to do?" Here, he is arguing that the abstraction of the game world in *Diabetes Dash* was so strong that it divorced the player from the reality of living with diabetes. The term abstraction is used to refer to the designer's representation of a real-world concept within the confines of the simulation. Immediately after John spoke, William made an important observation, stating that, "Right, it's like you couldn't sit somebody down in front of this and be like okay play this game so you can practice, it's like that's not all." Here, William indicates that pieces of information with great relevance to skill development are absent. John further identifies this point, stating that:

I mean like kind of the question is like again like if you were a diabetic would you now know what to do. I feel like this game gives you the basic idea and you are like, okay I get the basic idea but now in practice how do I do this and do that and check for this, and make sure how long it passes between this and that. When do I give myself insulin, how do I give myself insulin, like there is a lot of little level stuff kind of missing.

Here, John argues that the "little level" pieces of information that are missing from the simulation prevent a full understanding of how to actually perform self-management. From these discussions, it is clear that the first focus group believes they learned about something about basic diabetes management concepts, but have almost no idea how to actually employ those concepts.

The second focus group felt strongly that *The Diabetic Dog Game* did not allow them to confidently practice diabetes management skills. Indeed, the lack of effective in-game feedback undermined the second group's attempts to understand how to manage diabetes. Arnold explains that,

It wasn't clear if anything that we were doing ... the feedback wasn't clear enough, to be able to ... if we're testing the knowledge that we brought in from



life or gleaned from the manual, we tried to put that into practice and got no feedback about whether or not that was the right thing to do or not.

Here, Arnold argues that while the group was provided with basic information about diabetes by the manual, the lack of effective feedback left the group uncertain about how to utilize that information. Because the group did not understand whether they were taking either positive or negative actions, it cannot be said that *The Diabetic Dog Game* effectively allowed them to develop and practice self-management skills.

When evaluating *Equalize: Dependency*, the group found that while some of the actions available to the player allowed them to practice self-management skills, other actions required by the game distracted from that objective. Clarence explained that while “jumping for rings” was not related to diabetes management, constantly monitoring the blood sugar level feedback certainly was. Terry agreed with Clarence, and Arnold explained that the game was “compressing it down into something that’s a little more exciting, and reflex based and I think it’s ... it basically functions that way.” Ken argued that diabetes management actions included taking insulin and watching what you eat and that, “Those are the only things that really matter. There’s a bunch of other actions that are... have nothing to do with diabetic management directly, but it does serve to make the game work as like this weird metaphor.” Arnold disagreed with Ken, arguing that the “lock and key and switch puzzles” present in the game, and familiar to the platformer game genre, are “completely unrelated.” Clarence agrees with Arnold, stating that, “Walking, jumping, all of that was useless.” Finally, Terry argues that the presence of the non-diabetes related game mechanics crowded the game and frustrated his ability to focus on diabetes management actions. The group then agreed that *Equalize: Dependency* ultimately did a poor job of allowing them to practice diabetes management skills.

The third focus group found that *Coco's Cove* did nothing to facilitate the practice of diabetes management skills. The participants unanimously agreed on the lowest score possible for this question. Clark explained that if the game depicted some consequence, other than obtaining points for collecting the right food in the lowest amount of throws, some element of self-management might be reinforced. Patrick agreed, and argued that if the game had some sort of depiction of a blood sugar meter or consequences for eating too many doughnuts it might be able to help people practice skills. He further argued that,

It would be very cool if you had a meter and if it started to map with it low and then you actually need the doughnut and then you get the food, so you have to like, and maybe there's even insulin things, you have to give him a thing so you have to shoot up to the insulin and get that. Actually try to manage the stuff.

Clark concurred with Patrick, stating that, "It's not going to teach them." Bruce further agreed, explaining that, "Yeah, the only choice was which foods were considered healthy, that doesn't feel particularly relevant to me in terms of diabetes management, it just seems like a health thing."

### ***Teaching Diabetes Knowledge***

Rather than include information about diabetes and self-management in the gameplay, both *Diabetes Dash* and *Ketones Attack* included educational content only in a dense, text-heavy instruction page that could be accessed during gameplay. The first focus group had a very negative reaction to this approach.

When discussing the template question of how well *Diabetes Dash* taught basic diabetes knowledge, William remarked that:

I mean the instructions seem to show something, but they were pretty like dense and not very good at teaching or sort of like here's some stuff. I think it must have taught something or some kind of balance between taking stuff there, it's like what is basic diabetes knowledge? Like now I'm going to have to survive with like basic stuff.

Sara responded to William's comment, noting that:

There are two ways that this game could have taught us something. It could have either just set it on the instructions which the instructions weren't clear and were boring to read, and their typographies kind of ehh right. Then there's other aspect here which is like learning by inference from the game play. We had to try it a lot. Our inferences were not ... It was not obvious like when you eat a candy bar it does this.

From these comments, we understand that William feels like he learned something from reading the instructions, but isn't sure what he learned. Sara, in response, points out that *Diabetes Dash* had two opportunities to teach basic diabetes knowledge: through instructions and through gameplay. She further notes that the game failed on both counts. John agreed with Sara's assessment, arguing that, "Even now it's like we know how to play the game probably. We think we are pretty good at playing it, but that doesn't necessarily mean we know how that is intended to back, back to reality." In this statement, John makes it clear that although the group may have learned how to effectively play *Diabetes Dash*, they do not, as a result of learning to play that game, understand how the strategies they learned in the game map back to real-life behaviors. This suggests that one important way that a diabetes self-management game can fail is where it teaches an individual nothing more than how to succeed in an abstract game world.

The second focus group encountered the same kind of problem when attempting to play *The Diabetic Dog Game*. While the group was playing *The Diabetic Dog Game* and expressing confusion as to how the game's mechanics worked, Clarence stated that it was clear that, "we don't understand the effects of insulin." Arnold stepped in to clarify the function of insulin, explaining that, "Insulin is what diabetics cannot manufacture naturally in their body, and it's the thing that helps them get the sugar out of their bloodstream and into their metabolism." This answer satisfied Clarence and led to a brief discussion amongst all of the participants about the role of blood sugar, insulin, and food. Shortly into

the discussion Terry interjected that, “It’s worth noting that none of that came from the game.” The group then agreed that although there was some information about how diabetes works in the game’s manual, the in-game teaching was absent.

In *Equalize: Dependency*, information about diabetes is presented to the player in the form of floating text in the game’s background. The second focus group reacted negatively to this design decision. While Arnold reacted favorably to the delivery of information in a measured, one-bit-at-a-time fashion, Terry remarked that the information was only presented “on the wall as you ran by trying to do other things,” and that “there was no space for me to actually absorb any of the information. He further described the game’s obstacles (thugs), as implemented, as a distracting element, stating that, “When I’m playing a game I’m dealing with what’s in front of me. You could send all the text that you want, but I see a dude with a gun and I’m like, ‘I’m this first.’” Arnold and Clarence agreed. Thus, the group argued that, while gradually presenting information about diabetes in the game’s is not a bad idea, it must be done in a way that allows the player time to read and consider it. Where the information is present along with all of the game’s other elements and actors, the space becomes too crowded and learning is frustrated.

Reflecting on the birds-eye perspective automobile driving stages of the *Equalize: Dependency*, Terry explained that,

They’re trying to talk about the effects of this feeling while you’re driving, except that the way they do that is by immediately putting you in the middle of the situation, where you’re trying to do that which makes it way harder to actually absorb, the little information that they’re trying to convey.

Arnold agreed with Terry, and argued that the game should “go one step further and just have the intrinsic relationships. You discover and understand in a more implicit way, rather than someone just shouting at you.”

The third focus group mostly agreed that *Tina the Cat* did a poor job of teaching basic diabetes knowledge. Bruce explained that “I think in terms of basic principles, I got the idea. The insulin shots will lower. Exercise will also lower the glucose level and food will increase your glucose level. I felt like we understood that we needed to keep it between 60 and 150.” Patrick, however, disagreed, arguing that, “No, that wasn't very explicit, I mean it should have actually had some kind of feedback for that, which the normal levels in the game, so it has a meter but we should have actually given better feedback for that.” Wallace described his takeaway from *Tina the Cat* as being, “If I didn't know anything about diabetes and I played this game, I'd probably be like, okay, you need glucose or something and make sure you don't eat a lot, but it's not like I understand completely.” Patrick jokingly replied that, “You don't feel like you could take care of a diabetic patient after you play this game?” Ultimately, the group evaluated the game's ability to teach basic diabetes knowledge as being poor.

The third focus group also found that *Coco's Cove* did a very poor job of teaching basic diabetes knowledge. The participants were unaware that the game was about diabetes until this author provided them with the game's advertising copy. The consensus was that the game, despite the claims of the advertising copy, didn't actually have anything to with diabetes. Patrick explained that, if he hadn't seen the copy, which indicates that Coco herself is diabetic, “I could have thought, oh, monkeys maybe eating doughnuts would kill them and they shouldn't eat them.” Bruce agreed, adding that, “Even knowing stuff about diabetes, if I played this game and hadn't heard anything about it, I'd just immediately say it's about picking healthy foods and that would be it.” Clark explained that although he, “could see kids playing this on a road trip in the back seat of a car and enjoying it well enough,” the children would “absolutely not learn anything about diabetes.”

## II. Game Design Issues

### *Themes and Mechanics*

The first focus group, while discussing the question of how well the game *Diabetes Dash* rewarded players for practicing diabetes self-management skills, struck upon a discrepancy. By reading into the argument embedded in the design of the game's mechanics, the participants found that the message expressed by the functional structure of the game was directly at odds with the cheerful, positive message expressed by the game's aesthetics. In the context of games, mechanics refers to the underlying set of rules that dictate what actions and consequences are possible, as well as the relationship between the various actors in the simulation. The group discussed the game's failure to provide the player with any meaningful reward for a good performance, save for allowing them to continue playing. It was also noted that the game included no contextual information as to how a good performance in the game allowed the characters to lead healthy lives. As a result, Tim indicated that the game's design most closely resembled that of a game in the horror genre. He stated that:

I feel also like there wasn't really a reward that came, there was like a neutral state, and then you can only get worse. Which is maybe like depressingly realistic but like ... Yeah there is no like your ... It's not like you are doing well so you are winning. It was just like there is more like a survival horror game where it's like you are doing well so it's not game over.

Because there was no reward provided to the players save for the opportunity to continue playing a game that increases in difficulty until reaching a failure state, the argument embedded in the design is that no matter how well an individual performs they will eventually succumb to their disease.

When asked why he considered *Diabetes Dash* a horror game, Tim explained that it was because "There is no limit" and that:

Oh so for me it's because it's like, it's kind of dealing with the banality of micro-management of like you are always running out of your personal resources, like in a survival horror game. There is always like on the verge of running out of your HP bar, scavenging for an HP like a med kit or whatever in the game. It's kind of the same system here, it's like you are always managing your glucose level and all you can do is try and get by, for example. There is no like I'm trying to win.

In a horror game, a player does not hope to overcome an adversary but rather endeavors to endure a terrible situation. The “HP” Tim refers to is a term for “health points” or “hit points.” Many games use HP as a measure of a character’s physical well-being. When HP is depleted, the game is typically over. The argument that *Diabetes Dash* then implicitly makes is not one where effective management of diabetes leads to a high quality life but rather that the best diabetics can hope for is to struggle to hold on for as long as they can before they eventually succumb. By comparing a critical reading of the design of *Diabetes Dash* to the design patterns used in similar games, Tim is able to both stabilize his assessment of the game artifact in a way that the other expert participants understand as well as peel away the aesthetic layers of the game to assess how closely the game’s mechanics actually link with its themes.

John agreed, explaining that *Diabetes Dash* “has a lot of headroom to explain why you would want to perform this management.” He further explained that this problem could be ameliorated by adding narrative scaffolding that illustrates the benefits of effective self-management, stating that, “Even after one level you’ll see the like the girl’s learning the skateboard, and the next one it’s like it’s your friend’s birthday party, it’s like you get to keep on living. It’s actually a reward, I’m into it.” Collectively, the group scored the game’s implementation of rewards for successful self-management with the lowest possible rating they could.

Given the diabetes management literature’s emphasis on the critical role that self-efficacy plays in the effective management of the disease, it is clear that futility is not a

message that a game should be sending. Implicit messages about inevitability or steadily increasing challenge that tests, and eventually overcomes, a player's skill take on a different character where they are present in games about health management.

This problem partially arises from the borrowing of mechanical structures of games that were not intended to be persuasive. For example, within moments of playing *Ketones Attack*, Sara remarked that, "Oh its *Asteroids*, yeah. It is literally *Asteroids*." John immediately agreed with her analysis. After the underlying game design was identified, much of the discussion of *Ketones Attack* was framed in relation to *Asteroids*.

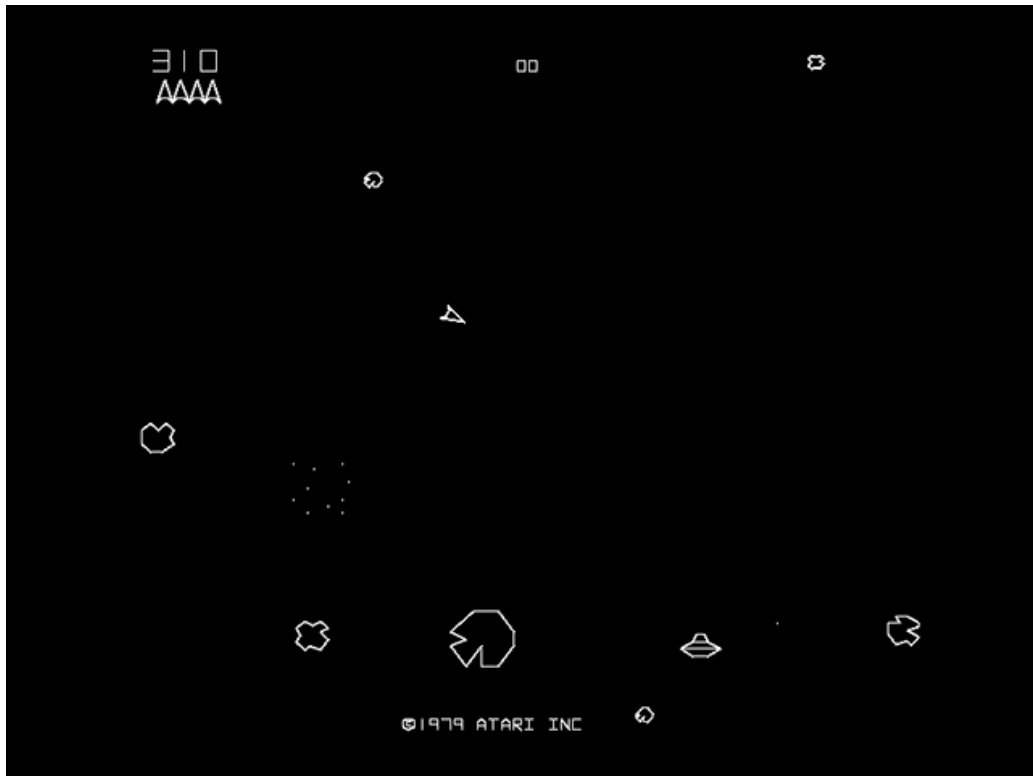


Illustration 20: *Asteroids* Gameplay

The participants attempted to map their understanding of diabetes with their understanding of the mechanics of *Asteroids*, and were perplexed. For example, when trying to understand the role of insulin in *Ketones Attack*, John remarks that, "Yeah, insulin is just good in this



game, it has no negative sides.” William replied, stating that, “It’s just... insulin is ammo, get it.” He then remarked that it was interesting to play *Diabetes Dash* and *Ketones Attack* back to back, noting that despite their extremely similar aesthetics, the two games portrayed the function of insulin completely differently. In *Diabetes Dash*, insulin is necessary when the glucometer is at a certain level, but can otherwise prove detrimental. Conversely, *Ketones Attack* treats insulin as a fundamental resource that should be collected and used whenever possible. In *Ketones Attack*, insulin simply replenishes the player’s stockpile of ammunition—a resource necessary to allow them to destroy the sugar cubes that float through the game’s environment. The ammunition resource mechanic was not present in *Asteroids*, which provided the player with an unlimited ability to fire the starship’s weapon. The mapping of what insulin does in the real world to what insulin does in the game world is broken in favor of shoehorning a preexisting game design into a superficially diabetes-centric concept. Such problems frustrate a game’s ability to teach basic diabetes knowledge. Ultimately, after playing *Ketones Attack*, Sara remarked that, “I somehow learned less about diabetes.” Similarly, Tim reported that he didn’t “learn a single thing from playing the game.”

### ***Peer Support***

The third focus group argued that *Tina the Cat* felt isolating and did not engender peer support. Bruce explained that, “It didn’t feel like it involved anyone else,” and that, “I don’t feel like it let anyone else in.” Clark agreed with Bruce and Patrick argued that, “Seems like it would have a message board or something built in or something there you could share with other people that have the same game, but there’s nothing more.” Bruce agreed with Patrick’s assessment, and added that:

Yeah, or even like, if there was something else to say, have Timmy do the insulin for you or something. It just seemed like something that you, I don't know. I guess

it might be two different things, but in generally it didn't seem to promote too much external support.

Here Bruce argues that the inclusion of another character, in this instance a human named “Timmy,” would decrease the sense of isolation and provide the player with a model for external peer support. This argument is similar to that advanced by John in his evaluation of *Diabetes Dash*. Specifically, it is related to his statement that the game could have depicted positive social outcomes as both a reward for and explanation of the importance of diabetes management. As it stands, *Diabetes Dash*, *Tina the Cat*, *Coco's Cove*, *Ketones Attack*, and *The Diabetic Dog Game* do not depict any human social interaction and social support.

### **Choice**

When responding to the template question, “How much choice are the players given?” John immediately indicated a score of one, to which William responded, “They are given the choice to die.” This is indicative of a salient design critique which reveals something important about the ways that the designers of both *Diabetes Dash* and *Ketones Attack* operationalize game mechanics. In these games, the players are really only given the illusion of choice. The reality is that the players either comply with the behaviors the game prescribes, or they fail.

When discussing the nature of the choice given to the player in *Diabetes Dash*, Sara observes that, “You have a lot of choices, but most of them will kill you. It seems like that's not really a good choice is it?” She further argues that:

There is no way you can play it against the grain. You cannot like in *Animal Crossing* or you can just decide I'm not going to do any favors for anybody, I'm just going to make a garden or in *Skate 3* where which is what I did. I'm just going to like record glitch videos, and I'm not going to act like well I did beat the game, but like I'm not going to play the game the right way until I have had all of my fun making glitch videos and like moving camera around. That this does not have any of that, it's like pretty much you can make the right the choice that there is

definitely a path that the game maker wants you to take, which is eat the healthy foods, they say that straight up. If you don't eat them you will die and you will not be able to play the game anymore.

*Animal Crossing* is a game in which the player is deposited in a town of friendly anthropomorphic animals, provided with a house, and left to their own devices. Players can choose to interact with their neighbors, grow crops, take on jobs to earn money, decorate their home, or simply wander around aimlessly. *Skate 3* is a 3D physics-driven skateboarding simulation which affords the player the opportunity to design his or her own skateboarding park. In *Skate 3*, players are free to move about the environment and interact with the objects it contains in a very open fashion, gliding from spot to spot while performing skateboard moves. In a sense, it is akin to a dance. In the quotation above, Sara is expressing how much of the enjoyment she derived from her experiences with *Animal Crossing* and *Skate 3* came from the game's ability to afford her a high degree of creativity and freedom. She also notes that *Diabetes Dash* provides the opposite type of experience, one born of obedience rather than expression. Both Tim and John agree with Sara's criticism, with John stating that, "Yeah we had to learn to obey so that we could continue playing the game. This is the philosophy here." One could imagine, however, that a player might play against the grain by trying to lose as quickly as possible, thereby teasing out the parameters of the game's systems. Even so, it bears noting that the systems of *Diabetes Dash* provide the player with only a small degree of freedom.

The first focus group found that the narrow possibility space of obey or fail expressed a lack of empathy towards diabetics. Sara remarked that, "I mean presumably the player is a diabetic right, but like one thing that strikes me is like, oh you did it bad. Like you did your diabetes bad, and now you lost." She further stated that:

It's that kind of like the thing I was just getting at where it's like you did your own health bad and now you should feel bad that you couldn't get insulin in time, which often is like not within your control, right? You are in school or whatever

you get detention, you can't get your insulin, I mean hopefully the school wouldn't like keep you in detention if you needed insulin desperately. Shit happens and like it's often out of your control, this makes it feel kind of like, oh you just didn't run fast enough or you just didn't catch the right things at the right time, I don't know.

In this instance, Sara is reading into the game's design and comparing it to what she imagines is the actual lived experience of a diabetic youth. William agreed, stating that "It doesn't contextualize really anything." Tim also agreed, stating that, "There wasn't really a moment where I felt like I was trying to reach out on an empathetic level..." The argument that the focus group makes then, is that by ignoring many elements that contextualize a diabetic's struggle and presenting a simplified abstraction that simply punishes the player for "doing their diabetes wrong" the game misses out on opportunities to demonstrate empathy.

This issue also presented itself in the second focus group's discussion of *The Diabetic Dog Game*. When discussing the degree of choice that *The Diabetic Dog Game* provides players, members of the second focus group came to the same conclusion about choice that the first focus group did—that what appears to be a choice is really no choice at all. Discussing whether or not he would really choose to do what is clearly the wrong thing, Terry remarked that:

The effectiveness of those choices in getting players to think about any kind of trade off, like I can choose to do a thing but I am going to choose to do that thing always, and every situation regardless. Right, so it really isn't ... it looks like a choice but it isn't a choice.

Arnold immediately agreed with Terry's assessment, describing the choice given to the players as a fork in the road where one side clearly leads only to a pit of spikes. The group then agreed that this was not a desirable design.

The third focus group was similarly frustrated by the lack of real choice in *Tina the Cat*. Clark explained that:

It's like the classic RPG [Role-Playing Game] where they ask you a question, answer yes or no and it doesn't matter. Really the choices are irrelevant, and really makes you more frustrated than if there was just was no choice given and it just took you to where it wanted to take you.

Here, Clark likens the player's journey through *Tina the Cat*, to primitive role-playing games in which it is blatantly obvious that the player's decisions have no effect on the outcome of the game. He argues that it would be better to remove the illusion of choice than it is to ask the player to make a frustrating series of inconsequential choices. Wallace agreed, explaining that while at first glance it might appear that *Tina the Cat* is full of choices and places to interact, the reality is that a simple game with one button that can be used at different times with different consequences has greater depth. Specifically, he stated that,

Something like *Canabalt*, you can only jump, but you can jump whenever you want and you have a lot of choice of when you jump and how many times you jump. Even though it's just one button, you feel like you have much more choice than the game with the cat, you have 20 things.



Illustration 21: *Canabalt* Gameplay

Here Wallace argues that choice flows from mechanical complexity—that the player’s decisions are mediated by a game’s systems to produce a variety of results. For example, the decision to jump may result in a variety of outcomes that are determined dynamically by the rules of the game. Bruce disagreed slightly, arguing that the key issue in choice is presentation. He explained that,

I think it's all on how it's presented to you in reaction to what you do. Something like *Mass Effect*, a lot of the choices you make don't actually affect anything, but you feel like they do, which is because it continues the narrative and you just feel like you're having a conversation and you're talking about interesting stuff and you know that maybe one day they can scrape that data to make it do something interesting, so I think it has to be how you feel about, how the game makes you feel about the choices that you've made. The cat one, just immediately you knew the choices wouldn't have any future consequence. It didn't react to us in a way that was meaningful.



Illustration 22: *Mass Effect* Gameplay

*Mass Effect* is a high-budget science fiction role playing game that allows a player to tailor, through conversation, decisions that affect small-scale details of the game, such as who the main character romances. Larger details, such as the overarching plot structure, are common from player to player. Practically, this means that the decisions made by the player expose them to pre-crafted content that reflects the outcome of their decisions. This content is high-quality, and includes such elements as professionally voice-acted dialogue and additional aesthetic elements. In the above statement, Bruce argues that the way in which *Mass Effect* presented choices and depicted their narrative consequence sold him on their importance. In this sense, Bruce effectively argues that he did not mind that his choices were not ultimately consequential to the game's outcome because they were presented in a fashion that he found interesting and compelling. In other words, the choices were interesting because of their accompanying trappings, not because they substantially

affected the course of the game. While the participants in the third focus group had different opinions about the importance of choice, they all agreed that *Tina the Cat* did a poor job of providing the player with interesting choices.

The third focus group found that *Coco's Cove* provided players with abundant gameplay choices. Wallace remarked that, "You can fling in different directions," to which Patrick replied, "It's infinite, like 360 degrees of choice..." Here, Wallace and Patrick are describing the manner in which the player may choose which direction to fling Coco in. Bruce agreed, stating that the game is "quite choice full." Patrick praised the inclusion of puzzle elements, such as sticky material on trees that Coco can attach to, arguing that it enriched the choices given to players. Bruce agreed, noting that the player was free to shape his or her own strategy, such as bouncing off walls versus straight shots. It is notable, however, that none of the choices revolved around the management of diabetes.

### *Characters*

The first focus group found that the characters in both of the games they reviewed are not really characters. They do not demonstrate a decision-making process and we do not see the outcomes of their health decisions. This is important because the diabetes games literature makes it clear that one of the most important ways a game can help young people understand how to manage diabetes is through modeling. These games miss out on the opportunity to show how the good or bad decisions made by the characters lead to specific results. There is also a layer of social and economic considerations that affect the management of the disease that could be leveraged to create empathy for diabetics but these elements are noticeably absent from the abstractions of these games' worlds.

William argued that the characters in *Diabetes Dash* were "poorly designed," and explained that the problem is deeper than aesthetics. Tim agreed, stating that "I feel like



they were avatars right now,” but was perplexed because the characters were given names in the game’s instructions. While the term avatar is sometimes used interchangeably in games with the term character, there is an important distinction: avatars serve as the player’s stand-in in the simulation but, unlike characters, avatars do not necessarily possess things such as a personality or behaviors. He also remarked he thought that the characters, “weren’t really meant to be like characters.” William indicated that he felt similarly. Sara, when responding to the question of whether or not the characters served as models for positive or negative behaviors, indicated that the only negative behavior demonstrated by the character was that they physically slowed down when the blood glucose level was in an unsafe state. She then asked the group whether or not the characters were “smiling all the time or did they start frowning?” John replied, “They smiled all the time.”

John reacted strongly against the presentation of characters in *Ketones Attack*, arguing that, “I thought they were inappropriate for this context, and they didn’t show well on screen and they are not very present.” The characters in *Ketones Attack* are viewed from a top-down perspective where the player only sees the tops of their heads. He also argued that the characters in *Ketones Attack* don’t at all serve as models for positive or negative behaviors and no other participant disagreed with him.

The second focus group agreed that the characters in *Equalize: Dependency* did an poor overall job of serving as models for health behavior. While they agreed that the main character demonstrated positive health behaviors, they were frustrated that all of the other human characters in the game served as mere obstacles to the main character. However, where the main character was concerned, half of the group, Terry and Arnold, agreed that the game’s depiction of the main character’s struggle to accomplish her mission whilst managing her diabetes was empathetic and humanizing. Terry and Arnold both expressed that they were able to put themselves in the main character’s shoes. Arnold even went so

far as to posit that the sugar weapons used by the game's antagonists could have been a stand-in for peer pressure. Ken, unpersuaded, argued that he felt no emotional connection to the main character and was irritated by the designer's decision to make the main character "jump around for pizza."

The third focus group struggled to identify any behaviors that were exhibited by the titular feline in *Tina the Cat*. Clark argued that no behaviors were displayed by Tina, describing the activity in the game as "user generated" and "You're the person doing the behaviors." Wallace agreed, stating that, "I didn't feel a connection to Tina at all, it's just like, we were injecting her with so much insulin but she was not reacting or anything." Bruce agreed with Wallace's assessment, noting that, "Yeah, she wasn't visibly changing." Patrick concurs and further identified the lack of behaviors on Tina's part as a feedback problem, articulating that, "You haven't had some kind of feedback for what you're doing, like purring, or hissing." Finally, Patrick described Tina as being "just a picture you're trying to do stuff with." This exchange indicates that the third focus group agreed that Tina was poorly characterized and does not serve as anything resembling a model for positive or negative health behaviors.

From these discussions we understand that the designers found the implementation of characters in the majority of the diabetes games to be wanting. If the characters were more robust, the games could have used them to do things like depicting them interacting with one another, with peers, or with family. Such interactions provide opportunities for the characters to demonstrate empathy for one another and model both positive health behaviors.

### *The Depiction of Health Consequences*

In spite of the diabetic theme of *Diabetes Dash* and *Ketones Attack*, the consequences of good or bad health behaviors are never made apparent. Rather, the only outcomes that matter remain contained within the abstractions of the game mechanics. This is to say that the link between what the player does in the game and the effect that it would have on a diabetic person is never made clear. This frustrates an understanding of diabetes and undermines persuasive elements.

When discussing the lack of feedback provided by the characters in *Diabetes Dash*, members of the focus group inferred health consequences that were not depicted by the game. William remarked that, “I thought they also effectively die. Maybe we are reading into that, but I’m seeing them as dying.” Tim followed suit, wondering if the characters instead went into a coma. This is problematic because it indicates that the group does not understand how extreme highs or lows in blood glucose would actually affect a diabetic person. This lack of understanding suggests that the game has not done a good job of providing the player with a rudimentary understanding of the effects of either hyperglycemia or hypoglycemia.

*Ketones Attack* fared even more poorly with the first focus group. John stated that, “There is no human consequence depicted at all, yeah.” Sara later remarked that, “Yeah, if you eat a lot of sugar you are going to die” and that, “Yeah, if you take your insulin you’ll be ok.” Nothing, however, in the actual world of *Ketones Attack* depicted the results of the player’s actions beyond the microscopic frame of sugar cubes floating around in a bloodstream. It does not, for example, demonstrate a person’s health improving or worsening as a result of the player’s success or failure in the game. John described the game as, “abstract,” and observed that because the game did not have “human scale

characters” it did not have “any human scale consequences.” It also noteworthy that the game assumes that children will be familiar with sugar in cube form.

*The Diabetic Dog Game* also obscures the actual health consequences of the player’s decisions. The second focus group interpreted the health consequences of poor performance as simply meaning death. In *The Diabetic Dog Game*, poor performance on the player’s part will eventually result in the game erasing the dog from an online database, which is described in the instructions as taking it away. Clarence and Arnold interpreted this as meaning the dog dies—that poor player performance results in the animal’s eventual demise. Indeed, reflecting on the gameplay experience of *The Diabetic Dog Game*, Arnold stated that, “...the game started, we read the wall of text, gained little from it, play, the dog started to die immediately and the first thing we did was open the wall of text again.” Later, Terry identified the goal of the game as being, “Don’t kill your dog.” In this sense, the focus group interpreted the game as being about the struggle to stave off the death of an animal.

The third focus group found that *Tina the Cat* completely failed to depict any health consequences related to diabetes. When trying to think of any health consequences that were indicated, Wallace remarked that, “We have an unhappy face [the screen is covered with a frowning smiley face emoticon] when we failed, so I don’t know what that means.” Patrick stated that he felt there were no real consequences. Bruce agreed, noting that “They didn’t really let us kill the cat, but that’s good.” Patrick argued that more feedback on health consequences would have been better, explaining that, “Getting an emoticon just doesn’t seem very powerful.” The group then unanimously agreed that *Tina the Cat* failed to demonstrate the consequences of health behaviors.

The third focus group also found that *Coco’s Cove* did nothing to depict the consequences of health behaviors on diabetes. Diabetes is never mentioned in the game,

and there is no indication of the effect of different foods on blood sugar levels. Furthermore, there is no depiction of regulation of blood sugar levels at all. Bruce explained that,

There wasn't any clear indication that it had anything to do with diabetes. If I had just been playing it, it would be those are healthy foods and those are unhealthy foods. I wouldn't have thought it had anything at all to do with diabetes. Generally, it was just healthy versus non.

Clark agreed with Bruce's argument, and added that, "I also felt that the key to the game was it needed elements like the other game [Tina the Cat], if you had some type of meter." Patrick further agreed, stating that, "Yeah, if they kept the thing where it showed you where you could go with the meter or whatever, but each time it could give feedback for it being lower, I would understand." Here, Patrick is referring to a feature in *Coco's Cove* where the player is initially shown a predictive trajectory for the arc that Coco will be flung in. After a couple of throws, this helpful feature is hidden and the player must rely on his or her own reasoning. By suggesting that the predictive arc be tied into some sort of blood glucose level, Patrick identifies a way that the game could have woven a kind of relationship to diabetes with Coco's in-game performance.

### ***Animals as Main Characters***

The second focus group found that the dog in *The Diabetic Dog Game* did not serve as a model for positive or negative behaviors. Terry argued that the dog "isn't really a model for anything." Reflecting on the dog's behavior, Clarence remarked that it was "just running around being a jerk." This prompted Arnold to explain that the dog is a kind of representation of the blood sugar meter, to which Terry observed, "You can't model your life around the behaviors of a dog." Given the literature's recommendation that characters serve as positive or negative models for the purposes of observational learning, a non-

human character with behaviors that do not map onto the human experience appears to be a bad design decision. Indeed, Clarence observes that the dog, “had no active participation in its own caretaking.”

The third focus group also took issue with the main (and only) character in *Tina the Cat* being an animal. While discussing the game’s goals, Bruce argued that the game should have had to deal with things other than diabetes, such as attending school and dealing with bullies. Later in the discussion, Clark explained why having a cat as the main character was problematic, stating that “anatomically animals and people can be very different from each other” and that the abstraction caused his suspension of disbelief to break. When asked to clarify this point, Clark stated that, “It feels like the value they put into the educational aspect of it, right out of the gate it’s probably very minimal, so I would take it less seriously, than if the game were truly trying to teach you about diabetes and the way it affects a person.” Here, he argues that the use of a cat as the main character indicates a lack of serious effort on the part of the game’s creators and that the lack of a human character makes him take the game, and its educational message, less seriously.

Clark also took issue with *Tina the Cat*’s decision to allow players to feed the cat food meant for humans. He remarked that, “Right away I thought it was weird that it’s a cat, but you are giving it all this human food.” Patrick and Bruce immediately agreed, and Clark followed up his comment with, “You couldn’t really have five cans of different tuna fish?” Patrick agreed, stating that “It feels weird giving a doughnut to a cat.” Bruce concurred, and noted that it was in fact a chocolate doughnut.

### ***Maintaining Player Interest***

One important problem with the design approach taken by *The Diabetic Dog Game*—that the gameplay only becomes interesting when the players have performed poorly,

was described by the second group. In *The Diabetic Dog Game*, when the player successfully performs the caretaking duties required, nothing is really happening. There are no obstacles that arise by chance, and no unforeseen circumstances. Rather, a successful performance is rewarded with no problems to solve. While this is certainly a welcome circumstance in real life, it does not make for compelling gameplay. Furthermore, it frustrates the educational intentions of the game by creating a situation where players are only going to encounter “exciting” scenarios where they have been unsuccessful in managing diabetes. Arnold explains this problem, stating that, “It’s a tricky thing because when you’re trying to...you’re trying to reward ...the reward for eating right when you have diabetes is that nothing happens. That’s what you really want to happen. However, he also observes that, “If anything exciting happens it’s because you screwed up.”

### ***Symbols and Game Worlds***

The symbol language of a game’s world functions holistically. Where there is incongruity in the degree of abstraction, the cohesion of a game’s world frays. The second focus group found such incongruity to be a substantial problem for *Equalize: Dependency*. In that game, certain objects in the game’s world clearly map back to the real world: food items such as apples and pizza and camera flash replenishing lightning bolts, which look exactly like the common symbol for a camera’s flash function. The inclusion of stand-ins for these real-world objects in a game intended to highlight the issues related to diabetic self-management made sense to the focus group but other objects, which occupied the same type of space in the game world, led to confusion. The stand-ins for real objects exist side by side with rows of glowing, floating rings that have no clear analog in the real world. These rings are collectable and factor into the player’s score at the end of a level, but they

have no impact on anything related to diabetes. Their inclusion frustrated the second focus group.

The rings are an artifact of traditional platforming game designs—something of a game design trope. However, their inclusion in this game dilutes the game’s persuasive content. Reflecting on the floating rings, Ken remarked that, “It scores you for how many pickups you’ve collected during the level. That wasn’t really the point.” Terry agreed, stating that while objects like the food items were related to diabetes, the glowing rings were not. Ken agreed, stating that, “That has nothing to do with diabetes.” Terry further reflected on elements of the game’s world, including the puzzle mechanics commonly associated with the platformer genre, and stated that he doesn’t normally have a problem with those types of mechanics but the fact that they were “happening in the exact same space as the actual diabetes management thing” hinders his ability to “parse what is actual diabetes management. He further stated that, “I don’t mind something entertaining that facilitates my learning” but suggests that the presence of the non-diabetes related elements leads to “cross contamination” that is “detrimental to my ability to take new information in.”

The third focus group was largely pleased with the game world presented in *Coco’s Cove*. They found that the aesthetics were appropriate for a children’s game and that the symbol language of the game was largely straightforward. Bruce remarked that, “I thought it was clear,” and that “there was all this floating fruit that you have to collect and I thought it was clear.” Patrick concurred, and explained that, “You had that sticky stuff and you knew what was bad, it was pretty easy to figure out.” The only thing that confused the focus group was the design decision to make Coco turn red when she collects junk food. This was confusing for two reasons. Firstly, in the common symbolic language of games, turning red usually indicates that a character is supercharged and may perform some kind



of special action. Secondly, turning red after eating a sugary item did not map back to reality in a way that made sense to the participants.

### **III. Issues with the Template Overall**

#### *Design Perspectives*

The first focus group found the design template to be problematically reductive. John remarked that he respected the questions asked by the template, but that he didn't "always like how they (the template) are asking the questions. Because it's not getting under the hood of game design very clearly or often or well, but I think this is where the rubber hits the road, so in that sense I respected it."

Sara objected to the assumptions in the template on the grounds that they represented a design perspective she does not agree with. She stated that, "This is a formalist; this is a list of formalist game design principles. You probably know that I'm very anti-formalist, I'm not like 'what a bunch of crap' because I understand the value of formalist questions, but I also I'm very weary of the problems associated with formalism and the serious games folks are all formalist as far as I know." She further explained her position, arguing that "They (formalists) would say something like 'well this isn't a game,' in a way, and my criticism is like gate keeping of like well 'this isn't a game, it's an interactive fiction.' Therefore I'm not going to study it and I'm not going to put it in the MOMA [Metropolitan Museum of Modern Art.]" She further explained that:

Yeah like the idea of even things like characters and challenge, but make some sort of assumptions about the game, like this would probably not work for a twine [a framework for making interactive text games] game. Like it might but it might not, and so formalism has like a certain ... There is a certain gate. That gate and it's fine to have gates and batteries [meaning fortifications], but that gate often leaves out marginalized creators, and so that's where I take issue with it it's like marginalized people who are intentionally working outside that framework. Then it's like, 'wow oh sorry like queer people of color,' but you are not making real

games, you are making some other bullshit that's not my problem. That's the problem I have with this list [the template questions] as a whole, and for me like I would love to see like social questions and reader response theory and things that are like once I have formalism like what happens to this game when it's in the world, and aside from what the game designer was trying to enact with the mechanics.

In expressing these views, Sara argues that the spectrum of games (and indeed, the viewpoints that inform the design of games) are unnecessarily defined and restricted by a set of assumptions about what counts as a “game.” She expands on her argument, stating that:

I would agree with that and I think there is value and I'm kind of joking with saying I'm anti- formalist. I totally understand the value in questions like these in formalism, but I guess I'm just pushing back in a way that I tend to push back on games such as that. To me it feels like some people get to design what a game is and it needs to have challenges and characters and what end social networking features. Like just the creation of these questions is a reflection of the people who are deciding what games are and ...

Here, Sara indicates that she recognizes value in the questions raised by the template, but does not believe that they are necessarily the “right” and certainly not the only questions that one might ask of a serious game’s design. This argument suggests that the space of game design is broader than what is present in the diabetes management game literature. Sara considers the case of a game she created, which was designed to challenge formalist concepts of game design, and concludes that assumptions that the template makes, such as the importance of being re-playable, would not apply to her work. However, the diabetes game literature indicates that re-playability is important for health games because it increases the player’s exposure to skill-building activities and persuasive content. That said, Sara’s response makes a very important point as it suggests that the template has waved away design approaches that could prove to be useful.

John shares Sara's disdain for the prescriptive aspects of the assumptions made by the template. Reflecting on whether or not a diabetes game needs high scores across the entirety of the template John explains that,

I think that a really excellent game for educating kids about diabetes has a lot of 2 answers. Because it's like you don't need to make *Skyrim* in the diabetes game, and you get 4s and everything, just so we get an excellent piece of software that can successfully accomplish the goal.

Here, John argues that an effective game might not possess, or excel at, all of the elements listed by the template. He compares a perfect score of four on all of the questions to *Skyrim*. *Skyrim* is an expansive, customizable, deep, and graphically intensive open-world role-playing game in which the player creates a character and is then free to roam the game as they please. It is the video game equivalent of a summer blockbuster. By invoking *Skyrim*, John argues that a game doesn't have to try to be everything. Reflecting on scores he assigned to template questions, John states that, "When I was giving it 2 I was like, yeah sometimes it's like yeah, your feedback really got to be better, you are just not succeeding in your goals. Other times I was like, I never wanted a 2 in narrative, but I'm really glad it didn't have a narrative." Here, he specifically objects to the template's mandate that games have compelling narratives. This suggests that there is a tension between the understandings held by expert game designers and the demands of the template. As with Sara's comments above, John's objections to the template, such as his rejection of the necessity of narrative, conflict with the beliefs held by the diabetes game literature. However, one can imagine games that did not have characters or narratives but that allowed users to practice some fundamental aspect of diabetes self-management such as numeracy for carbohydrate counting. Such a game would be valuable, even though it might not address the totality of diabetes self-management.

Patrick, in the third focus group, argued that *Tina the Cat* could have benefited from a narrative. Patrick explained that a narrative that included activities such as discovering and naming the cat could provide the player with a connection to the animal. Wallace agreed with Patrick on this point. It bears noting that neither participant expressed that the game must have a narrative, but rather argue that narrative techniques could have been used beneficially in a particular way in this case.

The diabetes game literature argues that narrative is important because it showcases the health behaviors, and the consequences thereof, to the player in a way that facilitates observational learning. While he does not know the diabetes game literature, John argues that the template's prescriptions are not helpful, stating that:

How many bowling balls are in the game 1 to 4? 1 it doesn't matter. 0 it doesn't matter. I wasn't ... It's almost like it's like we've [been] given the measurements. The game is 18 and a half centimeters by 32 centimeters by 5 centimeters. It's like, well therefore I would hate for someone to take that and be like, therefore this game is a huge failure. It's like well, there is only actually one, there is like basically in my opinion like 1 or 2 places where they really need to get up to a 3 or 4 for, but not to be a failure and that's which are... feedback clarity then playability.

Here, John again argues that a successful game doesn't have to excel in every aspect, but rather can succeed as a lean artifact that performs very well on fundamental levels. He also argues, with the "bowling balls" and specific measurement comments, that the template appears to arbitrarily mandate the design of a diabetes game. This is important because it suggests that a template, in an attempt to guide design, might actually prevent a robust design process.

Some members of the second focus group strongly disliked the way in which the template asked questions. Ken expressed skepticism, stating that:

It is like you're asking me these game design principle questions in isolation without necessarily tying it to the theme that we're trying to evaluate. These

questions on... seems a little weird. It's ... I wanted to just take these questions directly and at face value and would be like, "Does it provide clear goals?" I don't know if that's ... it doesn't necessarily get to good game design...

In this statement, Ken argues that merely answering these questions, or rather, satisfying the template's mandates, doesn't mean that you have good game design. Terry agrees with Ken, explaining that, "Because the questions are being asked without really any foundational understanding of what game design even is, so if you're not going to treat me like I understand what game design is, then I'm not going to reciprocate with depth of game design knowledge." Because he felt that the template's questions addressed design issues only superficially, Terry believed that they were not only not useful but somewhat offensive. Arnold didn't have as strong of a reaction to the questions, but rather explained that,

Like a lot of these things I feel like are so ... it's not that ... for me it's not necessarily that there's no understanding of game design. These things are just very ... if any of these are threes you can't do any. I think it's really, really hard to do real design mentorship on that, these are all of your basics, does it provide appropriate feedback? If that's not a four basically all of your mentorship it has to be loaded onto that, until that's a four and then you can start talking about subtlety.

In this statement, Arnold asserts that the questions provided by the template don't totally lack an understanding of design. He again argues that the template assumes no hierarchy of importance and that, like John in the first focus group, explains that the template should prioritize foundational elements before asking questions about subtler design concepts. Importantly, Arnold explains design as a process that is more complicated than ticking off boxes on a list, arguing that:

Step zero of mentoring game design in my experience is, interrogating the designer to clarify their goals, and every question that you ask of the design after that is trying to figure out if they're achieving their goals or not. That's step zero and the most basic thing is, have a very clear understanding of are they trying to make a game? What is the game supposed to do? Who is it for? All of those

things and to ... at that point start to have a dialogue about, what did you try also what's not in the game that you guys tried that already got thrown out so I can have that in the mix too, and now let's go through and highlight what we think are the lowest hanging fruit, as far as what are the cheapest smallest things that you can change to have the ... that would get you as far as possible along your trajectory towards your goals, and try and prioritize those things.

In this explanation, Arnold frames the process of game design as one of asking questions that are specific to the goals of the designer. He rejects a one-size-fits-all type of prescriptive response and advocates an analysis that prioritizes concepts such as the needs of the users. In this sense, Arnold articulates design in terms that are familiar to the general design literature. Namely, that design is a site-specific inquiry of unique phenomena and that broad, generalized solutions are not real solutions.

### ***Abundance of Choice versus Meaningful Choice***

In their analysis of *Tina the Cat*, the third focus group effectively argued that although that game provided them with a variety of choices to make, those choices did not appear to matter. They suggest, however, that the template would be better served by recasting the question of “How much choice as the players given?” around the concept of meaningfulness. While the third focus group agreed that *Tina the Cat* provided them with a large number of choices, such as what food to give the cat and where on the cat's body to apply insulin, they also agreed that these choices were frustrating because they were not meaningful. In the subsequent discussion, two concepts of “meaning” emerged. These types of meaning may be described as systemic meaning, in which the choice results in an outcome that alters the state of the game's objects through the application of the rules that govern the game world, and narrative meaning, in which the player's choice shapes the direction of a story and the fate of characters. These types of meaning are not necessarily mutually exclusive. However, it seems clear that merely asking about the quantity of

choice, as the template currently does, fails to fully consider the breadth of the concept of choice in games.

***Assuming Players are Learning the Intended Lesson***

John raises an important point, noting that the template does not ask whether it is possible for the players to learn the wrong lessons from the gameplay. The template, as presented to the focus group, contemplates possible failures to effectively deliver educational or persuasive content, but does not consider that the nature of a game might impart incorrect lessons. John states that,

Yeah, I think also in that sense I feel like question G, which is how clear is the relationship between the game's themes and the game mechanics, does not have enough room on this. Like it kind of needs to be broken up to a few different questions, like if you get good ... Like some questions should be like if you get good at playing this game have you therefore been educated on the subject matter? Does there exist the possibility that you can get good at the game, but be educated incorrectly like are there the degenerate solutions which actually educate you incorrectly?

He further asserts that,

I mean the fundamental question is when the user explores the possibility space that game presents in a way that users might end up doing so or whatever the intentions were for user's behavior. When they exhibit the behaviors that they tend to focus exhibit, were they then educated in a way that the game hopes to educate them, that's the fundamental question?

Here, the concern is raised that the educational takeaway the player receives as a result of mastering the game may have actually only taught them how to succeed at the game. If the abstractions of the game's mechanics do not map clearly, and correctly, onto the lessons a diabetic need learn in order to effectively manage diabetes, that individual may not have actually learned anything that helps them. Even worse, there exists a possibility of "degenerate solutions." In this case, a degenerate solution would be a strategy that worked in the context of the game, but does not work in the real world. In this way, a

poorly designed diabetes could end up being harmful if it teaches ineffective or incorrect management techniques.

In the case of *Equalize: Dependency*, the main character is in danger where his or her blood sugar level is too high or too low. However, the second focus group understood only that main character only “passes out” when blood sugar levels exceed a certain amount. In reality, very low blood sugar levels are dangerous to diabetics as well: a state called hypoglycemia. Hypoglycemia can lead to seizures and may become a medical emergency. The second focus group was not informed about hypoglycemia by *Equalize: Dependency*. The game does quickly inform the players via some text on the wall in an early stage that they should keep their blood sugar level between four and eight. However, because the enemies are shooting sugar and there are numerous food items to pick up to increase blood sugar, the group’s attention was focused only on lowering blood sugar levels. This is to say that their understanding of what was dangerous about diabetes was framed by the game and was entirely focused around preventing an excess of blood sugar, as opposed to maintaining a safe, balanced level. Arnold erroneously stated that, “Nothing in here is necessarily teaching you things that are actually dangerous to do.” Clarence agreed, jokingly adding that jumping off of train cars was potentially dangerous. The game designers in the second focus didn’t notice that they were only worried about high blood sugar levels, but it is likely that a medical professional would have noticed this problem. This point is important because it reinforces the necessity of the inclusion of medical expertise in the design of diabetes self-management games.

The third focus group identified a problem in *Coco’s Cove*’s modeling of diabetes. Specifically, in its failure to include anything about regulating blood sugar levels and in its depiction of sugary foods as being purely harmful to Coco, the game ignores the dangers of low blood sugar. Although the game’s “about” screen (which the participants never saw)



does mention that too many or too few carbs can lead to trouble, it makes no mention of other factors that affect diabetes. Bruce explained that, “Even in the case you are diabetic an in an extreme case it might be good to have a doughnut.” Patrick agreed, stating that, “Sodas, candy, whatever you feel like having.” Bruce further explained that, “It almost feels weird that the only thing that was bad was the doughnut. In the right situation, it may be beneficial.” Patrick agreed, with Bruce, and arguing that, “It could save your life.” He then proceeded to relate an event he had witnessed in the workplace in which a diabetic coworker experienced a seizure due to hypoglycemia and, “The paramedics came and they gave him some juice and some candy bar or something.” In its neglect to depict any of the consequences of low blood sugar, *Coco’s Cove* provides a potentially dangerously incomplete model of diabetes.

#### **LESSONS FROM THE EMPIRICAL FINDINGS**

There are a number of lessons and implications for future designs that may be distilled from the focus group findings. The lessons are found both where there are either tensions between the opinions of the focus group participants and the arguments made by literature related to diabetes self-management games, and as well as where there is harmony. These takeaways range from actual game design suggestions, to suggestions about how to approach design issues. Here, I explicitly enumerate and describe these lessons.

These lessons are valuable because the application of expert game design knowledge to diabetes self-management game literature helps to shore up a weakness in that body of literature. The literature argues that the quality of a game is important, but, according to the responses of focus group participants (all of whom are experienced game

designers), could do a better job of approaching game design. The lessons are not presented in a particular order.

### **1. Proper feedback and clarity are essential**

If a game fails to deliver clear feedback, if it is unable to communicate what is happening in the game world and clearly demonstrate the effects of a player's actions on the state of the game, then the game fails at every other level. As it was constructed and presented to the focus groups, the template assumed that each question was important as the next. The focus group participants, however, reacted strongly against this assumption. Over the course of the three focus groups, it became clear that some aspects are more important than others. All three of the focus groups identified feedback and clarity as being a necessary foundation upon which other aspects of the game artifact depend. Indeed, a game's reliance on clear feedback is so strong that it may be understood to be a foundational issue. The critical importance of feedback and clarity places concern over this aspect of the artifact above all others. In other words, before designers can hope to accomplish any of their goals they must first ensure that appropriate systems of feedback are in place. While the diabetes games literature acknowledges that feedback and clarity are important, care should be taken to communicate exactly how important these aspects of a game are (e.g. Makhlysheva, et al., 2016).

### **2. The template contains problematic assumptions**

As detailed in the third chapter of this dissertation, the template was derived not from this author's beliefs but rather were drawn directly from the scholarly literature related to diabetes and games. Each of the focus groups balked at the nature of the template's questions. In some cases, the participants' reaction was so vitriolic that they rejected the template outright. The participants' major objection to the template's approach

may be characterized as pushing back against what they perceive as broad, prescriptive mandates that undermine real design work. The first major arguments advanced against the template are that in stating that certain elements, such as narrative, social networking features, and replayability, must be present in order to have a “good” game, the template effectively skips the actual design process and thereby prematurely excludes a large swath of approaches to game design. For many of the participants, this seemingly arbitrary settlement on features and requirements signaled a lack of understanding of game design. The second major argument against the template is that it is vague. For example, the “sufficiency” of a challenge is a fluid concept. These arguments suggest that recommendations for design approaches and suggestions about problems to watch out for would be preferable to a laundry-list of requirements.

Tensions exist, however, between the beliefs of the focus group participants and the recommendations of the diabetes game literature. That literature makes a strong case for the inclusion or emphasis of certain features. For example, a game’s replayability increases the amount of time that a player spends with the game. As a result, the player’s exposure to the game’s persuasive and educational content is increased. For that reason, it makes sense that replayability would be a desirable characteristic for a diabetes self-management game. Another example is found in the concept of narrative. While one might imagine a diabetes-centered puzzle game that had no characters and no narrative but that perhaps allowed players to practice monitoring and controlling blood sugar levels, such a game would miss the opportunity to demonstrate the elements of social support and behavioral modeling that a narrative’s characters could offer.

There may exist many possible templates and guidelines for creating good diabetes self-management games. The pushback from the focus group participants suggests that the template derived from existing literature is not an example of a good template. It may be

that a superior approach is found in the form of well-reasoned design recommendations as opposed to hard mandates. The optimal presentation of such recommendations is a subject worthy of further inquiry.

### **3. The health consequences of behaviors for diabetics are unclear in the tested games**

The diabetes games literature strongly argues that diabetes self-management games should clearly depict the consequences of behaviors on health outcomes (Crowley, et al., 2008; Law, et al., 2008; Bandura, 2004; Gee, 2006). The clear presentation of health outcomes aids the development of self-efficacy and enhances a game's persuasive aspect. The focus groups found that the depiction of health consequences in almost all of the diabetes games was unclear. In the cases of *Diabetes Dash* and *Ketones Attack*, the consequences of good or bad health behaviors are never made apparent. Rather, the only outcomes that matter remain contained within the abstractions of the game mechanics. *The Diabetic Dog Game* obscures the actual health consequences of the player's decisions. The second focus group interpreted the health consequences of poor performance in *The Diabetic Dog Game* as meaning the death of the dog. In *The Diabetic Dog Game*, poor performance on the player's part will eventually result in the game erasing the dog, which is described in the instructions as "taking it away." *Tina the Cat* was entirely unclear and failed to depict any health consequences to Tina at all. *Coco's Cove*'s representation of health consequences was entirely limited to a monkey's head turning red. The only game that really did anything to depict health consequences was *Equalize: Dependency*. In the case of *Equalize: Dependency*, the game actually depicted human characters passing out and vomiting as a result of excess blood glucose. These findings suggest that the designers of the diabetes games are either unaware of the diabetes games literature or are unable to design and create games that effectively depict the effects of health behaviors on diabetes.

#### **4. Animals should not be the main characters**

The findings from the focus group suggest that animals are a poor choice for main characters in a diabetes self-management game. This finding is in line with the arguments advanced by the diabetes game literature (Fuschlocher, et al., 2001). Specifically, the literature argues that direct representation of diabetes is preferable to metaphorical representation. Animals are anatomically different from humans, and the two focus groups that played games with animals as the main characters expressed confusion as to whether or not what they were learning was really applicable to humans. Furthermore, the diabetes games literature argues that the design of the game's characters should reflect the health challenges faced by players. Such designs facilitate observational learning, whereby the player sees the consequences of good and bad behaviors upon a relatable character. The animals in the games examined by the focus groups are not in human circumstances. They live, for example in fields (*The Diabetic Dog Game*), in the canopy of a jungle (*Coco's Cove*), or in no particular place (*Tina the Cat*). With the exception of Coco the monkey, who jumps, or flings, at food, the animals are helpless and unable to self-manage their diabetes. Indeed, they cannot even take care of their basic needs. Finally, the attempts to map human food and human medical technology onto the lives of the animals, such as feeding a cat chocolate doughnuts and feeding a dog cake or honey, were met with confusion. This confusing arises from the fact that dogs and cats in the real world do not ordinarily crave the sweets that many humans do.

#### **5. Pre-existing game designs take on new meanings when repurposed for serious diabetes games**

Most of the games examined by the focus groups borrowed heavily from well-known, pre-existing games. For example, *Ketones Attack* is extremely similar to *Asteroids* and sections of *Equalize: Dependency* are similar to *Super Mario Bros*. In traditional (non-

educational) games that have a high-score mechanic, the invitation extended to the player by the game to continue trying to achieve the highest score possible does not carry an implicit message about the futility of struggle. However, if that design is taken and repurposed for diabetes self-management, then the game takes on a different character. Now, it becomes about how long an individual can hold out against a certain fate—how many points that individual can score and how long they can last in an increasingly difficult and hostile environment. In such designs, the reward for successfully managing diabetes is that the player gets to stay alive and continue to struggle to continue to manage diabetes. Such designs do not encourage self-efficacy, which the diabetes management literature argues is a crucial element in the successful management of diabetes. Therefore, it is clear that another scenario is necessary. The specifics of this scenario are as of yet undetermined, but they might involve presenting the player with positive rewards, in the form of simulated social celebrations, or reframing the management of diabetes as part of a larger goal.

#### **6. Players should learn actual diabetes management skills, not just how to succeed at a game**

In all of the focus groups, the participants learned to play the games but expressed concern that they still did not really understand how to manage diabetes. For example, in the case of *Diabetes Dash*, Sara explained that while she was confident that the group was able to play the game properly, she was not confident that she understood how the experiences of the game mapped onto reality. In the case of *The Diabetic Dog Game*, Clarence explained that he didn't understand the effect of insulin. The participants in the third focus group agreed that they learned nothing about diabetes management from *Coco's Cove*. Designers must take care to ensure that the players are learning actual skills that will help them manage diabetes as opposed to just learning how to succeed at a diabetes-themed game. Diabetes game designers must also be careful that the modelling of diabetes in the

game accurately represents the disease and does not encourage the development of incorrect approaches to self-management. Lastly, it bears noting that this lesson emerged from the discourse of the focus groups and, while it is considered by the serious games literature (Brown, 2005; Greitzer, et al., 2007), it is not considered by the diabetes games literature.

## **7. Genre tropes threaten to confuse players and frustrate persuasion**

None of the diabetes games examined by the focus groups can be said to be wholly original. Rather, each of these diabetes games belongs to a preexisting subset, or genre, of games. *Equalize: Dependency* is a “platformer,” similar to *Super Mario Bros*. *Ketones Attack* is almost exactly a clone of *Asteroids*. *Coco’s Cove* is a physics driven puzzle game, similar to other popular mobile games such as *Angry Birds*. *The Diabetic Dog Game* and *Tina the Cat* belong to the virtual pet genre, which includes games such as *Nintendogs* and *Tamagochi*. It is not unusual for a game to share design elements with another game. Indeed, popular genres may count among their numbers many thousands of games that look and play similarly. It is not surprising that designers seeking to make diabetes games would turn to what might appear to be “proven” game designs. Problems arise, however, where design tropes familiar to a given genre intrude on the diabetes management game’s ability to immerse and instruct the player. An example of this problem was found in the inclusion of the floating rings in *Equalize: Dependency*. The player directs the main character to jump for and collect these rings but the rings are symbols that do not mesh with the rest of the game’s world. The rings are an arbitrary visual abstraction that only serves the game’s scoring mechanism. They do not have anything to do with diabetes but are rather a troublesome holdover from the platforming genre. These findings suggest that rather than try to work from scratch to design a game that revolves around the concepts of

important to diabetes management, the designers of diabetes games have tried to awkwardly force diabetes-related content onto familiar game designs. This point, as well as that of the baggage associated with genre tropes are not addressed by the diabetes game literature.

#### **8. Things only get interesting when something goes wrong**

In the second focus group, Arnold explained that designers seeking to make games about diabetic management face a problem that arises from the straightforward in-game modelling of the disease. He explained that it is difficult to engage players with regular diabetes management because the reward for successfully performing that management is that nothing bad happens. While this is certainly a desirable outcome in real life, it does not make for compelling gameplay. This implies that the rewards and goal structures of the games, which are considered to be important by the diabetes games literature (Brown et al., 1997, Fuchslocher et al., 2001) are not well implemented. Arnold argued that *The Diabetic Dog Game* only escapes monotony when the player fails. Specifically, he stated that interesting, or exciting, things only happen in the game where the player fails. This argument suggests that another scenario is needed. This scenario should scaffold the management aspect of the game with other types of game elements. For example, the diabetes management features of the game could be only one component of a much larger game. For example, one can imagine a game about going life in high school where the player interacts with characters, participates in sports, and manages diabetes. This point was also not considered by the diabetes games literature and emerged from the focus groups.



## **9. Poor balance between fun and education**

Like other serious games, the effectiveness of diabetes self-management games relies heavily upon a proper balance between fun and education. There is a wide consensus in both the general games literature and in the diabetes games literature that games should be fun (Aoki, et al., 2004; Crowley, et al., 2008; Sweetser & Wyeth, 2005; Thompson, 2012; Joubert, et al., 2016). Games differ from other forms of software that people use to accomplish tasks in that people play them for entertainment purposes (Sotamaa, 2007; Pagulayan, et al., 2008). The focus groups uniformly found that the balance between fun and education was broken in each of the diabetes self-management games. With the exception of *Coco's Cove*, the focus groups found that the games were not entertaining. In the case of *Coco's Cove*, the third focus group found that the game was entertaining but taught absolutely nothing about diabetes. This finding strongly suggests that new diabetes game designs are necessary.

## **10. Choices should be meaningful, not just plentiful**

The choices afforded to players should be meaningful. This point is well established in game design literature (Crawford, 2003; Crowley, et al., 2008; Schnell, 2008) and is acknowledged by the diabetes games literature (Makhlysheva, et al., 2016). However, despite the widespread consensus that an element uncertainty and the player's ability to shape the game's state are necessary, the focus groups found that the diabetes games failed to provide meaningful choice. Choice cannot be said to be meaningful where the player's only real decision is whether or not to die. The focus groups found that what appeared to be a choice was not really found to be a true choice in *Diabetes Dash*, *Ketones Attack*, and *The Diabetic Dog Game*. Choice is also not meaningful merely because it is plentiful: decisions must lead to a diverse set of results in order to actually matter. In the case of *Diabetes Dash*, the first focus group agreed that the game had a narrow and prescriptive

set of choices. In that game, the player's choices were basically limited to whether or not they tried to catch healthy or unhealthy food as it fell from the sky.

#### **11. Lengthy instructions and manuals are not effective at teaching diabetes knowledge**

Designers should not assume that players will read the manual and thereby be educated about either diabetes or how to play the game. Three of the games (*Diabetes Dash*, *Ketones Attack*, and *The Diabetic Dog Game*) examined by the focus groups relied upon large bodies of text in the form of a manual to convey information about both diabetes and how to play the game. In every instance, this proved problematic. The participants wanted to play the games, not read the manuals. Learning to play a game by reading an instruction manual is no longer a common practice. Modern games typically provide the player with in-game instruction in the form of tutorials and tips. Today's players are likely unaccustomed to reading lengthy instructions. In some cases, such as that of *The Diabetes Dog Game*, the manual was so long and dense that the participants struggled to comprehend it. As a result, the players were confused about both diabetes and the game. This suggests that diabetes games are better served by gradually introducing new information and new features rather than dumping everything on the player at once. This point is not explicitly addressed by the diabetes games literature and emerged from the focus groups.

## **Chapter 5: Conclusion**

This dissertation began by introducing the problem of diabetes, explaining that there is a belief that serious games can aid diabetics, and by posing a series of questions. It asked to what extent expert game designers agreed with the arguments made by the diabetes games literature, what their opinions are regarding a set of diabetes games that are available to the American public, and whether or not, where tensions arise, they could identify solutions. It then surveyed a broad body of literature related to serious games and diabetes, and found that the voice of the game designer is absent from the diabetes games literature. In order to add the voice of the game designer to the diabetes games conversation and to test the claims of the literature against the beliefs of a community of game design experts, I crafted a design template. The third chapter detailed precisely how the design template was derived from the arguments advanced by the literature reviewed in the second chapter. It then discussed why focus groups were an appropriate method, how the focus groups of expert game designers were recruited, how the focus groups themselves were conducted, and how the data from those focus groups was captured and analyzed.

The findings of the focus groups made it very clear that, in the opinions of the participants, the developers of the diabetes management games had not really gone through a proper game design process. The application of this design expertise to these diabetes games and the arguments made by the diabetes games literature reveals a series of problems that may well be severe enough to call for a fundamental reimagining of approaches to diabetes games. Instead of actually negotiating with the “site” of diabetes, the developers of these games imposed a diabetes theme onto the structure of another, popular game. The tropes that come along with established game genres were not developed by designers who were thinking about representing real-life health issues. As a result, much of the gameplay

in these diabetes games isn't really *about* managing diabetes. Rather, it is about doing other, non-diabetes related, tasks while things related to diabetes drift around in the periphery. The mapping of the in-game actions to real life actions is unclear, at best. While we don't know exactly why the developers made the decisions that they did, I believe that a likely reason is that the development teams for the games reviewed by the focus groups were missing persons with expertise in game design.

The focus groups further found that the template contained numerous problematic assumptions and prescriptions about what a game should be. This was perceived as being arbitrary, reductive, and naively exclusive by the focus group participants. The participants generally argued that the possibility space of games is much larger than what is described by the template. A tension exists, however, between the reasons that the diabetes games literature mandates the inclusion of certain features, such as replayability, and the beliefs of the expert game designers. The game designers argued that not every game need be replayable—that many good games only warrant one playthrough. However, the diabetes games literature argues that replayability is a desirable characteristic as it exposes the player to the persuasive content multiple times. Although they disagree, the game designers and the diabetes game literature both make sound arguments. There is no readily apparent solution to this conflict.

Finally, the fourth chapter also detailed the lessons that we may take from the focus groups. Some of these lessons provide straightforward guidance. For example, there findings indicate a number of reasons why animals should not be the main character in a diabetes game. It is easy to envision a design that does not require an animal to serve as the game's character. Other lessons pose more greater challenges. For example, there is no simple solution to balancing fun and education—the answer to that type of problem will likely be specific to each game design scenario. These broader types of problems, whose

solutions are not self-evident, are unlikely to be solved without the application of game design expertise. This last point is highly important, as it stresses the importance of the designer's competence and skill in crafting an effective product.

### **REVISED DESIGN TEMPLATE**

The following revised design template is offered to persons interested in designing serious diabetes management games. This template, in contrast to the initial template, is presented as a series of points to consider, rather than essential elements, when designing such games. The author has recast the design template in the interest of integrating the lessons from the focus group findings with the arguments made by the diabetes games literature. This revised template may also be understood as a set of guidelines. In this sense, the revised template is a provision of guidelines derived from expert knowledge to aid with a specific design goal. Such provisions are familiar in the literature of design (e.g. Brown, 1998).

The template is divided into two sections. The first section directs the designer's attention to foundational elements that should be in place before the issues in the second section are addressed. Another way of explaining the division of the sections is to explain that the successful implementation of the elements described in the second section is contingent upon the successful implementation of the elements described in the first.

#### **Foundational Elements**

1. The game must clearly communicate what is happening in the game's world, what the player's goals are, and what effect the player's actions are having.
2. The game should not be a simple repurposing of a pre-existing game. The game should fundamentally be about diabetes management. The actions taken by the player in the game should clearly map back to real-life actions.

## **Second-Order Elements**

1. The game should not rely on lengthy bodies of text to teach players about diabetes management. Find ways of slowly introducing educational content and reinforcing it through gameplay.
2. The nature of the game's challenges and progression should foster the development of self-efficacy. Players should not feel that they are trapped in a scenario that they will eventually fail. Rather, the game should communicate that the player has the ability to manage diabetes.
3. The consequences of health behaviors should be clearly depicted and adequately explained.
4. Aesthetic elements should be carefully designed to support the game's themes and mechanics.
5. Don't overreach. Do not employ features that cannot be implemented at a high standard of quality.
6. Characters should not exist in a vacuum. Social relationships, including family and peer support, should be depicted.
7. Design decisions should privilege empathy towards diabetics and their health circumstances.
8. Consider designing characters whose circumstances closely resemble those of the intended audience.
9. Provide players with meaningful choices. These choices may be either meaningful in the sense that they factor into the functions of game mechanics, or meaningful in a narrative sense.

10. The exciting elements of the game should not appear only when something is wrong with the diabetic management. Successful management should also be engaging.
11. Avoid using animals as the main characters.
12. Strongly consider a design that is replayable. Replayability increases the player's exposure to the game's educational and persuasive content.
13. Be careful to avoid designing systems that allow for degenerate solutions to diabetes management. Present the player with an accurate depiction of diabetes.
14. Carefully balance the entertaining and educational aspects of the game. If the game is not fun, people will not play it.
15. Be mindful of the baggage that genre tropes bring. Ensure that decisions are made to further the game's high-level design goals, not simply to create a game that fits within an established genre.
16. Strongly consider integrating features that link players with other players or encourage people to play together.

### **SIGNIFICANCE OF THE STUDY**

This study advances our understanding of diabetes self-management games by introducing the previously absent voice of the expert game designer. By confronting the diabetes games literature and the diabetes games themselves with the opinions of expert game designers, this study finds that the literature is riddled with problematic assumptions and the games themselves are poorly designed. The introduction of the designers' voice reveals issues that were not previously visible. The lessons from the focus groups indicate that, in the opinions of expert designers, there are fundamental problems with the way that

the diabetes games literature struggles to understand game design. This is critically important because the developers of diabetes management games rely upon the medium of the *game* to achieve their goals. This strongly suggests that a new approach is necessary—one that integrates the types of expertise that expert game designers possess.

This dissertation provides individuals interested in the development of serious games for diabetes management, and to some extent other chronic diseases, with a set of guidelines that help them to think about issues central to the effectiveness of a game artifact. Unlike the original template, the revised template is comprised of two tiers of concerns. This distinction is intended to help developers construct games that not only function well but also speak directly to the issues that persons tasked with chronic disease management face. The second tier of the revised template is intended to not only assist developers in avoiding the pitfalls that were identified by the expert game designers in the diabetes games focus groups but also help those developers to explore novel game design scenarios.

In a broader sense, this dissertation argues for the importance of design expertise. It is easier to apply design strategies that have proven successful in the past than it is to interrogate a problem space through the design process. However, as the lessons from the focus groups indicate, the mere application of pre-existing design strategies threatens to invite unforeseen problems. As a result, identifying the right design scenario necessitates a real interrogation of the specifics of the problem.

#### **LIMITATIONS OF THE STUDY**

While this study reveals issues with the diabetes games literature and provides lessons that are helpful in directing game designers towards better diabetes game designs, there are a number of important questions that it cannot answer. The first of these questions



is about the designers of the serious diabetes games. While a critical analysis of the design structures of the existing diabetes games provides us with some insight into what the designers of these games were attempting to accomplish, we can't really know why they made the design decisions they did without actually talking to them. While we can look at the prescriptions that are present in the diabetes games literature, we can't be entirely sure that those prescriptions guided the work of these designers. We don't really know anything about who made these games, how much experience they have previously had with games, how many individuals were on the development teams, or what the skillsets of those individuals were. In other words, the process by which the games in this study were developed is obscured. Answering these types of questions would require a different study.

Another limitation is found in the efficacy of the diabetes management games examined by the focus groups in this study. While there is literature that argues that diabetes management games improve health outcomes for diabetics, the specific games included in this study have not been the subject of published clinical studies. The focus groups were very clear in their disdain for the game design work that has been done, but that doesn't necessarily mean that these games, even though they were found to be of poor quality, do not somehow improve health outcomes. For example, improvement could come from making the struggle to manage diabetes visible—thereby making it the subject of a conversation. Perhaps that conversation leads to increased support from peers or family members. Without another study, that actually involves diabetic patients and health care providers, we cannot be certain that the existing games won't help. It is possible that these games do help, but provide substantially less benefit than they would if they were better. It would be useful to know precisely how effective (or ineffective) the games included in this study actually are in affecting positive health outcomes.

## **DIRECTIONS FOR FURTHER RESEARCH**

The results of this study suggest a number of avenues for further research. One next step might be to actually assemble an interdisciplinary group that included seasoned game designers as well as health care professionals to attempt to prototype and test new games. Here, the goal would be to find a way to represent the actual management of diabetes in the form of a game. Rather than strap elements of diabetes management onto an existing game design, as has been the historical trend in diabetes management games, this project would endeavor to deeply negotiate with the specific case of diabetes. Hopefully, it would identify a new type of game—one uniquely suited to modeling and teaching diabetes management skills. The revised design template serves as a guide for these efforts.

Another further step might be to attempt to answer some of the questions raised in the discussion of this study's limitations. Understanding who is making these types of games and what is guiding their process might result in a more focused intervention. It would also be useful to understand how much the quality of a diabetes game affects health outcomes. If, for example, we were able to determine that a bad game results in little to no improvement, we could then argue that these types of games are not worth making unless they are made well. However, it might be possible that even games that expert game designers balk at are enjoyed by children, and that those children then demonstrate better health behaviors.

It would also be interesting to attempt to replicate the success of Brown et al.'s 1997 study that documented a dramatic decrease in unplanned doctor visits in diabetic children that were playing the Super Nintendo game *Packy and Marlon*. Repeating the study with a twenty-year old game would tell us something about how today's youth respond to digital game-based interventions that have proven successful in the past. It may be that diabetes games are something that must constantly be updated to meet the

expectations of the young. Unfortunately, such a study would be difficult and costly. Super Nintendos are obsolete consoles and finding enough working machines to enable the study would not be a trivial task. Furthermore, functional *Packy and Marlon* game cartridges are rare, coveted by collectors, and costly. While this study would be difficult, it would be very helpful to know whether successful diabetes self-management games have a limited life-span or they only appeal to their target audience for a short amount of time.

It seems that the next steps for this area of research must involve expert game designers, health care professionals, and actual patients. Developing a way for these different actors to work together is a challenge in and of itself. It would be very helpful to partner with people who are accustomed to working with children in a healthcare capacity. It may be that medical researchers, such as persons in the school of nursing, would be strong collaborators. The research divisions of medical schools are another good possibility. There may also be opportunities to develop partnerships with some of the larger organizations that work tirelessly to improve the lives of persons suffering from chronic illness.

## Appendix A: Design Template

Please indicate your response by putting a 1 – 4 by each question. 1 is the lowest score and 4 is the highest.

- I. Diabetes Principles
  - a. How well does the game teach basic diabetes knowledge?
  - b. How well do characters, if present, serve as models for positive or negative behaviors?
  - c. How empathetic is the game towards diabetics?
  - d. How well does the game allow users to practice skills related to diabetes management?
  - e. How well does the game present the consequences of health behaviors on diabetes?
  - f. How well does the game reward players for practicing self-management skills?
  - g. How well does the game promote discourse about diabetes?
  - h. How well does the game suggest that people can effectively manage diabetes?
  - i. How well does the game engender peer support?
  - j. How well does the game balance fun and education?
  
- II. Game Design Principles
  - a. How aesthetically pleasing is the game?
  - b. How strong, if present, is the game's narrative?

- c. How clearly does the game communicate what is happening in the game world?
- d. How easy is the game to pick up and play?
- e. How well does the game provide the players with clear goals?
- f. How well does the game provide users with appropriate feedback?
- g. How clear is the relationship between the game's themes and the game's mechanics?
- h. How strong is the sense of progression provided by the game?
- i. How sufficient are the game's challenges?
- j. How well-designed, if they are present, are the characters?
- k. How much choice are the players given?
- l. How much do player decisions affect future gameplay?
- m. How much does the game reach into the real world? For example, does it have social networking features that link users?
- n. How replayable is the game?

## **Appendix B: Templates Scored by Focus Groups**

### *COCO'S COVE* TEMPLATE SCORES

- I. Diabetes Principles
  - a. How well does the game teach basic diabetes knowledge? **1**
  - b. How well do characters, if present, serve as models for positive or negative behaviors? **2**
  - c. How empathetic is the game towards diabetics? **2**
  - d. How well does the game allow users to practice skills related to diabetes management? **1**
  - e. How well does the game present the consequences of health behaviors on diabetes? **1**
  - f. How well does the game reward players for practicing self-management skills? **1**
  - g. How well does the game promote discourse about diabetes? **1**
  - h. How well does the game suggest that people can effectively manage diabetes? **1**
  - i. How well does the game engender peer support? **1**
  - j. How well does the game balance fun and education? **2**
  
- II. Game Design Principles
  - a. How aesthetically pleasing is the game? **3**
  - b. How strong, if present, is the game's narrative? **2**
  - c. How clearly does the game communicate what is happening in the game world? **3**
  - d. How easy is the game to pick up and play? **3**

- e. How well does the game provide the players with clear goals? **3**
- f. How well does the game provide users with appropriate feedback?

**3**

- g. How clear is the relationship between the game's themes and the game's mechanics? **1**
- h. How strong is the sense of progression provided by the game? **3**
- i. How sufficient are the game's challenges? **3**
- j. How well-designed, if they are present, are the characters? **2**
- k. How much choice are the players given? **3**
- l. How much do player decisions affect future gameplay? **3**
- m. How much does the game reach into the real world? For example, does it have social networking features that link users? **1**
- n. How replayable is the game? **3**

## *DIABETES DASH* TEMPLATE SCORES

- I. Diabetes Principles
  - a. How well does the game teach basic diabetes knowledge? **2**
  - b. How well do characters, if present, serve as models for positive or negative behaviors? **2**
  - c. How empathetic is the game towards diabetics? **2**
  - d. How well does the game allow users to practice skills related to diabetes management? **2**
  - e. How well does the game present the consequences of health behaviors on diabetes? **1**
  - f. How well does the game reward players for practicing self-management skills? **1**
  - g. How well does the game promote discourse about diabetes? **1**
  - h. How well does the game suggest that people can effectively manage diabetes? **3**
  - i. How well does the game engender peer support? **1**
  - j. How well does the game balance fun and education? **2**
  
- II. Game Design Principles
  - a. How aesthetically pleasing is the game? **2**
  - b. How strong, if present, is the game's narrative? **1**
  - c. How clearly does the game communicate what is happening in the game world? **2**
  - d. How easy is the game to pick up and play? **3**
  - e. How well does the game provide the players with clear goals? **2**



- f. How well does the game provide users with appropriate feedback?  
**1**
- g. How clear is the relationship between the game's themes and the game's mechanics? **3**
- h. How strong is the sense of progression provided by the game? **2**
- i. How sufficient are the game's challenges? **1**
- j. How well-designed, if they are present, are the characters? **2**
- k. How much choice are the players given? **2**
- l. How much do player decisions affect future gameplay? **3**
- m. How much does the game reach into the real world? For example, does it have social networking features that link users? **1**
- n. How replayable is the game? **1**

## *THE DIABETIC DOG GAME* TEMPLATE SCORES

- I. Diabetes Principles
  - a. How well does the game teach basic diabetes knowledge? **1**
  - b. How well do characters, if present, serve as models for positive or negative behaviors? **2**
  - c. How empathetic is the game towards diabetics? **2**
  - d. How well does the game allow users to practice skills related to diabetes management? **2**
  - e. How well does the game present the consequences of health behaviors on diabetes? **1**
  - f. How well does the game reward players for practicing self-management skills? **1**
  - g. How well does the game promote discourse about diabetes? **1**
  - h. How well does the game suggest that people can effectively manage diabetes? **2**
  - i. How well does the game engender peer support? **1**
  - j. How well does the game balance fun and education? **1**
- II. Game Design Principles
  - a. How aesthetically pleasing is the game? **2**
  - b. How strong, if present, is the game's narrative? **1**
  - c. How clearly does the game communicate what is happening in the game world? **1**
  - d. How easy is the game to pick up and play? **2**
  - e. How well does the game provide the players with clear goals? **2**

f. How well does the game provide users with appropriate feedback?

**1**

g. How clear is the relationship between the game's themes and the game's mechanics? **2**

h. How strong is the sense of progression provided by the game? **1**

i. How sufficient are the game's challenges? **1**

j. How well-designed, if they are present, are the characters? **2**

k. How much choice are the players given? **1**

l. How much do player decisions affect future gameplay? **1**

m. How much does the game reach into the real world? For example, does it have social networking features that link users? **1**

n. How replayable is the game? **1**

*EQUALIZE: DEPENDENCY TEMPLATE SCORES*

- I. Diabetes Principles
  - a. How well does the game teach basic diabetes knowledge? **2**
  - b. How well do characters, if present, serve as models for positive or negative behaviors? **2**
  - c. How empathetic is the game towards diabetics? **2**
  - d. How well does the game allow users to practice skills related to diabetes management? **2**
  - e. How well does the game present the consequences of health behaviors on diabetes? **3**
  - f. How well does the game reward players for practicing self-management skills? **3**
  - g. How well does the game promote discourse about diabetes? **2**
  - h. How well does the game suggest that people can effectively manage diabetes? **3**
  - i. How well does the game engender peer support? **1**
  - j. How well does the game balance fun and education? **3**
  
- II. Game Design Principles
  - a. How aesthetically pleasing is the game? **3**
  - b. How strong, if present, is the game's narrative? **2**
  - c. How clearly does the game communicate what is happening in the game world? **2**
  - d. How easy is the game to pick up and play? **3**
  - e. How well does the game provide the players with clear goals? **3**

- f. How well does the game provide users with appropriate feedback?
- 3**
- g. How clear is the relationship between the game's themes and the game's mechanics? **2**
- h. How strong is the sense of progression provided by the game? **2**
- i. How sufficient are the game's challenges? **2**
- j. How well-designed, if they are present, are the characters? **2**
- k. How much choice are the players given? **2**
- l. How much do player decisions affect future gameplay? **1**
- m. How much does the game reach into the real world? For example, does it have social networking features that link users? **1**
- n. How replayable is the game? **1**

## *KETONES ATTACK* TEMPLATE SCORES

- I. Diabetes Principles
  - a. How well does the game teach basic diabetes knowledge? **2**
  - b. How well do characters, if present, serve as models for positive or negative behaviors? **1**
  - c. How empathetic is the game towards diabetics? **1**
  - d. How well does the game allow users to practice skills related to diabetes management? **1**
  - e. How well does the game present the consequences of health behaviors on diabetes? **2**
  - f. How well does the game reward players for practicing self-management skills? **1**
  - g. How well does the game promote discourse about diabetes? **1**
  - h. How well does the game suggest that people can effectively manage diabetes? **2**
  - i. How well does the game engender peer support? **1**
  - j. How well does the game balance fun and education? **1**
  
- II. Game Design Principles
  - a. How aesthetically pleasing is the game? **1**
  - b. How strong, if present, is the game's narrative? **1**
  - c. How clearly does the game communicate what is happening in the game world? **1**
  - d. How easy is the game to pick up and play? **2**
  - e. How well does the game provide the players with clear goals? **1**

- f. How well does the game provide users with appropriate feedback?  
**1**
- g. How clear is the relationship between the game's themes and the game's mechanics? **3**
- h. How strong is the sense of progression provided by the game? **2**
- i. How sufficient are the game's challenges? **1**
- j. How well-designed, if they are present, are the characters? **1**
- k. How much choice are the players given? **1**
- l. How much do player decisions affect future gameplay? **2**
- m. How much does the game reach into the real world? For example, does it have social networking features that link users? **2**
- n. How replayable is the game? **2**

## *TINA THE CAT* TEMPLATE SCORES

- I. Diabetes Principles
  - a. How well does the game teach basic diabetes knowledge? **2**
  - b. How well do characters, if present, serve as models for positive or negative behaviors? **1**
  - c. How empathetic is the game towards diabetics? **2**
  - d. How well does the game allow users to practice skills related to diabetes management? **2**
  - e. How well does the game present the consequences of health behaviors on diabetes? **1**
  - f. How well does the game reward players for practicing self-management skills? **1**
  - g. How well does the game promote discourse about diabetes? **1**
  - h. How well does the game suggest that people can effectively manage diabetes? **2**
  - i. How well does the game engender peer support? **1**
  - j. How well does the game balance fun and education? **1**
- II. Game Design Principles
  - a. How aesthetically pleasing is the game? **1**
  - b. How strong, if present, is the game's narrative? **1**
  - c. How clearly does the game communicate what is happening in the game world? **1**
  - d. How easy is the game to pick up and play? **3**
  - e. How well does the game provide the players with clear goals? **1**



- f. How well does the game provide users with appropriate feedback?  
**1**
- g. How clear is the relationship between the game's themes and the game's mechanics? **2**
- h. How strong is the sense of progression provided by the game? **1**
- i. How sufficient are the game's challenges? **1**
- j. How well-designed, if they are present, are the characters? **1**
- k. How much choice are the players given? **3**
- l. How much do player decisions affect future gameplay? **1**
- m. How much does the game reach into the real world? For example, does it have social networking features that link users? **1**
- n. How replayable is the game? **1**

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